Why IT Projects are Riskier than Planned and what to DO about it

Going beyond ROI toward a More Robust Approach to Investing in Technology

By David Bartenwerfer

TECHNOLOGY INVESTMENT is critical: whether to shave costs, generate revenues, or outpace rivals, investment in technology is an integral part of most corporate strategies. Successful investments can be game changers for companies—but a colossal failure can be a game changer as well. The sad fact is that far too many technology investments go badly wrong, destroying profits, careers and sometimes entire companies.

Successful investments deliver benefits that outweigh the costs, hence the popularity of return on investment (ROI) analysis. However, today's mainstream methodologies and frameworks for measuring ROI have proved to be insufficient; this is particularly true for technology initiatives. Business leaders who want to increase the likelihood of the success of their investments should think beyond ROI and employ a more robust process that drives organizational clarity and accountability while uncovering the potential for both hidden profit and hidden risk.

Challenges to the Process

Technology by itself cannot create success within a company, but technology investments can be difference makers, for better or worse. A recent study at Oxford University found that major IT projects are twenty times more likely to fail than other business projects. The study found that companies were not taking into account unpredictable events when planning IT projects, basing their analysis only on average performance. Yet when projects spiral out of control, the careers of the managers and even the future of the organization are at risk. IT projects are now so complex with so many points of interaction (with consumers, other organizations, other businesses or even government) that this poses an extraordinary new challenge for top managers.

The concept of a Black Swan—an event that is unexpected yet has a drastic impact—has permeated the public consciousness in the wake of the turbulent financial markets of 2008 and beyond. This concept serves to highlight that outlier events are more frequent than we care to admit, and that these outlier events radically impact outcomes. Furthermore, there are psychological biases that make people blind to that uncertainty. Previous research of IT projects missed the influence of these value-destroying Black Swans by focusing on average cost overruns, thereby muting the impact of any significant variation in forecasts.

Yet, the accuracy of forecasts of costs, benefits and other impacts of planned projects remain poor, despite claims of improved forecasting models and methodologies, more and better data, etc. And, when forecasting errors affect both the costs AND the benefits, the resulting impact on measures of ROI can be frighteningly large. This challenge represents a wake-up call for management considering investments in technology. Standard technology project management suffers from some serious flaws, but a combination of improvements to analytics and process can be employed to reduce project risk and thus drive increased likelihood of success.

A Better Approach

Companies typically traverse several decision stages before making any investment. Pain points are recognized, processes and organizations are considered, budgets are created, solutions are identified. For each new initiative, a business case is likely conducted, assessing the benefits which are then traded off against the costs. Those with the lowest cost, largest positive impact and the fastest payback are rightfully given priority. However, ROI analysis often overlooks the potential for variability, or risk, in estimates.

This raises the question: is ROI the most reliable tool to predict success or failure in an uncertain world? The answer is "Yes", provided that the following challenges are acknowledged and evaluated: calculating the potential for outlier scenarios to significantly impact expected returns; creatively quantifying intangible costs and benefits; measuring costs and benefits for the entire project lifecycle; and ensuring that the company has the right organizational and leadership framework to maximize the likelihood of success. Fundamentally, the business case should answer three questions: "How much?", "How soon?", and, perhaps most importantly, "How certain?" Traditional ROI addresses the first two questions; a more evolved approach addresses the third question by upgrading the decision process and the associated analytical frameworks. This achieves three objectives: more accurate and robust quantification of costs and benefits, more rigorous and consistent evaluation of risk and uncertainty, and ways to uncover and reduce that risk. A robust process enables a vigorous analysis to be performed quickly yet comprehensively and with great flexibility. And, these approaches can be applied to a wide range of other project types, including construction projects of all sorts (both public and private from stadiums to new manufacturing facilities), transportation and aerospace projects, and the development of new products and new markets.

A Comprehensive Approach

The best approach to decision analysis starts with a comprehensive and creative evaluation of costs and benefits—an analysis of ROI—based on actual results from previous projects and augmented by the addition of random variables and probability distributions to account for risk.

Business Case Basics

A business case is a tool that supports planning and decision making and forecasts the financial consequences of some action. Decisions such as which projects to fund, which vendor to select, or when to initiate a project are particularly conducive to business case analysis. Essentially, effective business cases estimate how the outcomes under one possible scenario compare to outcomes under another (or against no action at all).

While many simple decisions can be made by intuition alone, most business decisions place both time and money at risk, and thus should be subjected to more rigorous evaluation. Making business decisions involves analyzing a finite number of options in accordance with some structured evaluative criteria. In a business context, these criteria typically involve the careful evaluation of costs and benefits expressed in financial terms as ROI.

ROI is a popular metric because it is versatile and simple. If an investment does not have a positive ROI, or if other competing projects produce a higher ROI, then the effort is not undertaken. However, ROI analysis can be mis-leading—while an ROI-centric approach may on the surface appear to provide enough information for decision makers to proceed confidently, the approach is limited and can be vastly improved.

Costs and benefits in business cases are essentially forecasts of the future and as such they are not certain—and should not be treated as such. Business cases can be much improved if subject matter experts can gauge the risk of each line item in a business case objectively and in an unbiased way. Then these 'certain' estimates of costs and benefits can be replaced with random variables and probability distributions to account for their uncertainty and thus rejecting the false comfort of this 'certainty'.

Improving ROI

ROI analysis is a performance measure used to evaluate an investment and/or to compare different investments. To calculate ROI, the net benefit of an investment is divided by the cost; the result is expressed as a percentage or a ratio:

$$ROI = \frac{(\text{Gain from Investment} - \text{Cost of Investment})}{\text{Cost of Investment}}$$

ROI is a popular metric because it is versatile and simple and gives a simple judgment as to the merits of an investment. While an ROI-centric approach is important, a simple ROI analysis may not provide enough information for decision makers to proceed confidently. The approach can be improved in the following ways:

Measure all the costs: When evaluating costs, be comprehensive. A framework called total cost of ownership (TCO) has been developed to help managers determine the total investment costs of a potential project. Managers should employ the best-of-breed TCO model for their particular investment and include oft forgotten costs like administrative and executive time in decision making, budget for subject matter experts to help end-users, lost productivity from eventual users of the system due to ramp-up time, and on-going end-user training and tech support. For product development initiatives, costs for supporting marketing, sales, and call center education and materials are sometimes overlooked.

Measure all the benefits: One surprising result of the Oxford study was that only 20 percent of their surveyed projects analyzed any business benefits before decisions were made. Managers should take the opposite approach and be as comprehensive as possible. For most investments, additional benefits fall within four broad categories in two dimensions: direct and indirect and increasing revenues or decreasing cost. Examples of each can be found in Exhibit 1 on page 4.

Measure the risk: Measuring only expected values implies perfect predictions of the future. The more evolved approach looks to historical outcomes or subject matter experts for guidance as to the magnitude and risk of each cost and benefit. The risk of each cost and benefit

Article Summary

Business leaders that desire to turn technology investing into a competitive advantage should improve both their investment decision process and their analytical tools.

Black Swans are random events that radically impact outcomes, but psychological biases blind forecasters to this uncertainty. Business leaders can overcome this by bolstering their business cases with grounded risk metrics, probability theory and Monte Carlo simulations.

The risk of cost overruns can be predicted based on the level of project complexity and on the organizational familiarity with the new technology. Variability in benefits can be evaluated based on the level of organizational familiarity with both the new process and new product.

Subjecting the business case to a simulation of several thousand iterations enables an insightful look at the full range of possible financial outcomes and their likelihood.

line-item in the business case can be better understood by considering the level of complexity of the implementation and the organizational familiarity with that technology (more on that later). This approach is far superior to simply using a discount rate because managers are forced to understand and confront each element of risk in their projects. Furthermore, when projects compete for resources, a better understanding of each projects risks enable managers to better predict which projects are more likely to meet success thresholds.

Build a Better Analytical Model: Each individual cost and benefit line item in financial models should be replaced with a random variable and probability distribution. The resulting set of costs and benefits should be run through a Monte Carlo Simulation model with enough iterations to give a clearer picture of the overall likelihood of project success or failure.

Measure the detail: Consider a more granular analysis of each project subcomponent or capability and then assessing the costs and benefits of each separately. Breaking down a system into its core components enables a more robust analysis of the value, and potentially increased ROI as lower value subsystems are individually identified and potentially excluded from the investment.

Be robust, Prepared and Realistic: One of the biggest concerns for top management is that claimed benefits are not realistic and/or will not materialize. In situations where management is lacking confidence in the business case, managers can build a supplemental business case that only includes direct/hard benefits. This second financial model will determine if the project returns remain robust if only the direct benefits materialize.

Furthermore, management must be prepared to follow through on the results of the analysis. For example, productivity benefits may be difficult to realize unless management is prepared to reduce headcount, cut budgets, or increase sales thresholds. If a technology product promises to improve the productivity of a defined group of employees that will result in financially measurable increases in output (or reduced budgets when output is stable), then this productivity increase can be considered to be a hard benefit. But if the impact on output or budgets can not be measured or enforced then these productivity increases should be considered as a soft benefit. This one distinction can make a material difference on the potential outcome of a business case.

In addition, it will take time for all elements of the organization to learn and integrate new technology into their daily processes. The full weight of the expected benefits will not accrue immediately (though costs usually do) but will require a "ramp up" period. Different benefit types will have different ramp-up periods:

- Immediate: the full weight of the benefit or cost accrues immediately. This is the case for most costs but very few benefits,
- Aggressive: benefits involving little or no change existing processes can be modeled as ramping up (i.e. a linear function) where the full benefits accrue in as soon as one to three months,
- Average: benefits with easy-to-learn new processes for an organization of limited size can be expected to achieve their full potential in three to six months,
- Conservative: benefits requiring new processes, new markets or change that is occurring over large organizations can expect to achieve the promise of full benefits over six to twelve months, ramping up to those full benefits over that time period, and
- Step function: benefits requiring difficult-to-achieve productivity gains may not accrue at all for the first twelve months and then increase quickly thereafter.

Measuring Costs

To economists, a cost is something of value given up as a result of some decision and are either one-time or on-going. When evaluating costs, it is important to be comprehensive and ensure that all potential costs are accounted for. Consider a large west coast city that was looking to reduce operating costs. One of their solutions was to clean the streets every other week instead of every week. While this saved quite a bit of money on operating expenses, what the city planners failed to analyze and account for was the loss of parking ticket revenue generated from residents who failed to move their cars on street cleaning days. Parking tickets were now only issued twice a month instead of weekly, a significant revenue loss for the city. The failure to account for all the potential costs of the decision resulted in a revenue shortfall measured in the millions of dollars.

A framework called total cost of ownership (TCO) has been developed to help managers determine the total investment costs of a potential project. In general, TCO helps create an estimate of all the direct and indirect costs associated with the acquisition of an asset over its entire life cycle. In the context of a technology investment, the TCO would represent the total direct capital investment in hardware and software plus the indirect costs of installation, training, maintenance, downtime, technical support and any future upgrades. As hardware is purchased and installed, the share of the budget devoted to 'operating' categories such as staff training and technical support should increase as well. Some experts estimate that these costs can be as much as 50% of the original equipment purchase price.

A comprehensive discussion of TCO for a technology investment should include both up-front and future costs from the following four areas: equipment and software, implementation and administrative, technical support, and end-user costs. The first two represent up-front costs and the latter two on-going costs.

Equipment and software costs include expenditures for hardware (i.e. the purchase price, network, server, workstation, printers), software licenses and fees, and

warranties. These are typically the easiest to establish because vendors typically provide that information.

Implementation and administrative costs include costs associated with project management, installation and integration, testing, configuration, and deployment of the project as well as management costs associated with making the decision.

Support costs are comprised on-going support for deployed technologies (i.e., vendor support costs, financing, staff for IT support, infrastructure, electricity, testing, upgrading, downtime, security, and insurance). Support costs may include training for IT personnel as well.

End-user costs represent costs incurred by those transitioning to the newly deployed technology such as end-user training, personnel costs for end-user support (for dedicated expert users), and any lost business unit productivity as the company transitions to the new technology.

MEASURING BENEFITS

The foundation of a business case is comparing the benefits to the costs of that investment. Benefits are those quantifiable, positive qualities associated with the completion of some task or project, which are then traded off against the lifecycle costs. Benefits are typically on-going and can be either hard/direct (such as increased revenues) or soft/indirect (such as increased customer satisfaction).

Measuring benefits presents three challenges: identifying and quantifying all the hard and soft benefits, ensuring the right calculations are employed, and accounting for future uncertainty. Measuring soft benefits can be particularly challenging and may require some analytical creativity.

Identifying benefits requires taking a creative and holistic look at all the potential positive impacts that decisions can have on the organization. An investment in new technology or the creation of a new product can contribute to the bottom line in several ways. But most benefits fall within four broad categories in two dimensions: direct and indirect and increasing revenues or decreasing cost. Examples of each are presented in Exhibit 1. Most critical is to ensure that ALL potential benefits are accounted for, regardless of how easy or difficult it is to quantify those benefits.

Investments that enable the acquisition of new customers or increases purchases from existing customers helps to directly drive revenues. So does creating new products or services. Whereas investments that improve brand perceptions or increase customer satisfaction and/or loyalty also drive revenue increases, albeit in an indirect way. Investments that displace costs or reduce capital requirements can directly decrease costs. So can increases in productivity – provided the business leaders are willing to make changes in their budgets to account for that productivity improvement. Examples of indirect cost reductions would be improving speed to market, reducing support requirements or reducing error rates.

Another important note regarding the calculation of benefits, effort should be undertaken to avoid double counting benefits (and more broadly, to understand how two different benefits are correlated). Sometimes this serves to decrease the benefits (as in the case of double counting) and sometimes it serves to increase them. For example, if a technology can both increase the number of leads that are acted upon AND improve the lead closure rate, then the total benefit from these two items would exceed the evaluation of each benefit separately.

Different types of decisions require different approaches. While business cases regarding new product development are inherently outward looking, analyses of both internal and external factors are required for evaluations of many technology investments. Productivity, speed to market, reducing costs, or reducing customer support requirements are metrics drawn from internal data. Metrics such as market penetration and prospect win rate are external metrics. Customer win rates and revenues draw from both.

For an example of an inward-looking indirect benefit, consider the case of an internet retail company that was contemplating the deployment of an online coupon system. The goal of the system was to provide parity with competing bricks-and-mortar retailers (external) and to drive additional revenue for existing customers (internal) by increasing their share-of-wallet. When evaluating internal factors, the marketing team examined the existing customer base and how their overall spend varied over time and mapped that to total relevant potential spend. The following variables were identified:

Customer Segments were determined based on the size of household from particular items that were purchased in the past (i.e., diapers indicated a 'family').

EXHIBIT 1

Examples of Benefits

	Increase Revenues	Decrease Costs
Direct	• Acquire new customers • Increase purchases from existing customers • Develop new products and services	• Improve productivity • Displace costs • Reduce capital requirements
Indirect	• Improve brand perceptions • Increase customer satisfaction • Increase customer loyalty	• Increase speed to market • Reduce customer contact/support requirements • Reduce fulfillment or customer response errors

Customer Size for each customer was evaluated based on the range of total monthly revenues over the past twelve months.

Customer Potential was determined by observing the largest customers in each segment and using those monthly revenues as a proxy for the true potential for each customer in that particular segment.

Coupon Impact was estimated by taking the percentage of the overall product line represented by the coupons and multiplying that by the likely impact on the growth of share of wallet. It was not possible to create confident estimates of either the representation of the product mix or the likely impact on the customer share of wallet. So, all available data was assessed, and a small team of subject matter experts (SMEs) created a range of possible values based on their experience in the off-line world for these numbers in an effort to create a 90% confidence interval.

Contribution Margin was also given a range of possible estimates by using the company's weighted average contribution margin for the basket of goods represented by the coupons and employing the expertise of SMEs.

This thorough approach enabled the company to estimate the likely increase in incremental profits, which in turn enabled the company executives to more accurately compare the benefits against the costs of the deployment.

MANAGING RISK

Risk is a part of almost every human endeavor, so given its ubiquity, it is surprising how little consensus there is on its definition. In this discussion, risk denotes a probability of a different set of possible outcomes—the variability in our estimates for the future. Black Swans happen all too frequently but there are tools to help predict the likelihood and impact of these outlier scenarios.

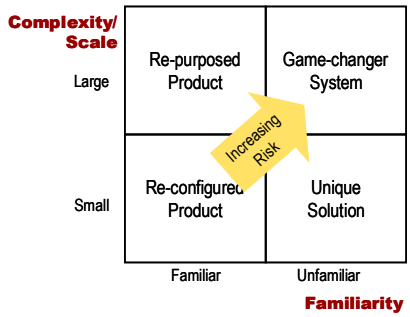
Most every cost and benefit of any new investment are subject to variability/risk, rendering it impossible to estimate the precise costs to implement a new technology or the downstream profit impact of that implementation. In fact, risk, rather than the difficulty of accounting for indirect benefits, is the primary reason executives are reticent to approve many innovative and potentially game-changing technology projects.

Addressing such reticence requires more than a simple discussion or plan of action of how the risk will be managed. Instead, confront the uncertainty head-on by first looking for actual historical precedents of cost over-runs of similar projects to overcome any bias of optimism or misrepresentation and second communicating the risk in financial terms so that economic models account for the downside risk of both cost over-runs and unrealized benefits.

Optimism bias is a demonstrated tendency found with most people to be overly optimistic about the outcome of planned projects, which includes over-estimating the likelihood and magnitude of positive events and the opposite for those on the negative side. It is also possible for projects to suffer from issues of misrepresentation if the project has some political implications. The way to solve for both, is to look for actual outcomes from previous similar projects and evaluate the risk accordingly.

EXHIBIT 2

Complexity-Familiarity Matrix for Cost Risk



Also, it should be noted that since the notion of risk is independent from that of expected value, adding risk metrics to business cases improves the level of analytical rigor and enhances decision making.

The process of upgrading business cases to account for risk is a relatively straightforward three step process:

1. Consider all costs and benefits to be uncertain, like a random variable—not certain, like an expected value;
2. Evaluate the variability of each cost (or benefit) by engaging the appropriate subject matter expert (SME) in the organization to employ the analytical tools in the next section to estimate the level of risk;
3. Assess the overall costs and benefits and their variability using a Monte Carlo Simulation model with the appropriate number of trial runs.

Practical ways to Estimate Risk

How many person-weeks of effort will it take to deploy a new software product? What will be the resulting revenue or productivity growth from that implementation? Life insurance firms stay in business because they have good statistics on how quickly their customers would collect on their policies. Auto insurance companies have accumulated large data stores on the expected frequency of collisions and likely repair costs. However, to date there has not been any systematic collection of corporate-level data about the success or failure of corporate investments of any sort. Without the equivalent of actuaries for corporate investments, management often relieves anxiety by either (semi-)blind faith or by requiring technology investments to meet increased financial thresholds.

However, a better approach to managing risk is to first acknowledge its presence and then account for it by

adding risk analysis into every important business case. To do this, the risk must first be identified, then measured, and finally articulated in a financial context. At one end, a fixed price contract with a highly experienced team with penalties and a performance agreement approximates a risk-free scenario. Imposing an unproven solution on an unreceptive and untrained work force represents the other extreme. Most projects fall somewhere in between.

An assessment of risk for each identified cost or benefit can be performed in order to account for potential variability in those estimates. A subject matter expert (SME) can help the process by making an educated estimate of how much the actual cost or benefit is likely to vary from its estimate based on their experience with similar projects. Such an assessment adds a reality-grounded estimate of how the actual costs or benefits can vary from their expected values.

Cost Risk

If all corporate projects were always delivered on time and within budget there would be no reason to measure cost risk. This is clearly not the case—so business plans should go beyond a simple analysis of expected values.

The greater the risk of a line item on a budget, the greater the likelihood of that cost varying from its expected value. Thus each line-item in the cost budget should be modeled as a random variable. Basic probability theory can be used to properly evaluate this risk. A random variable is a quantity whose value is not fixed, but whose outcome can vary in accordance with a pre-described formula, called a probability distribution. A probability distribution describes the range of possible values that a random variable can attain and the probability that this value is within any measurable subset of that range.

There are two core dimensions that increase the risk of cost over-runs in a corporate investment, the combination of which gives a clearer picture of how the estimates are likely to vary from the expected value. The first dimension is the level of familiarity or experience of the team tasked to build or implement the product. The investment is less risky when an organization has demonstrated the ability to contain costs in the past for similar projects. The second dimension is the size or level of complexity for the effort. The results of a deployment of large and complex products are more unpredictable than those that are smaller and less complex.

These two dimensions form what could be called a *Complexity-Familiarity Matrix* (Exhibit 2). The horizontal axis measures the size and complexity and can be assessed in several ways, for example by number of end-users or function points. Familiarity measures the level of expertise of the teams involved. The lower left quadrant would include technology investments that are both limited in scope and familiar to the organization and thus less risky. The upper right quadrant includes new solutions implemented by new teams and thus present the greatest risk of cost over-runs. The most important part of assessing either dimension in this framework is to be consistent as you compare different (and potentially competing) opportunities.

When measuring either dimension, a helpful guide is to take an objective look at what is required and compare that with the competencies of the organization. The following scenarios provide the range of risk due to unfamiliarity:

- Lowest Risk: The effort required is the type of work that is performed at the company 'all the time';
- Greatest Risk: Nobody has succeeded at this, ever.

This enables the SME to position the particular cost (or entire project) on the complexity-familiarity matrix. The position in that matrix determines the potential level of variability to assign.

For example, an experienced vendor offering a fixed-price contract with performance guarantees reduces the likelihood of cost overruns and thus would have a tight probability distribution. Depending on the terms and the nature of the project, the cost curve could be one of C1, C2 or C3 on the top of Exhibit 3, depending on the potential for fee-able change orders. For an untried technology, the ultimate costs are more uncertain, creating a longer tail on the cost curve demonstrated on the lower portion of Exhibit 3. The variability also depends on the level of clarity and finality of the specifications.

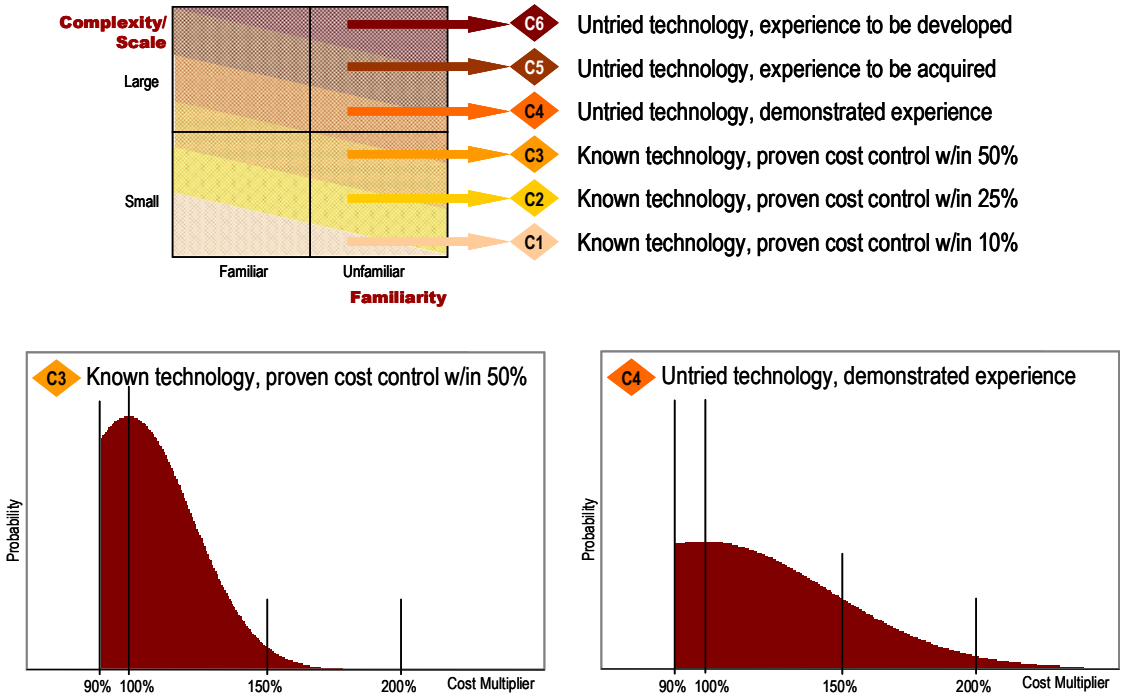
So the typical cost line-item in a business case with now have three parameters: the expected value, the level of variability (or risk), and the shape of the probability distribution which best represents that variability.

Graphing the probability distribution of the ratio of actual to budgeted costs can enable a more complete understanding of the variability of project cost estimates and thus ensuring that the business model will better represent reality. The resulting probability curve for costs should have a long tail to the right to account for cost "over-runs" (which can sometimes run into many times initial estimates) but be truncated to the left because budget "under-runs" are rare and typically very close to the initial estimate. This type of curve would look like a normal distribution (i.e., a 'bell' curve) but with the ends truncated either at 90% or 100% on the low end and either not at all or some upper bound like 150% or 200% on the high end. Note that 100% indicates an outcome that exactly equals the expected costs and an outcome of 120% would be indicative of a 20% cost overrun. The bottom of Exhibit 3 gives examples of similar probability curves. The height of the curve is an indicator of the likelihood of each percentage cost multiplier, so with cost type C3 the likelihood of the cost being within 10% of the estimate is greater than with cost type C4.

The endpoints of the truncated normal distribution should be driven by historical experience and the nature of the project. This example shows a cutoff at 90% of the cost

EXHIBIT 3

Translating the Complexity-Familiarity Matrix to Variability in Expected Costs



estimate but should be adjusted upward to 100% in many circumstances. In this case, the technology buyers' bills would cluster around the quoted estimate; more than a 10% under-run can not be expected because any large "windfall" savings will be diverted to another cost group on this or some other project. The right tail accounts for the possibility that costs exceed those quoted (and that probability grows as the cost risk increases) and becomes more common in highly complex projects.

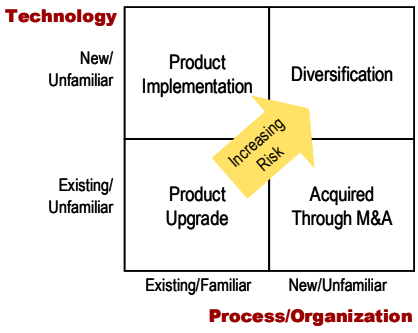
BENEFIT RISK

The potential for variability in estimating benefits is usually even larger than with estimating costs because realizing benefits relies on more complicated interrelationships between more highly uncertain variables. Quantifying the risks for benefits also requires analysis along two dimensions. The first is the level of a firms experience with using the technology for a project in question. The more an organization can draw upon product knowledge when trying to realize the benefits of a technology solution, the less variable the outcome (and thus the resulting probability distribution will have a smaller, "tighter" variance). For example, implementing a product in an organization already familiar with it's features would be considerably less risky (and enable tighter estimates) than if a completely new and untried product was to be imposed on an unenthusiastic set of users. The second dimension accounts for the fact that more organizational expertise with the product or process, the lower the variability/risk (Exhibit 4).

Describing the probability distribution of benefit risk is simpler than for costs. The benefits from any investment are the result of many interactions among many parties such as employees, customers, competitors and other stakeholders, thus a uniform distribution is likely the best option to model the situation when a large number of unpredictable interactions influence an outcome.

EXHIBIT 4

Product-Market Matrix for Benefit Risk



As Exhibit 4 shows, the level of uncertainty increases as the strategy moves away from known quantities—the familiar technology and the familiar process, i.e., moving up and to the right in the matrix. Thus, implementing a completely new and unproven technology (with new required processes to support that technology) on a wary and untrained workforce presents more risk than updating an existing technology on a highly trained and enthusiastic set of users.

Measuring the potential variability in benefits requires taking an objective look at what is required for those benefits to materialize. The following scenarios provide the range of risk due to unfamiliarity:

- Lowest Risk: The benefits are dependent on the type of work that is performed at the company 'all the time';
- Greatest Risk: Nobody has succeeded at realizing benefits from this new solution, ever.

So, like costs, the next step is to have SMEs take an objective look at the risks of each identified benefit and plot each group on the product-process matrix. The position in that matrix drives the level of variability to assign to that cost variable (left side of Exhibit 5). So, the typical benefit line-item also has three parameters: the expected value, the level of variability (or risk), and the shape of the probability distribution which best represents the expected value of that benefit. Alternatively, these parameters could be the low and high bound on the CI and the shape of the curve, which is essentially the same thing. For example, consider what can be expected if the SME calculates a benefit estimate that falls into risk group B3 (known market or organizational change, control within 50% of benefits estimates). This could be considered typical for a major new technology investment that does not significantly alter the current organizational structure or employee roles. In this case, the benefits estimates would fall somewhere between 50% and 150% of the estimate.

Measuring Risk Saves Time

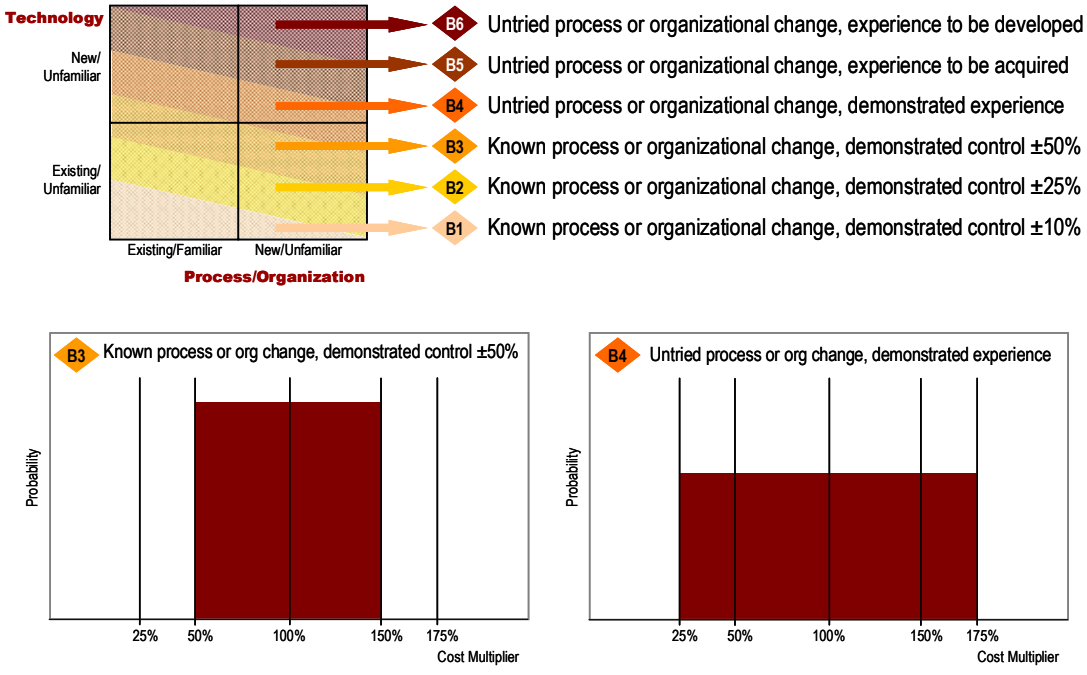
There's no point in going to great lengths to measure costs or benefits with extreme precision when the fog of variability renders that precision practically meaningless. Making an informed judgment of the likely upper and lower bounds (or optimistic and pessimistic scenarios) of both costs and benefits is usually a relatively simple exercise for an SME, and enhances the analytical model to better represent reality.

Risk Management through Simulation

Rather than actually measure risk, many organizations characterize risk by using designations like 'high', 'medium' and 'low', or perhaps a scale from 1 to 5. The trouble with this subjective assessment is that while risk may be noted, it is not properly quantified. Also, these designations have no consistent meaning so any comparisons between projects are without merit. Another approach supplements a business case with sensitivity analyses. Sensitivity analysis is a technique whereby parameters in a mathematical model are systematically

EXHIBIT 5

Translating the Product-Process Matrix to Variability in Benefits



changed to determine the effects of such changes on the outcome. However, this approach falls short on several fronts. Sensitivity analysis can be performed at +/- 10%, 20% or more. However, which is the right number? Sensitivity analysis glosses over the actual evaluation of the risk. Also, when every variable has risk, a static model with sensitivities added does nothing to evaluate the interactions with sensitivity on multiple variables. Furthermore, when comparing competing projects, sensitivity analyses do not help arbitrate between projects that have different degrees of risk. For example, when comparing a 'challenging' project with one that has never before been attempted, enhancing the model with sensitivity on each variable at +/- 10% does nothing to account for that difference in risk.

A better approach replaces the expected values with a random variable fit to a probability distribution where the variance of the random variable reflects the level of risk. While thoughts of probability theory tend to spark unpleasant memories in most, this approach can actually be performed with relative ease. Most business cases have many inter-related variables, so the easiest way to manage this risk is usually to employ a technique called Monte Carlo Simulation, an analytical technique used for solving problems by performing a large number of trial runs (i.e., simulations) and inferring an answer from the collective results. Coupled with the use of random variables, this powerful tool produces a probability distribution that illustrates the likelihood of an investment exceeding defined thresholds (e.g., profitability, ROI, or payback period). This enables decision makers to see not only the expected ROI, but also the likelihood that the investment exceeds certain thresholds.

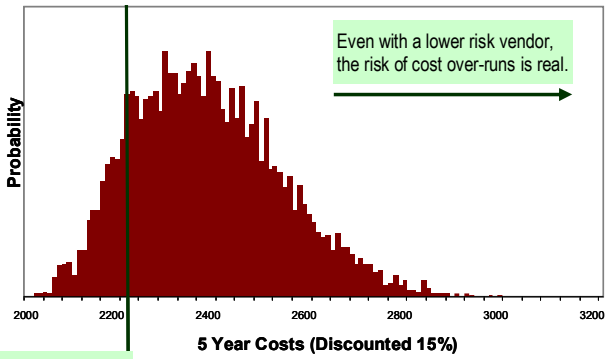
Exhibit 6 illustrates the impact of increasing risk on a cost budget in two scenarios with the same expected level of investment.

EXHIBIT 6

The Impact of Increased Risk on Simulated Costs

The two examples below show different scenarios of the same project (i.e., they have the exact same expected values) but the top project is judged by experts to be less risky than the bottom (this scenario equates to the typical decision of buy-versus-build where the build component is less risky but it typically met with more enthusiasm by the IT department). Note that the risk scores range from C1 to C3 in the top scenario while the lower scenario has a number of C4 risk metrics (which are still relatively conservative and assume a very experienced team). The end result of the simulation runs is a rightward shift of resulting total five-year costs indicating a much greater increase in cost overruns. Indeed, the simulation shows that 4.7% of the iterations had a cost overrun of 20% or greater while the likelihood of the second scenario was 32%.

Costs	Total	Risk Score
Initial		
Software Licenses	$275	C1
Implementation Services	$180	C2
Staff and IT Training	$65	C3
Additional Hardware	$5	C2
*Administrative	$100	C2
Total Initial Investment	$625	
On-going		
Support Contract	$50	C1
IT Headcount	$200	C3
*Purchase of 3rd Party Data	$50	C1
*Future Training	$50	C3
*SME Headcount	$125	C3
Total Annual Investment	$475	
Total 5 Year Investment Cost	$2,216	



Expected Costs

Costs	Total	Risk Score
Initial		
Software Licenses	$275	C4
Implementation Services	$180	C4
Staff and IT Training	$65	C3
Additional Hardware	$5	C2
*Administrative	$100	C2
Total Initial Investment	$625	
On-going		
Support Contract	$50	C4
IT Headcount	$200	C3
*Purchase of 3rd Party Data	$50	C1
*Future Training	$50	C4
*SME Headcount	$125	C4
Total Annual Investment	$475	
Total 5 Year Investment Cost	$2,216	

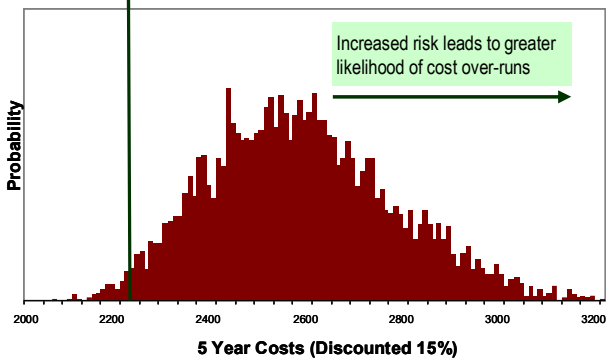
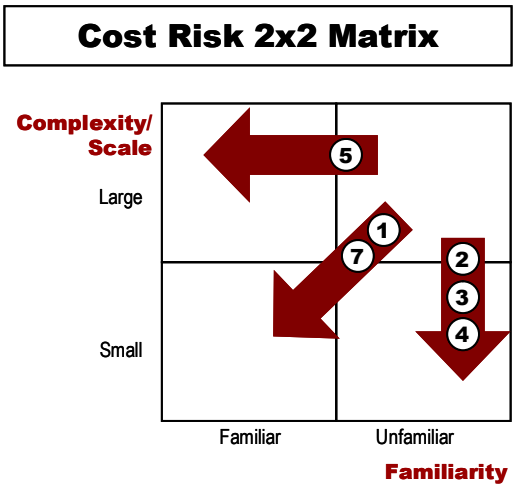


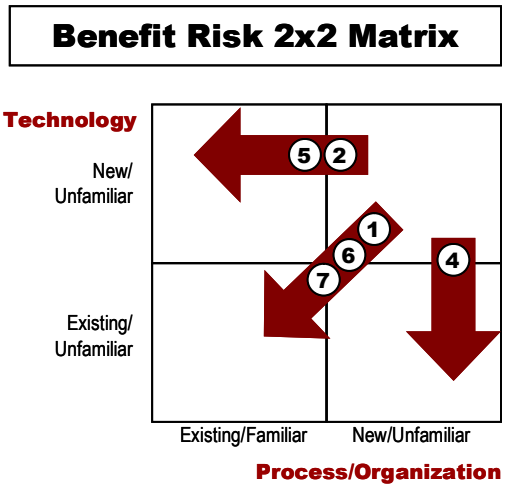
EXHIBIT 7

A Practical Framework for Risk Mitigation in Technology Projects

There are several steps that managers can take to improve the outcomes of their technology projects by reducing the risk of projects going awry. Managers can employ the cost and benefit risk 2x2 matrices to identify potential areas for risk mitigation. In each case it is possible to identify a characteristic of the project and reduce the level of risk on one or more of the dimensions outlined in these matrices.

1. **OBJECTIVITY:** Forecasts for costs and benefits for technology typically fall victim to optimism biases that must be rooted out based on experience from past projects. Typically costs and timelines are under-estimated, and benefits are over-estimated. With all these biases, the potential to make the wrong decision is very real. One way to overcome this is to augment internal resources with outside expertise to assist and/or audit the output for an independent evaluation and account for that risk in the financial models.
2. **SCOPE:** Reducing the level of complexity and size into more manageable pieces can dramatically reduce the risk of budget over-runs. IT departments and engineers are often motivated by building rather than implementing new technology, by creating an entire new customer product from scratch where an off-the-shelf product will perform adequately. There are tangible benefits to going with something off-the-self in terms of reducing the complexity and increasing the familiarity of the technology solution.
3. **DURATION:** One key factor to keep a project from spiraling out of the control is to manage the duration of that project. There appears to be a strong correlation with a project's duration and its level of cost risk—thus there is a tangible payoff to finding ways to break a project into discrete and distinct manageable pieces, preferably maxing out between 12 and 24 months.
4. **CLARITY:** Without clear goals that have been finalized and received buy-in, requirements are ill-defined, business processes are ill-conceived, and costs are difficult to contain as project sponsors try to hit a moving target. The risk of cost over-runs can be greatly reduced if clear objectives and requirements have been established by both senior management and the eventual end-users.
5. **EXPERIENCE:** Experience with the technology and associated processes can mitigate both cost and benefit risk. By employing experienced project managers and developers, the risk of cost over-runs is reduced because personnel have already learned the key lessons on other projects. If they are learning on-the-job, the results can be costly. Furthermore, expert builders understand how the technology can best integrate with your existing organization thus reducing the risk that benefits don't materialize.
6. **SUPPORT AND TRAINING:** Providing training and support for the eventual end-users (both technical and functional) can mitigate benefits risk by reducing the risk of downtime (technical), increasing ramp-up time to full productivity with the system, increasing adoption rates and reducing mistakes among end-users, and reducing the risk of lost productivity within the organization when employing the new technology for their organization.
7. **ACCOUNTABILITY:** Establishing a project sponsor who both leads the effort and is accountable for the results can have an impact on each dimension of both matrices. With both leadership and accountability (and the risk of impacting their careers), managers are on the hook to closely manage every detail of the project which can have a dramatic across-the-board impact on risk mitigation.





EXAMPLE

To illustrate the differences between the common approach and one that employs the tools outlined above, consider the decision facing a growing tech company looking to add a multi-module system for managing elements of the marketing process. There are two vendors competing for the business, Vendor A and B.

THE STANDARD APPROACH

Vendors A and B present competing proposals. Relevant business unit leaders, including IT and Finance, then conduct an analysis of the potential costs and benefits of each option (Exhibit 8). In addition, the following information is garnered from the discussions with other vendors and industry groups:

- Vendor A's product costs less but is harder to train/implement,
- Both products have roughly the same capabilities, but Vendor A's product enables both the Marketing and Sales departments to be more productive,
- Vendor B's product enables a greater reduction in dependence of outside service vendors, and
- Vendor A is a well-capitalized start-up while Vendor B is a division of a large multi-national corporation. Vendor B has three times as many customers.

So, based on the analysis of payback period and ROI, Vendor A has the solution that pays for itself most quickly (9.0 months versus 9.7 months) and has the highest ROI after five years (119% versus 105%). But even if both solutions meet minimum thresholds for ROI and payback period, the company knows that there is uncertainty in many of the model inputs so management may be rightly uncomfortable proceeding with Vendor A even in light of the compelling business case.

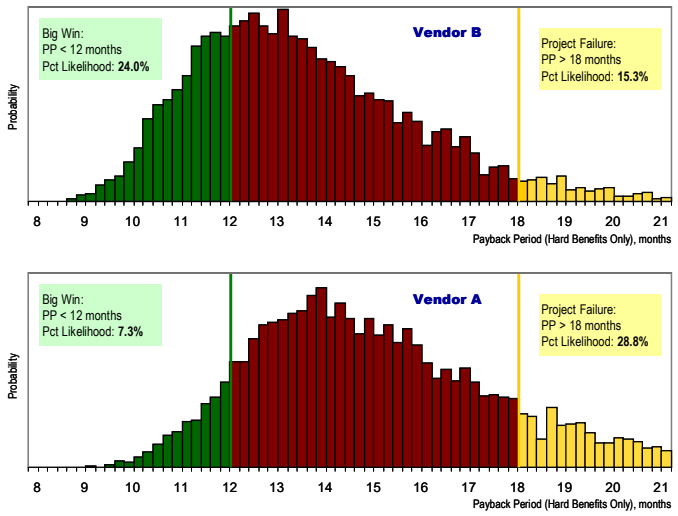
EXHIBIT 8

Typical Business Case Comparing 2 Vendors

Costs	Vendor A	Vendor B
Initial		
Software Licenses	$275	$300
Implementation Services	$180	$150
Staff and IT Training	$65	$50
Additional Hardware	$5	$5
Total Initial Investment	$525	$505
On-going (Annual)		
Support Contract	$100	$104
IT Headcount	$200	$200
Total Annual Investment	$300	$304
Total 5 Year Investment Cost	$1,531	$1,524
Benefits		
Revenue Gains		
Increased Lead Conversion Rate	$150	$150
Increased Prospect Response Rate	$100	$100
Reduce Discarded Leads	$150	$150
Cost Savings		
Increased Sales Productivity	$250	$180
Increased Marketing Productivity	$100	$50
Reduced Vendor Dependency	$250	$300
Total Annual Benefits	$1,000	$930
Total 5 Year Benefits	$3,352	$3,118
Payback Period	9.0	9.7
Five year ROI (15% discount)	119%	105%

EXHIBIT 9

Payback Period Simulation Distribution (Vendors A & B)



APPLYING THE MOVE EVOLVED APPROACH

The results from the more thorough analysis—changing the selection to Vendor B! Key modeling and operational changes that were made:

- Management considered only hard benefits since Marketing/Sales would not cut budgets based on predicted productivity gains.
- New costs and (hard) benefits were uncovered, evaluated, and added to the model.
- Each cost/benefit was assigned a probability distribution and variance based on input from SMEs from the most relevant organizations.
- Management ultimately judged the investment based on payback period using only hard benefits.
- When each sub-system (of the entire product suite) was evaluated separately, it became obvious that one sub-system did little to enhance ROI for either vendor and was dropped.
- The main risk, limited user adoption, was alleviated by adding a strategic hire with system expertise. This hire ensured effective training and faster organizational ramp-up.

Exhibit 9 shows the final results of the two offerings. The project would be considered a "big win" if the payback period fell below 12 months (shown in green) and would be deemed a "failure" if 18 months or more was required for payback (yellow). Vendor B's experience and willingness to provide implementation cost guarantees offered greater cost certainty which drastically reduced potential outlier scenarios. Because management decided to exclude soft benefits like productivity gains, Vendor A's offering (which enabled greater productivity gains in Sales and Marketing) was less compelling. In the end, Vendor A's failure likelihood was predicted to be an unacceptable 28.8%. Management selected Vendor B with a failure likelihood of a more tolerable 15.3%.

THE BUSINESS LOGIC FOR ACTION

Business leaders are challenged to identify technology that offers the greatest competitive advantage. And while any investment should undergo a careful evaluation of potential return, business leaders who want to ensure success of their technology investments should think beyond traditional ROI. A more evolved approach supplements ROI analysis with a robust process that drives organizational clarity and accountability and delivers a more comprehensive analysis to expose both hidden profit and risk using random variables and Monte Carlo Simulation models. In so doing, business leaders can gain an insightful look at the full range of possible financial outcomes (and their likelihood) and thus make the most informed decisions.

Large-, mid- and small-sized companies alike can gain fast and meaningful benefits from taking a more comprehensive approach to their business decisions. Improving the value generated by technology investments should be every company's strategic imperative. Bringing thoughtful analysis and process improvement to the measurement of ROI will pay large dividends, specifically:

- **MANAGING RISK** – Avoiding "betting the company" on an investment and conversely avoiding "analysis paralysis" for otherwise compelling investments.
- **INCREASED ACCURACY** – When companies more thoroughly measure the costs and benefits over the entire lifecycle of the investment, they avoid often painful surprises of cost over-runs or benefits that don't materialize.
- **INCREASED PROJECT ROI** – Employing a more granular analysis enables a heightened focus on only those elements of projects that drive ROI, non-value-added components can be eliminated or reduced.
- **INCREASED SUCCESS RATE** – improving organizational clarity and accountability improves the chances of following through with successful implementations.

Following this enhanced analytic strategy, it is possible for any company to both improve the effectiveness and reduce the risk of technology investments by a measurable and meaningful amount.

AUTHOR

David Bartenwerfer is the founder of Quantum Consulting and Technology. QuantumCT provides a combination of products and consulting services designed to deliver results more quickly than the traditional strategic consulting approach. Mr. Bartenwerfer has over twenty years experience in the high-tech, Internet, and financial services industries and holds a B.S. in Systems Engineering from the University of Virginia and an M.B.A. from the Stanford Graduate School of Business. For further information, contact the author at dbartenwerfer@quantumct.com.