



# IT Portfolio Management: An Overview

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## CHA CHA CHANGES IN THE CURRENT ENVIRONMENT

The unabated growth in information technology (IT) spending, a primary means of economic expansion before 2000 due to large-scale enterprise resource planning (ERP) implementations, Y2K, and the hypergrowth attributed to dot.com and e-business, is, for the time being, over. In today's turbulent environment, companies face new hurdles from:

- Greater uncertainty
- Increased commoditization
- Nontraditional entrants with competitive offerings
- Shorter half-life of information (moving strategic enablers to commodity)
- Tighter spending
- New technologies
- Changing customer demands and higher levels of personalized preferences
- Multiple pricing, service, and utility models
- Government regulations, legal compliance, and safety standards
- Increased transparency of information due to the blurring between customers, competitors, and suppliers

While many of these challenges are externally driven, the internal challenges faced by many companies include:

- Clearly defined and clearly communicated business and strategic objectives, and consensus building around these objectives
- Complexity associated with introducing and infusing change and innovation
- Identifying and managing investments across multiple divisions and business units
- Product versus service focus
- Value chain partners
- Sourcing relationships
- Cost reductions
- Responsiveness improvements
- Efficiency enhancements

Although change will continue to accelerate and have more impact, many companies continue to either reduce or maintain current levels of IT spending. CIOs and other IT management leaders are now being called upon to justify the business value of IT. Critical capabilities to supporting the business value of IT include:

- Prioritization and alignment with the corporate vision
- Balanced investments across business units
- Pragmatic cost and risk-control mechanisms
- Rational decision-making processes
- Flexibility to reassess and rebalance priorities in the face of a fluid environment
- Adherence to mandated compliance and regulatory requirements

Achieving growth and business value in today's challenging economy has driven many companies to focus on their core competencies: the unique and differentiated knowledge contained within their processes, technologies, relationships and extended enterprises, skills, and culture that provide a leveragable competitive advantage. Focusing on core competencies also means developing a closer alignment between business and IT, as IT represents a sizable percentage of the budget spending for companies and is quickly developing into a valuable strategic asset. In fact, according to recent research, IT spending as a percentage of gross revenues is currently 1.5% to 7.0% and represents greater than 70% of capital spending for most companies.

## **FOCUS ON IT INVESTMENTS**

IT can have a significant impact on the quality of services and solutions and the performance of a company. Efficiently and effectively managed IT investments

that meet business and mission needs can create new value–revenue generation, build important competitive advantages and barriers to entry, improve productivity and performance, and decrease costs. Similarly, poorly aligned and unmanaged IT investments can sink a company.

IT investments represent a profound hole within companies. There are no other investments within a company that occupy such a large and growing expenditure yet lack disciplined management, processes, and performance measurements. However, a majority of companies are aggressively scrutinizing the amount of investment allocated to IT in an effort to cut costs, achieve economies of scale, and drive shareholder value to get more and do more for less. The primary focus on IT investments is on short-term projects and priorities with near-term benefits, delaying and in many cases eliminating long-term strategic investments.

Concurrent to cutbacks in IT spending and a short-term focus, management within companies is demanding an increase in IT productivity, expanding IT's role from internally focused to customer facing and making IT more relevant to the business strategy as resources are scaled back. Customers are demanding more rapid, real-time, customized, total solutions, while competitors are forcing companies to frequently innovate to maintain their market position. Additionally, regulators are requiring new levels of accountability and traceability of corporate behavior (e.g., the Sarbanes-Oxley Act), prompting increasing levels of compliance. The information systems department is not immune to compliance requirements mandating microscopic examinations of areas such as careless project overruns.

Besides deploying Six Sigma practices and cutting costs by freezing projects, laying off employees and contractors, or renegotiating supplier contracts, many companies are utilizing supply-side self-funding IT activities to get through turbulent times, including:

- Simplifying, migrating, retiring, and/or consolidating legacy systems to decrease operations and maintenance costs and increase flexibility and agility
- Standardizing, reengineering, and utilizing commercial off-the-shelf technologies and open standards for new product development to speed time to market and avoid the expensive use of proprietary technologies
- Externalizing processes through outsourcing and establishing value-network partner ecosystems and shared services, resulting in lower costs and focus on core competencies

IT portfolio management is a tool that supports companies during times of both robust growth and economic downturn. IT portfolio management supports disciplined improvement and thrives on consistency, repeatability, and accountability. However, a key challenge for companies during periods of boom

or bust is aligning to the corporate strategic intent and developing a framework for measuring, balancing, prioritizing, selecting, and flexibly changing the composition of IT investments and assets. Many companies are hemorrhaging in IT spending due to:

- A prevalence of pet projects
- A reluctance to kill projects and/or retire assets
- Too many active projects and a huge backlog of projects
- A myopic focus on exotic and cool technologies
- A lack of a detailed cataloged, organized, and aggregated view of critical versus immaterial assets
- Inconsistent and incomplete criteria to assess IT investments
- Underestimation of the total cost of ownership
- Inadequate governance
- Ad hoc program management processes

This situation is reflected in the following survey results that highlight the shortfalls of the majority of companies in attaining optimal value at acceptable risk levels for their IT investments:

- 84% of companies either do not do business cases for their IT projects or do them on a select few key projects.
- 83% of companies are unable to adjust and align their budgets with business needs more than once or twice a year.
- 67% of IT organizations are not market ready. Benchmarking is done less frequently than once a year.
- 89% of companies are flying blind, with virtually no metrics in place except for finance.
- 57% of companies perceive they are balancing the pressures of cost cutting and IT effectiveness.

Most companies maintain a list of more IT projects than their budgets can support. Ironically, many business and IT managers are unaware of:

- The types of ideas and concepts being worked on within research and development
- How many IT projects are in the development cycle and their alignment with the future strategic direction
- The amount of resources allocated to, or the risks associated with, each IT investment

- The reason why IT investments were initiated or the criteria used to approve IT investments

In addition, information regarding the size and magnitude of the operations and maintenance budget as a percentage of IT spending, and how this funding is allocated among new systems versus legacy systems, is typically not readily available. Hiding IT costs associated with pet projects, political power plays that override strategic objectives, and implementation and execution of rogue systems is easy and commonplace. Unfortunately, most companies lack the discipline to continuously measure performance. To complicate matters, it is not unusual that accountability to initial assumptions made in IT investments is nearly impossible to trace, since roles, responsibilities, and ownership are vaguely defined. Welcome to the world of configuration management, change management, transition management, and governance processes at the lowest levels of maturity. It is impossible to effectively and efficiently manage IT resources without awareness and a detailed catalog of all IT investments, identifying who is accountable, and relevant metrics.

The flaws and disconnects as discussed are manifested in the figures:

- 72% of IT projects are late, overbudget, lacking in functionality, or never delivered.
- Of the 28% “successful” projects, 45% were overbudget and 68% took longer than planned.
- 50% of managers said they could have realized value with 50% of the cost.
- Only 52% of the projects realized strategic value.

According to the Project Management Institute, North American firms spent more than \$1 trillion on IT deployments and surrendered nearly \$300 billion on late, overbudget, or failed implementations during 1999–2001.<sup>1</sup> Focus, direction, and control mechanisms are not core competencies within many companies. These figures are particularly alarming considering that projects and initiatives in the pipeline should represent the engines for growth, modernization, and transformation. Projects and initiatives typically average approximately 25% of the total IT budget (the remainder allocated to assets within operations in such areas as existing applications, infrastructure, people, processes, etc.). Assuming a 30% success rate, only \$1 out of \$14 spent by the average company’s IT budget can be correlated with new benefits. This is a relatively accurate assertion.

IT continues to subsume a larger percentage of the enterprise budget. The criticality of IT to business operations and the rising cost of downtime will increasingly impact the bottom line. As customer demands continue to increase and as companies expand their operations beyond their own facilities, it is imperative

that they focus on demand-side efficiencies and provide impeccable quality, service, integrity, and continuous innovation. As a result, converting fixed IT costs into variable costs through such mechanisms as utility-based on-demand offerings and outsourcing (e.g., infrastructure, application development, application maintenance, business processes) allows companies to focus on their core value propositions. This practice has recently gained traction.

Many companies maintain a sequential series of tightly coupled, hardwired systems that dictate business logic and processes. The resulting infrastructure is inflexible and ineffective in data aggregation and synchronization. Costly overruns are commonplace in extending or adding new processes across divergent and distributed environments. The ability to extend, migrate, refurbish, or retire systems or applications is very difficult as key dependencies, support, and constraints with other applications and systems are often unknown. Thus, it is not surprising to find multiple and redundant enterprise resource planning, supply chain management, portals, customer relationship management, middleware, and operating systems consisting of undocumented ad hoc upgrades and patches analogous to a “spaghetti” architecture.

Technical, business, operating, system, logical, and physical views of the architecture are typically outdated or nonexistent. Misalignment between IT and the strategic intent, inability to establish a common IT architecture, and a highly redundant and undocumented as-is architecture will result in high operations and maintenance costs. Furthermore, this will limit a company’s ability to rapidly respond to unforeseen events and prioritize and reprioritize investments. In today’s unforgiving economy, the result of not conforming to a disciplined IT portfolio management framework is undisciplined growth and drift of business processes that are typically expressed through lack of innovation, slow market responsiveness, and dissatisfied customers. These shortfalls are exposed swiftly, causing debilitating and adverse effects on valuation and the sustainability of a company as an ongoing entity.

To further complicate matters, the emergence of web services, business process management systems, and services-oriented development of applications (SODA), which enable more specialized, plug-in applications, are seminal elements in realizing the vision of an agile enterprise. These flexible new technologies are creating an unprecedented demand for systems to interoperate. Web services and SODA will continue to make the business and IT relationship more critical as IT continues to become increasingly more integral to business processes. The layers of abstraction added to technologies are becoming more visual and model driven. In addition, the introduction of emerging technologies or often just the hype around them (e.g., nanocomputing, grid computing, and peer-to-peer computing) will continue to add to the complexity of IT, making IT portfolio management an increasingly critical capability.

## FORMING, NORMING, STORMING: THE IT LIFE CYCLE

Unfortunately, there is no single point of failure that is causing breakage. In fact, there are failure points across the entire IT life cycle that contribute to poor planning, execution, and alignment of projects and initiatives. According to research, fewer than 25% of Global 2000 IT staff have been formally and effectively schooled in project management. The IT life cycle is comprised of three primary phases: the IT discovery phase, the IT project phase, and the IT asset phase.

### IT Discovery Phase

Sometimes called the fuzzy front end, the IT discovery phase occurs during the concept and idea stages of basic research. This phase matures IT investments that are typically longer term, riskier, and more uncertain than the other two phases discussed below. The IT discovery phase provides the locomotive that companies utilize to grow and transform the business. Investments in this phase are inventoried, assessed, balanced, optimized, and selected in the IT discovery portfolio.

### IT Project Phase

Sometimes called new product development, this phase is governed by a series of stages and gates for managing the life cycle of projects. Investments made in the IT project phase typically are medium- to short-term investments that companies use to help transform and grow the business. Investments in this phase also include mandatory requirements (e.g., legal, compliance, and safety regulations). Investments in the IT project phase are inventoried, assessed, balanced, optimized, and selected in the IT project portfolio.

### IT Asset Phase

The IT asset phase describes the portion of the IT life cycle that are currently in operations and maintenance. This phase monitors and evaluates the existing infrastructure, software, human capital management, processes, data, and information. Investments in the IT asset phase are used to help run the business and are inventoried, assessed, balanced, optimized, and selected in the IT asset portfolio.

## Shortfalls in the IT Life Cycle

Exhibit 1.1 describes the three primary phases of the IT life cycle, the shortfalls within each of these phases, and the impact as a result of these shortfalls. The bullet points shown in the shortfall areas under the specific phases in Exhibit 1.1 do not necessarily correspond to the phases under which they reside. The majority of companies have formal return on investment, payback period, internal rate of return, and/or economic value-add metrics. However, most do not consistently apply both financial and nonfinancial measurements and processes for evaluating projects and initiatives, and most do not track metrics after implementation.

Decentralization and lack of visibility of IT spending create misalignment, leading to redundancy and lack of reuse. Many groups within companies do not see the IT department as an entity that can quickly and effectively resolve their issues; therefore, business units typically will design and build their own “sandbox” of systems and solutions completely under the radar screen of corporate IT governance. Unfortunately, maintenance, product, and service enhancements form the majority of IT spending, many utilizing nonstandard processes, leading to high total cost of ownership. Companies frequently underestimate the total cost of ownership for investments: ongoing maintenance and enhancement costs, licensing, upgrades, training, and other ongoing costs associated with the “tail” of an investment.

## DOES IT REALLY MATTER? THE IT PRODUCTIVITY PARADOX

Many executives question whether they are receiving full value from their IT spending and whether this spending is being properly directed. In the 1980s, a series of studies found that despite the improvements made by technology, the correlation between how much a company spends on IT and the accompanying productivity generated as a result of IT investments is minimal. This is referred to as the IT productivity paradox. The IT productivity paradox has recently been examined in numerous studies including one by Dedrick, Gurbaxani, and Kraemer, who concluded that “the productivity paradox as first formulated has been effectively refuted . . . greater investment in IT is associated with greater productivity growth.”<sup>2</sup> Appendix 1A provides a summary of selected studies on the IT productivity paradox.

One of the more interesting research studies conducted recently is from Mainstay Partners. In 2002, Mainstay surveyed 450 companies across the energy, financial services, health care, manufacturing, retail and consumer products, and telecommunications industries. The survey showed that IT-smart organizations—defined by companies that actively and effectively manage their IT investments through the use of IT portfolio management—derive measurable value from IT investments. Although the number of these companies is small, the research concluded that for IT-smart organizations:

## EXHIBIT I.1 THREE PHASES OF IT LIFE CYCLE

IT Discovery Phase	IT Project Phase	IT Asset Phase
<b>Shortfalls</b>		
<ul style="list-style-type: none"> <li>• Requirements, future capabilities and as-is versus to-be architecture not adequately considered when assessing concepts.</li> <li>• IT concepts are not linked to business, functional, or divisional strategy.</li> <li>• Poorly defined, nonstandardized business cases; assumptions that are not complete or accurate and do not consider risk outliers, feasibility, correlation with other investments, and other dependencies and constraints; lack of decision criteria.</li> <li>• Lack of weighting of attributes.</li> <li>• Distributed, siloed repository of concepts.</li> <li>• Too many concepts in the pipeline, with too few support resources; best resources are not allocated to concepts and ideas.</li> <li>• Few concepts considered that will transform the company; many initiatives are disassociated with the long-term strategic objectives; moving fast can be difficult.</li> <li>• Deficient communications result in fragmented efforts, as resources are not optimally aligned and deployed.</li> </ul>	<ul style="list-style-type: none"> <li>• No centralized project management office; no single and consistent project manager throughout the cycle.</li> <li>• No central and visible repository of all projects.</li> <li>• Lack of governance and cross-participation from key executives.</li> <li>• Inadequate gating and filtering mechanisms; ad hoc entry and exit criteria at each major phase.</li> <li>• Inability to optimally scope, cost, schedule, and allocate resources to projects.</li> <li>• Gaming the system with pet projects.</li> <li>• Unwillingness to “kill” projects.</li> <li>• Development methodologies such as spiral, rapid application, and time-box approaches are not utilized; customer/end user feedback is inadequate.</li> <li>• Assumptions are never revisited.</li> <li>• Lack of headroom for resources/funding for unexpected events prohibits ability to rapidly reprioritize and switch directions.</li> <li>• Never turning down a customer, senior management, or marketing request.</li> </ul>	<ul style="list-style-type: none"> <li>• Employee skill sets and processes needed to support new solutions are not adequately considered.</li> <li>• Integration and interoperability with existing systems and business processes are not fully assessed.</li> <li>• Refusal or inability to continuously assess as-is versus to-be architecture and optimally decide whether to retire, migrate, or keep existing systems and solutions.</li> <li>• Ineffective feedback loop to IT or corporate strategy.</li> <li>• Distributed and siloed repository of assets.</li> <li>• Lack of metrics prevents objective evaluation of performance and development of sustainable service levels.</li> <li>• Applications and systems define business logic.</li> <li>• Opportunity to outsource maintenance and support of applications and systems is not given adequate consideration.</li> <li>• Benchmarking performance against similar entities does not occur on a regular basis.</li> <li>• Above-average IT spending occurs in maintenance and support, with little left to grow or transform opportunities.</li> </ul>
<b>Results</b>		
<ul style="list-style-type: none"> <li>• Inaccurate prioritization of IT investments; investment imbalance, as important and strategic projects are underfunded.</li> <li>• Duplicative spending and redundant R&amp;D investments.</li> <li>• IT portfolio risk profile reaches an unacceptable level.</li> <li>• Nonstandardized initial business cases create difficulty comparing and contrasting various types of IT investments.</li> <li>• Sustaining innovations that do not create long-term competitive advantage.</li> <li>• Resources not optimally aligned.</li> </ul>	<ul style="list-style-type: none"> <li>• Majority of projects do not meet expectations.</li> <li>• Costs exceed budgeted levels; scope creep and project drift are commonplace.</li> <li>• Projects are late or projects go on for years and are never “killed.”</li> <li>• No flexibility to rapidly reprioritize.</li> <li>• Committees are powerless and lose the trust of senior management as well as employees.</li> <li>• Too many projects in the pipeline prove costly and divert resources.</li> </ul>	<ul style="list-style-type: none"> <li>• Projects meet objectives but do not meet customer needs (suboptimal performance).</li> <li>• Misalignment and lack of interoperability with enterprise architecture; scaling of solutions is virtually impossible.</li> <li>• Elements of cost such as upgrades, maintenance, user support, etc., are improperly calculated, resulting in exorbitant life cycle costs; many costs buried in line item areas and true costs are difficult to uncover.</li> <li>• Rogue systems and redundant solutions increase error rates, support costs, and stifle flexibility and agility.</li> </ul>

*The correlations, constraints, and dependencies of IT investments are not typically combined and aggregated under one view to enable the representation of the holistic and complete alignment with strategy, balance across the company, and assessment of overall risks, costs, benefits, timing, and value.*

- Optimizing existing processes for incremental productivity improvements resulted in 10% to 15% general and accounting savings
- Reconstructing core processes for changes in productivity and efficiency resulted in 2% to 3% operating margin improvements
- Inventing new processes and organizational capabilities for growth typically resulted in a ten-fold return on invested capital (ROIC)

The research also showed many areas of breakdown for the non-IT-smart organizations, including:

- Companies spent a lot more on IT than their budgets indicated, since IT budgetary control leaked from the CIOs/CFOs into the lines of business.
- Ad hoc decision processes were used for prioritizing and managing technology investments.
- Poor visibility to accurately measure the business impact of technology investments with unclear business metrics. Very few companies measured the actual results of execution.
- Ineffective ability to tie IT investments with business strategy and goals.
- Lack of business management involvement, poor communication of IT strategies across the company, and an absence of effective governance.<sup>3</sup>

Another research study conducted by Bruque and Medina in 2002 identified areas that probably contribute to the IT productivity paradox:

- Not properly focusing on and managing critical areas within the life cycle
- Reactive moves that defy standardized evaluations, such as defensive postures as a result of a competitor announcement triggering an IT investment
- Value generated by IT investments not being the same for all companies and to a large extent being dependent on the nature of their business
- The effect and importance of complementary resources such as certain human and management elements
- Unrealistic business models bound to fail irrespective of the investments made<sup>4</sup>

Companies witness a positive correlation between IT spending and increased productivity when:

- Senior leadership is strongly supportive and committed
- Governance boards adhere to policies and guidelines yet maintain agility
- Organizational structures and cultures are incentivized and motivated to integrate and align IT and business management

It has been said that “we have a lot of common sense . . . because we don’t use it much.” Deferring to common sense, if automation is applied poorly to suboptimal processes and bad data, processing, analysis, portfolio management, or just about anything will show that bad results occur with greater frequency. IT portfolio management is reliant on a solid foundation of supporting processes and grounded data. Assuming these are in order, IT portfolio management is an integral framework, language, and tool in realizing the positive correlation between the amount spent on IT and the corresponding increase in productivity.

## IT PORTFOLIO MANAGEMENT | 101

### Overview

There are elements of IT portfolio management that exist in all companies. They have very similar goals and objectives: maximizing value (tangible and intangible) while managing risks and costs. Most companies utilize simple and straightforward financial models to make investment decisions. For these companies, the IT portfolio management framework is incomplete; it is missing key criteria, is not conducted uniformly, and is not applied across the entire organization nor over the entire life cycle of an IT investment. The framework contains information about each portfolio and the investments that comprise each portfolio, highlighting both the positive and negative aspects of these investments. Analysis of the IT portfolio identifies specific areas in need of improvement, holes in the requirements and architecture, misalignment to the strategic intent, areas that are being overserved and underserved, and so on. There are three primary areas of IT portfolio management:

1. Processes and a framework to plan, create, assess, balance, and communicate the execution of the IT portfolio. For best-practice companies, these processes are standardized, consistent, and visible across the enterprise.
2. Tools that analyze information and data, such as value, costs, risks, benefits, requirements, architecture, and alignment to business and strategic objectives. Information and data are derived from the strategic intent, strategic plan, and business and strategic objectives. Information and data are fluid. Weighting and scoring are applied against information and data in order to prioritize and rank investments. What-if analysis can be performed, which will impact and alter the ranking and prioritization of IT investments.
3. A common business taxonomy and governance that communicates and defines the principles, policies, guidelines, criteria, accountability, range of decision-making authority, and control mechanisms.<sup>5</sup>

The IT portfolio management step-by-step methodology presented in detail in Chapter 5 is a proven process for applying IT portfolio management and has eight stages. These stages are not intended to be applied in a waterfall manner (i.e., serially). They serve as a framework that should be adjusted based on the reader's objectives. In today's fast-paced world, waterfall approaches to delivering anything are proving less and less effective. Nonetheless, the eight basic stages are:

1. Developing an IT portfolio management game plan
2. Planning the IT portfolio
3. Creating the IT portfolio
4. Assessing the IT portfolio
5. Balancing the IT portfolio
6. Communicating the IT portfolio
7. Developing and evolving IT portfolio governance and organization
8. Assessing IT portfolio management process execution

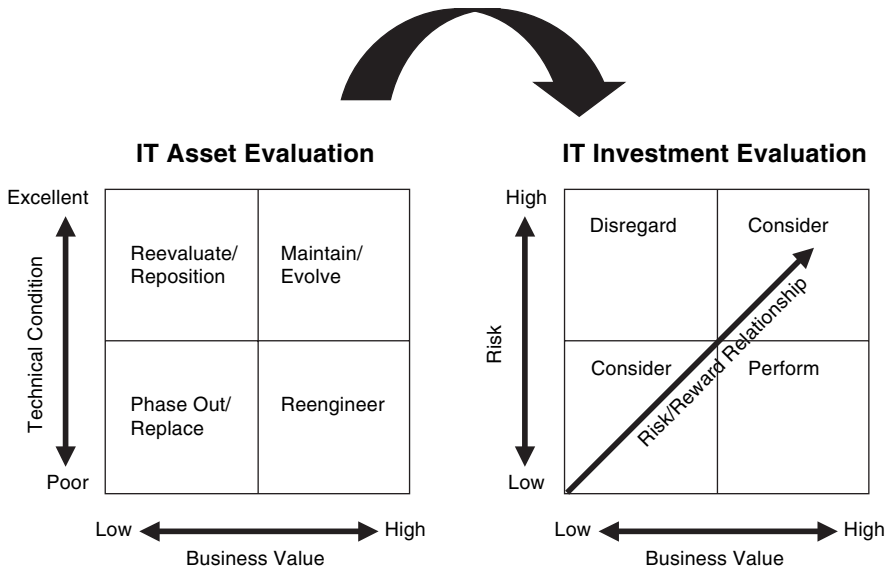
The first stage, the game plan, determines the objectives for IT portfolio management and assesses the main points to establish the most practical areas to address. It encourages users of IT portfolio management to avoid analysis paralysis and begin to make decisions.

The second step, planning, involves building upon the efforts of phase 1 and providing the foundation to plan the investment strategy and portfolio/subportfolio structures.

The third step, creating, inventories all significant IT investments, both current and planned. Each potential IT investment is captured in a standardized business case and located in a centralized database. Assumptions are cataloged, screening decisions are memorialized, and alternatives are identified in each business case. Metrics are defined and portfolio views are built. In the creating stage, weighting information and data form the criteria for screening new or existing investments. Companies should develop a consistent and standardized set of criteria with threshold levels (e.g., risk tolerance, funding and resource capacity and constraints, cost limitations, must-have versus nice-to-have requirements, investment categories). The level of detail associated with the screening process can vary based on the size, risk, complexity, technology, and business/mission maturity of the investment, and if the investment is based on a mandatory requirement. For the IT asset portfolio, analysis of IT investments includes assessment of technical condition, business value, and risk as shown in Exhibit 1.2.

The screening mechanism serves as a check and balance that ensures multiple, relevant, and timely criteria are assessed against each IT investment to assure IT's success in enhancing business and mission performance. The screening

## EXHIBIT 1.2 ANALYSIS OF IT INVESTMENTS



process helps to identify related investments that might be candidates for consolidation. The process also helps to identify potential candidates for acceleration or decommissioning before a large dollar exposure is incurred. As part of this screening process, detailed gaps in requirements, standards, stakeholder analysis, architectural views, and a detailed catalog of the description of IT assets should be published and made available to key employees so that IT investments can easily be mapped to these areas. The criteria used for the screening process should also be made available so that answers to many questions can be anticipated in advance and addressed in the business case.

The fourth stage, assessing, measures the portfolio against targets and monitors internal and external conditions for possible trigger events. IT investments are tracked and monitored both individually and within the IT portfolio. Status reviews evaluating actual versus forecasts made in costs, schedule, value, benefits, scope, and so on, are conducted at least on a quarterly basis (more often depending on the costs, complexity, risks, and value of the IT investment). As mentioned, data and information can change, which could alter the path of IT investments. Balanced scorecards, key performance indicators, critical success factors, service-level agreements, and other metrics provide valuable warning signs relevant to the health and well-being of IT investments. Large deficiencies and imbalance, such as poor project management or risks surpassing threshold levels, can trigger changes to the IT portfolio. As investments are evaluated, the business case for

each IT investment should be frequently evaluated and updated. This serves as important feedback for other IT portfolio management processes.

The fifth stage, balancing, identifies tuning options and determines trade-offs within the portfolio. A committee of senior management personnel performs a what-if analysis, adjusting key constraints, variables, and other parameters of the portfolio; assesses the impact of alternative investment options; and determines the optimal allocation of investments into pools (categories). Research indicates that high value is obtained by dividing the overall IT investment pool in a manner that mirrors the enterprise strategy and its time horizon. The same committee serves as the decision authority and selects which investments get funded. The selected investments are mapped into an IT portfolio.

The sixth stage, communicating, creates a consistent approach for driving awareness around the portfolio, goals, status, and what needs to change. This awareness needs to be driven by a communication plan that tailors messages to specific audiences and makes sure these messages are received and acted upon. Communications must occur throughout all phases. Communication is of such critical importance to IT portfolio management that it must be considered at the onset. People, communication, and collaboration form the most seminal aspects of IT portfolio management.

The seventh stage, governance and organization, identifies the roles, responsibilities, and processes for governing the portfolio management process.

The final stage, assessing execution, evaluates program execution and the actual portfolio performance against objectives defined in the game plan. It's the capstone phase where value is demonstrated. If initial objectives were met or exceeded and metrics validate this fact, license exists to evolve the IT portfolio management process, ultimately weaving it into the fabric across all divisions/business units of the organization.

Lessons learned from the performance of investments and the IT portfolio form the golden nuggets (*keisen*) to improve the processes, data, and information as well as the communication and collaboration aspects of IT portfolio management. An example of some areas of input that serve as feedback into IT portfolio management for continuous improvement include:

- Evaluation of the quality and accuracy of assumptions used as the basis of the investment (e.g., actual versus planned schedule, deliverables, costs, and risks)
- Level of support to the customer's business processes, and customer satisfaction with the IT investment
- Achievement of target objectives and benefits (e.g., reduction in cycle time, compliance with regulatory requirements, increase in productivity, and cost savings)

- Utilization of the IT investment (e.g., adequate training, features and functionality, and forecast versus actual users)

Taking corrective actions to enhance the IT portfolio management process, the quality and accuracy of the data and information, and communication and collaboration is a never-ending, fluid aspect of IT portfolio management.

An IT portfolio planning and management approach forces companies to think through the enterprise implications of their IT spending. Research consistently finds that when companies initially institute a portfolio approach, IT expenditures decline by 15% to 20% with no significant negative impact. Given the potential savings and the fact that IT expenditures tend to run between 1.5% and 7% of a company's revenue, using a portfolio approach is a no-brainer. Studies indicate organizations that are mature in IT portfolio planning and management tend to be industry leaders. These organizations consistently maintain sharp focus, balance the needs of current market areas and new growth segments, and exhibit higher performance levels than their competitors, rapidly eliminating underperforming IT investments and reallocating funds to new value-revenue generation opportunities.

## IT Portfolio Approaches and IT Subportfolios

IT portfolios are defined using two approaches. The tactical, bottom-up approach leverages existing IT assets and IT projects in the pipeline to define the composition of the portfolio. The strategic, top-down approach decomposes the corporate strategic intent to business and strategic objectives and the IT plan, which records the priorities, timing, and metrics required to achieve the defined goals of the company.

Funding and resource allocation decisions made to specific pools (investment categories) of the IT portfolio are formed based on the top-down approach. We believe that incorporating both the top-down and bottom-up approaches are representative of best practices. Irrespective of the approach, IT portfolio management is a major element of the IT plan and is usually managed by the CIO. IT portfolio management, as shown in Exhibit 1.3, provides an analysis and decision-making framework between employees, customers, partners, suppliers, and distributors. It is supported by many key skills and areas, and it is an aggregation of three subportfolios that provide the entire, holistic, risk-versus-value cost perspective:

1. *IT discovery portfolio*: comprised of longer-term investments in the IT discovery phase
2. *IT project portfolio*: comprised of medium- to short-term investments in the IT project phase
3. *IT asset portfolio*: comprised of existing investments in the IT asset phase

EXHIBIT 1.3 IT PORTFOLIO MANAGEMENT

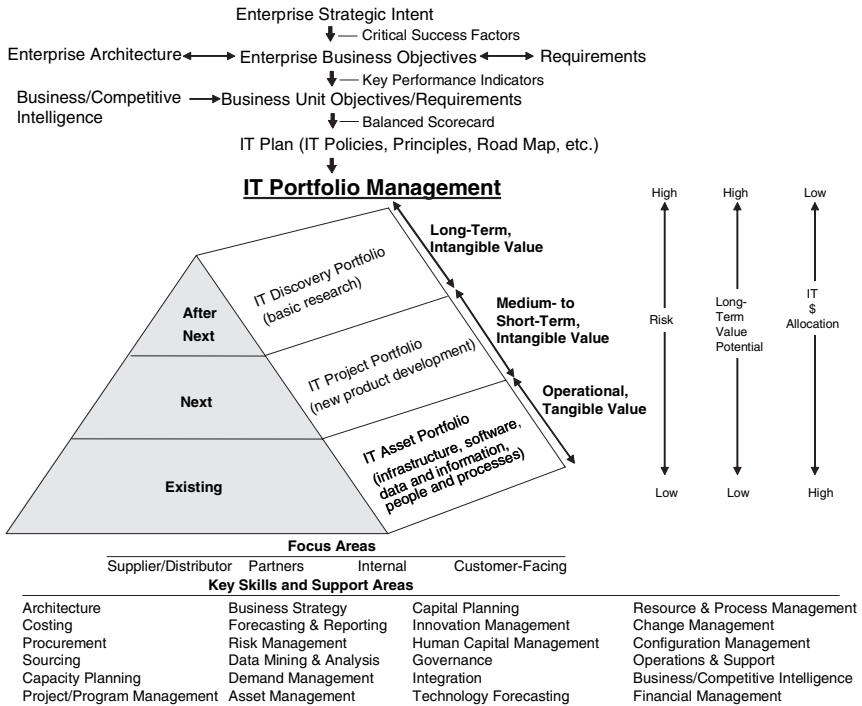


Exhibit 1.3 is for illustrative purposes only; for ease of use, there are some feedback loops purposefully not reflected. Business objectives, requirements, critical success factors, key performance indicators, balanced scorecard, IT subportfolios, and key skills and support areas are discussed in detail throughout this book.

### “To Boldly Go Where No Man Has Gone Before”: The IT Discovery Portfolio

The IT discovery portfolio is a framework used in the front end of the IT life cycle. In the discovery phase, investments are classified as concepts or ideas; thus, value, costs, benefits, and risk are somewhat difficult to quantify. The IT discovery portfolio aligns, prioritizes, and balances new technologies, which form the basis of strategic enablers and transformation. It has been susceptible to cost cutting, as many organizations focus on short-term, sustaining, low-risk initiatives

and bypass the experimental, higher-risk, longer-term innovation and incubation initiatives. The IT discovery portfolio only functions optimally when IT and business have a highly functional relationship, which according to research occurs in only 2% of companies.

Many companies now recognize that mergers and acquisitions, geographic expansion, increase in business development, or cost-cutting efforts will not drive consistent and sustainable growth. As resources have become tighter over recent years, discovery and research have become accountable and performance oriented. They are inextricably linked to delivering elements of the business and strategic objectives, producing targeted and measurable results that increase value and growth consistent with the strategic intent.

Unlike the mid to late 20th century, when discovery and research could take a decade or more from initial idea through commercialization, the majority of companies today cannot afford to spend a sizable amount of resources over such a long period of time. The IT discovery portfolio provides the framework to assure investments are in line with expectations.

## Ready, Aim, Fire: The IT Project Portfolio

The IT project portfolio takes input and direction from the corporate strategic plan, external and internal requests, the discovery portfolio, and the IT asset portfolio. IT projects are evaluated based on the input and assumptions made in the business case. The business case details the alignment to the business and strategic objectives, assessment of key stakeholder needs, critical dependencies and constraints, risks, value, costs, benefits, and adherence to compliance/regulations. IT projects are intangible assets in that they have not proven their mission or business value. However, investments in the IT project portfolio are the seminal building blocks in the execution of strategies—vehicles to execute change that are critical to a company's survival. Failure to efficiently manage projects in a repeatable way will destroy a company.

The IT project portfolio focuses on all the projects in development across a company and consolidates one view of the overall value and risks. It serves as a gating mechanism for assuring projects are in alignment with the strategic intent, assumptions in the business case are adhered to, and decisions are based on accurate and timely data.

IT portfolio management is dependent on expertise in project, program, and enterprise program management:

- Project management is focused on single project execution usually in support of a business objective (e.g., upgrade network servers, install desktop operating system). Project management is concerned with project timelines,

budget, tasks, and deliverables. Close coordination with people (employees, customers, suppliers, regulators, etc.) is important in managing this aspect of the portfolio.

- Program management is focused on coordination of multiple related projects usually in support of one particular mission or business theme (e.g., customer relationship management, supply chain management). Program management is concerned with synchronized delivery of project results, inter-project dependency management, resource sharing (e.g., people, time, and money), issue and risk management, and budget control to achieve program success.
- Enterprise program management is a holistic view of the coordination and oversight management of all programs/projects within the enterprise. Enterprise program management is concerned with the integration of planning, strategy, resource allocation, and architecture management to achieve best value to the company. This includes value management, process management, and human capital management. The enterprise program management office plays a critical role in IT portfolio management, ensuring that projects and programs are aligned with the business direction. This office provides the management framework for improving project performance through consistency of management approach and process knowledge.

An efficiently run IT project portfolio results in driving higher project success rates. The IT project portfolio does not help companies attain 100% project success, but it improves the successful track record of project investments and helps companies learn how to “fail” properly and faster.

## If It Ain't Broke, It Probably Will: The IT Asset Portfolio

An IT asset is defined as anything in the operational baseline under the domain of IT (e.g., hardware, software, data and information, people, and processes). The IT asset portfolio provides a framework to catalog and continuously monitor the business alignment, value, risks, costs, benefits, and balance associated with infrastructure, software, human capital management, processes, data, and information. It represents the largest expenditure for the IT organization.

Applications, typically one of the largest subportfolios in the IT asset portfolio, are categorized according to technical condition (e.g., architecture, adaptability, stability, etc.) and functional/business value (e.g., scope of use, reusability, criticality, completeness, ease of use, stability, cost, dependencies). Assessment and analysis of the IT asset portfolio is partially based on the weightings of these criteria. Weighting can be defined according to different users, industries, and the maturity

stages of an application's life cycle. Depending on the technical condition (high versus low) and the derived business value (high versus low), Exhibit 1.2 will facilitate the decision to maintain the existing application, reengineer, retire, or migrate an application.

Of the three portfolios, the IT asset portfolio typically represents the largest expense. Companies have a long way to go to fully map their IT assets and develop a holistic view of the business processes, constraints, dependencies, value, total cost of ownership, metrics, and risks associated with these assets. This analysis provides important feedback to the project portfolio and is used as a basis to consolidate and streamline, retire, wrap, outsource, upgrade, or replace assets. Chapter 6 discusses the maturity of the IT portfolio marketplace and provides insight into the maturity and direction of the IT asset portfolio.

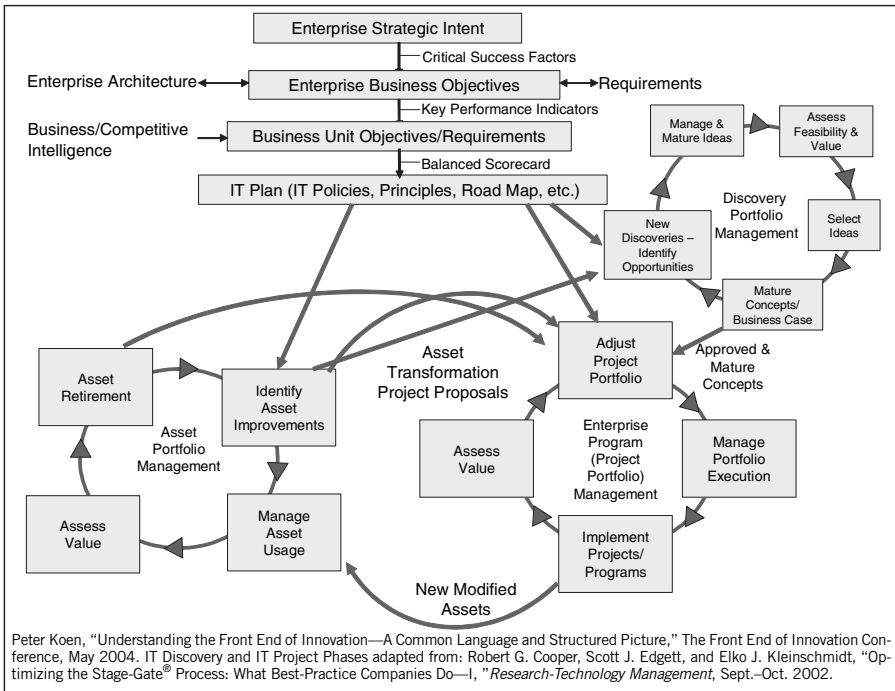
IT portfolio management, encompassing the IT discovery portfolio, the IT project portfolio, and the IT asset portfolio, is shown in Exhibit 1.4. For illustrative purposes only, the processes shown in Exhibit 1.4 in each IT subportfolio are shown in a sequential manner. In reality, many of these processes can occur concurrently, nonsequentially, and nonlinearly. In addition, for ease of representation, many feedback loops were purposefully not shown in this exhibit.

## The IT Portfolio Focus on People

Critical and often underestimated elements of the success of IT portfolio management are the people and cultural aspects. Research shows that while financial and operational metrics are important, the attitude, perceptions, and measures of customers, employees, suppliers, regulators, and shareholders are the largest differentiators between high- and low-performance companies. At least on a quarterly basis, measuring, analyzing, and creating course-correction action plans based on asking questions and gathering input from end users and managers of the IT portfolio management process are viewed as best practices. Although understanding individual behaviors and outliers is important, group trends and patterns are critical leading indicators.

IT portfolio management engages cross-functional management and end-users, providing information and data to multiple stakeholders to obtain buy-in regarding prioritization of limited investment dollars, allocation of resources, and a plan to proceed forward. According to research, individual productivity is significantly higher when work is proactively structured around goals. Training to improve learning effectiveness, early and prudent risk taking, and employee empowerment also improve productivity and serve as important behaviors for IT portfolio management. However, resistance to adopt IT portfolio management within business units and divisions that have become accustomed to operating

EXHIBIT 1.4 IT PORTFOLIO MANAGEMENT PROCESSES



within their siloed environments is not unusual. Many people simply despise change, and IT portfolio management for many companies and their employees involves making numerous changes to the status quo.

Currently, many business units are meeting the near-term needs of their customers without having to justify, or perhaps prolong, the decision-making process by adopting a holistic IT portfolio management framework. While operational decisions and measures should be kept locally within business units, strategic decisions and linkages to key performance measures must be centralized in order to create the ideal enterprise architecture. One of the most effective ways to change behavior is to create clear metrics, linking individual performance strategic objectives with incentives based on desired behavior and positive adjustments to meet performance and objectives.

Key performance measures must be clearly defined, well communicated, and reinforced. Measurements must be linked to performance standards, reviewed frequently, and closely tied to reward and recognition systems. Without a clear

understanding of how key measures relate to both individual and group performance and accountabilities, resistance to change will be pervasive.

## COMPARISON OF IT PORTFOLIO MANAGEMENT AND FINANCIAL PORTFOLIO MANAGEMENT

Stock traders and money managers of mutual funds tailor a portfolio of investments based on their customers' risk and reward profile, with a keen understanding of the fundamentals associated with investments in the portfolio. Regardless of whether money managers oversee a risk-averse or a highly risky portfolio, the objective is to maximize investment return at an acceptable risk level. As conditions change, money managers must make buy, sell, and hold decisions concerning individual projects and initiatives within portfolios. Money managers are able to communicate in real time the overall performance and value of the portfolio they manage. The liquidity of the majority of their investments means that investments can be bought, sold, or traded with minimal effort.

In addition, money managers have many metrics to compare their performance with other fund performance and investment alternatives. It is important to note that money managers have an immense amount of relatively reliable and standardized information regarding individual assets within their portfolio such as annual reports, financial statements, industry and analyst reports, competitor information, and so on. The tools used for analysis of financial portfolios are generally well established. However, Enron and Worldcom remind us that surprises can occur from time to time.

IT portfolio management leverages many of the rigorous constructs and best practices from the financial marketplace. But there are numerous differences due to the complexities, high exit costs, low salvage value, and lack of securitization associated with some elements of IT. As opposed to a portfolio of investment that might consist of treasury bills, bonds, precious metals, money market, fund shares and private and public equity, IT portfolio management is applied within companies and government agencies to assess and arbitrate alternative investments that compete for limited resources. Unraveling IT investments is usually more complex and takes more time than a publicly traded instrument.

A failed IT investment could have a sizable impact on business continuity and mission critical operations. Some IT investments may not produce the optimal level of financial return due to mandatory legal, safety, and regulatory constraints, which can trump ROI calculations. The decision support tools and information regarding an IT portfolio are not as well established or as robust as the resources available to money managers. IT portfolio management involves more factors than financial portfolios. Similar to how money managers operate their financial

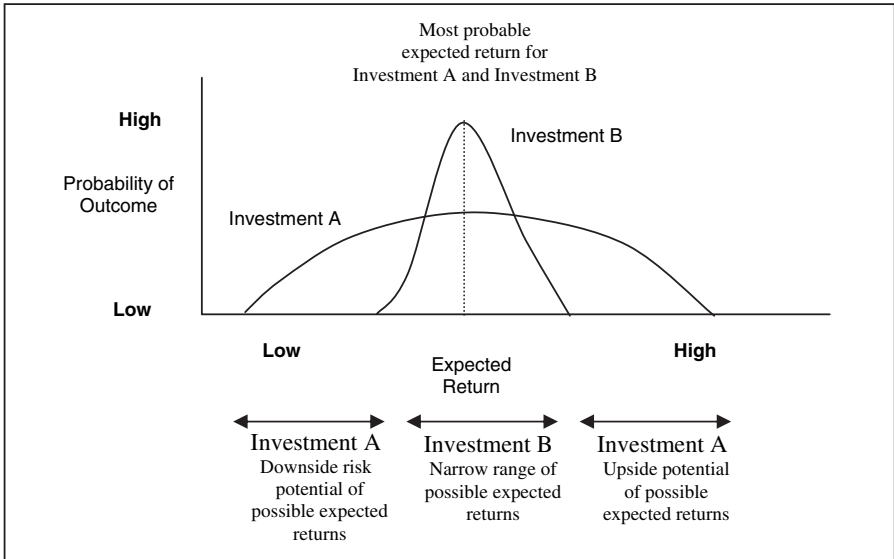
portfolio, IT portfolio management provides reporting and performance metrics that constantly assess, reprioritize, and rebalance a series of buy, hold, and sell decisions related to a suite of technology, process, and tradecraft investments as market conditions and corporate needs change.

An important similarity between a money manager's financial portfolio and an IT portfolio has to do with correlation, or the interdependency between investments in the portfolio. With constrained and limited resources and constant change, it is important to understand not only the risks associated with each individual investment but also the impact, dependencies, and uncertainty across investments. Understanding these relationships and effectively diversifying high-, medium-, and low-risk investments in short-term, medium-term, and long-term initiatives across business and functional areas will minimize the level of risk associated with a portfolio at any given time. The Efficient Frontier, a tool that was originally established for the financial market, is being used to calculate risk versus value of the entire IT portfolio and the effect of individual investments on the IT portfolio (see Chapter 5 for more information regarding the Efficient Frontier).

## VALUE AND RISKS

Investors must have some willingness to commit to a level of uncertainty. For investments that have a low probability of an expected result and a high number of possible outcomes, investors expect to receive a higher rate of return due to the potential volatility (investment A in Exhibit 1.5). In contrast, for investments that have a high probability of an expected result and a low number of possible outcomes, investors expect to receive a lower rate of return due to the increased certainty (investment B in Exhibit 1.5). Triangular or normalized probability distribution curves are used to visually show the range of possible outcomes for investments.

For many investments, there is typically a positive correlation between risk and the variability potential for reward—the higher the risk, the higher the variability in the return (or, conversely, the higher the risk, the lower the probability of obtaining a desired outcome). In 1952, Dr. Harry Markowitz, Nobel Laureate and pioneer of portfolio management, published “Portfolio Selection” in the *Journal of Finance*,<sup>6</sup> which showed that a diversified portfolio of high- and low-risk investments yields a higher return than a portfolio comprised of solely high-risk investments or a portfolio of only low-risk investments. Dr. Markowitz described a concept called modern portfolio theory—an efficient suite of investments at a defined level of risk that will maximize return. Modern portfolio theory states there is no single optimal portfolio, but at a given level of value and risk that an investor is willing to incur, an efficient portfolio can be created to maximize returns. Dr. Markowitz made the assumption that investors know and can

**EXHIBIT 1.5 SAMPLE PROBABILITY DISTRIBUTION OF INVESTMENTS**


accurately define their objectives. For some companies, the strategic intent and strategic objectives are not clearly defined and clearly articulated, making the IT portfolio difficult to manage in these instances.

Through his capital asset pricing model, arbitrage pricing theory, and value at risk, William Sharpe showed the interrelationships between investments in a portfolio, which we defined earlier as correlation, and how these interrelationships can be risk elements that are just as vital as the individual risks associated with each investment.<sup>7</sup> In 1984, Elton and Gruber mathematically defined an efficient frontier curve, which displays the set of efficient portfolios, demonstrating optimal portfolio combinations for various levels of expected returns versus covariance of return.<sup>8</sup>

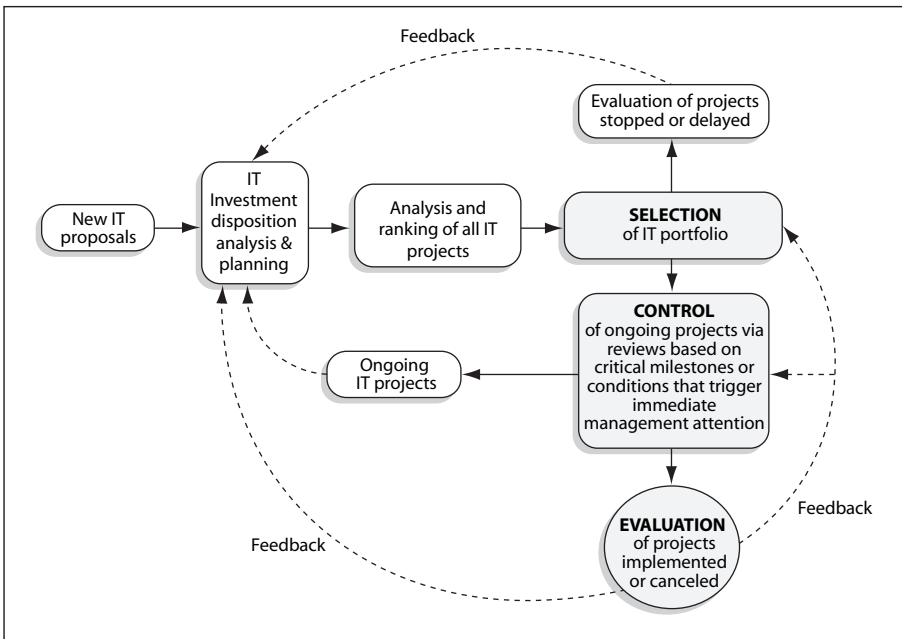
Currently, IT portfolio management has become the framework used by leading private- and public-sector entities. Within the public sector, both the U.S. General Accounting Office (GAO) and the Office of Management and Budgeting (OMB) advocate IT portfolio management as a central tenet to sound IT investment management. In Circular A-130 in 2000, the OMB found, “The portfolio will provide information demonstrating the impact of alternative IT investment strategies and funding levels, identify opportunities for sharing

resources, and consider the Agency’s inventory of information resources.”<sup>9</sup> The GAO considers portfolio management as a nucleus for IT investment decision-making. The GAO provides a sound approach to IT portfolio management, and Exhibit 1.6 illustrates how the process works. The three seminal phases shown in Exhibit 1.6 are:

1. *Selection phase*: identifies and chooses IT projects that maximize mission needs using standardized, up-to-date data (risks, proposed benefits, etc.).
2. *Control phase*: progress reviews that measure and monitor actual versus forecast costs, schedule, and benefits. Areas of concern are quickly identified and actions to continue, modify, or cancel are assessed.
3. *Evaluation phase*: determination of the impact on performance. Lessons learned are fed back into the IT portfolio management process for future improvements.<sup>10</sup>

Companies use portfolio management as a strategic and tactical tool to deliver

**EXHIBIT 1.6 GAO IT INVESTMENT MANAGEMENT PROCESS**



Source: “Assessing Risks and Returns: A Guide for Evaluating Federal Agencies’ IT Investment Decision-making,” United States General Accounting Office, February 1997.

business value and gain maximum benefit from investments (e.g., productivity increases, decreasing time to market, cost savings resulting from retiring legacy systems and solutions). Value from IT portfolio management is also gained from the ability to anticipate change, maintaining a readiness state for future needs and adjustments while demonstrating the traceability to strategy and planning, architecture, and program management. Some best practices to raise awareness and management control of critical performance and value drivers include:

- Scorecards that track IT's contribution to operational excellence, product leadership, customer intimacy, and financial metrics visually represented via a dashboard interface
- Benchmarks to compare resources and performance by unit
- Benchmarking to compare practices within the same or different industries

Understanding the balance of forces enables IT to take control of value creation.

Attention to risk management and business continuity has increased substantially since September 11, 2001. By incorporating risk-scenario planning within IT portfolio management, IT investments can be aligned with organization risk tolerance. Failure to incorporate risk-scenario planning up front forces organizations to rely on reactive risk management, luck, and firefighting.

A main goal of portfolio management is to spread risk among multiple decisions. By determining what percentage of investment dollars should go into run-the-business versus grow-the-business versus transform-the-business categories, an organization is asserting its risk tolerance on its IT portfolio. Organizations that are risk adverse will spend less resources in transformation-based investments. However, portfolio risk management and tolerance should also evolve to embrace change as the organization's portfolio management skills evolve. The enterprise program management function must instantiate an actionable risk management approach based on culture and risk tolerance. This must incorporate regularly updated standardized risk assessments for initiatives that include traditional risks (e.g., critical skills shortage, technology failure) and dynamic risks arising from less predictable environmental changes (e.g., regulatory changes, market risk, political instability).

Similar to other assessments made to secure an investment, the majority of companies never revisit risk assessments during development or post-implementation. According to research, less than 20% of global organizations have adopted an IT risk management framework such as CobiT (control objectives for information and related technology). CobiT, developed by the Information Systems Audit and Control Association, is a generally accepted standard for IT security and control practices and provides a framework for management, users, and IT audit professionals. Further discussion on CobiT can be found in Chapter 3.

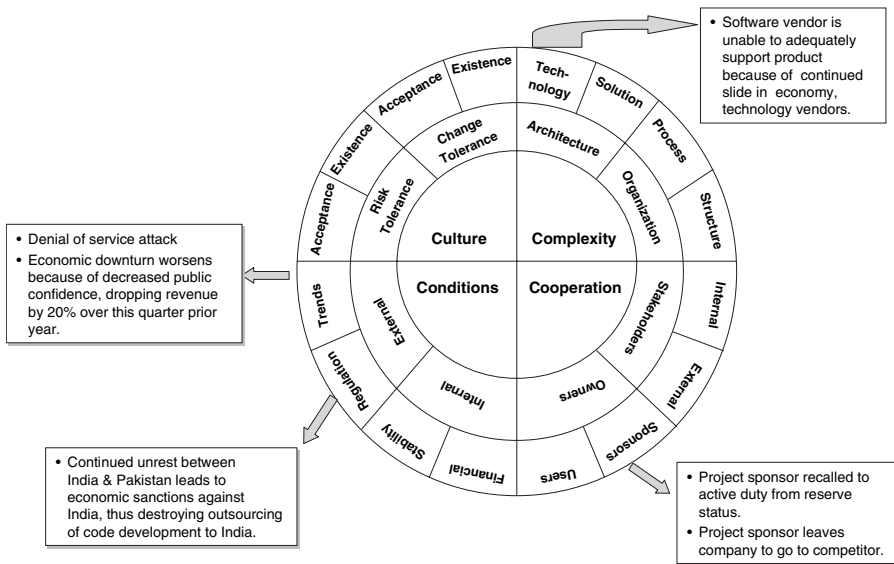
A major challenge with risk management is determining the probability and potential impact of a major problem when an initiative is a complex one-time event. No historical information exists to apply in a probabilistic manner. To manage risks for complex one-time initiatives, scenario planning is used to identify possible issues.

Risk-scenario planning involves several steps that must be performed regularly, providing a means to minimize the IT portfolio’s variance of return. The first step in scenario planning involves determining a suitable time horizon. The duration must be reasonable to accommodate risks that emerge in the current fast-paced environment and span no further than the life expectancy of initiatives in the IT portfolio. Next, a wide range of scenarios must be developed to describe possible future events. In Exhibit 1.7 scenario planning determines the potential risks as a result of the cultural, conditional, complexity, and cooperation aspects.

The probability of each risk scenario transpiring is determined, as well as the impact of each risk scenario on initiatives in the IT portfolio (Exhibit 1.8). This information is used to:

- Fine-tune the portfolio to add or remove initiatives that have other-than-expected risk-adjusted value

EXHIBIT 1.7 SCENARIO PLANNING EXAMPLE



## EXHIBIT 1.8 SCENARIO PLANNING PROBABILITIES

Scenario	Magnitude	Probability	Impact	Mitigation Strategy
Denial-of-service attacks	\$2,500,000	20%	\$500,000	Put appropriate technology in place and ensure for cost containment of \$100,000
Economic downturn worsens because of decreased public confidence, dropping revenues by 20% over this quarter prior year	\$42,857,143	70%	\$30,000,000 (IT budget reduction)	Institute IT portfolio program and proactively attach attributes to projects to determine which are discretionary
Continued unrest between India and Pakistan leads to economic sanctions against India, thus destroying outsourcing of code development to India	\$50,000,000	40%	\$20,000,000	Require source to be archived to local servers nightly; create alliance with offshore developers in other nations
Software vendor is unable to adequately support product because of continued slide in economy, technology vendors	\$16,666,667	30%	\$5,000,000	Require source to be held in escrow; check media quarterly
Project sponsor recalled to active duty from reserve status	\$14,285,714	70%	\$10,000,000	Develop relationship with heir apparent to existing project sponsor
Project sponsor leaves company to go to competitor	\$500,000,000	2%	\$10,000,000	Nothing

- Determine risk-adjusted portfolio value
- Develop enterprise risk-mitigation strategies including cost-containment insurance

Risk-scenario planning is an effective tool to maximize IT investment returns by minimizing transformation risk.

## CONCLUSION

Mercy Health Partners implemented IT project portfolio management. According to James J. Albin, vice president and CIO of Mercy Health Partners, and

Pacific Edge Software, Mercy's enterprise portfolio management solution provider, Mercy has achieved results within 18 months:

- Reduced IT costs by \$4 million.
- Gained a highly satisfied customer base by involving customers in the project approval process. Customers set priorities based on the current number of projects in the queue and resource availability.
- Strategically aligned how resources are allocated to projects. Resource tracking helps the information systems (IS) department prioritize projects based on availability.
- Communicated and improved the understanding of IT's direction. With clear visibility into project portfolios and easily accessible reports, executives and senior management make better business decisions based on strategic goals. They can analyze budget and time information, easily obtain project completion reports, prioritize projects based on criteria, and explain impacts of resource management.
- Enhanced project approval and prioritization process.<sup>11</sup>

As you can see from the benefits for Mercy Health Partners, the results of IT portfolio management are tangible and measurable:

- Duplicative efforts are eliminated, resulting in dollar savings.
- Pet project and uncoordinated funding are minimized.
- Low value-added investments are identified early in the process, and action is taken to revector resources to more critical priorities. Alignment and balance is quickly achieved.

Diversification of risks is an important aspect of IT portfolio management. Risks are minimized by spreading and diversifying resources across short-term and long-term investments, high- and low-risk projects, existing infrastructure and new innovations, and by project types, product lines, strategic versus nonstrategic, regions, and market segments. Most companies passively manage their IT portfolios. Migrating to active IT portfolio management takes many years. The next chapter discusses the planning aspects of IT portfolio management and the IT portfolio maturity model.

## NOTES

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## Selected Firm-Level Studies of IT Returns

Study	Data Sample	Findings
<b>IT and Firm Performance</b>		
Strassmann [1990]	38 U.S. companies	No correlation between IT spending and firm performance.
Loveman [1994]	60 Business units in 20 U.S. companies	IT investments add nothing to output.
Barua et al. [1995]	Same as Loveman [1994]	IT improves intermediate output if not final output.
Brynjolfsson and Hitt [1993]	Large U.S. manufacturers	Gross-marginal product of IT is over 50% per year in manufacturing.
Brynjolfsson and Hitt [1995]	Large U.S. manufacturers	Firm effects account for half of productivity benefits of earlier study.
Lichtenberg [1995]	U.S. firms, 1989–1991	IT has excess return; one IS employee can be substituted for six non-IS employees without affecting output.
Brynjolfsson and Hitt [1996]	367 Large U.S. firms	Gross return on IT investments of 81%. Net return ranges from 48% to 67%, depending on depreciation rate.
Hitt and Brynjolfsson [1996]	370 U.S. firms	IT investments increase firm productivity and consumer welfare, but not profitability.
Dewan and Min [1997]	300 Large U.S. firms	IT is a net substitute for both capital and labor, and shows excess returns relative to labor input.
Black and Lynch [1997]	1621 U.S. manufacturing establishments	Productivity not affected by presence of a particular management practice but by implementation, especially degree of employee involvement.

Nonmanagerial use of computers related to productivity.

Brynjolfsson et al. [1998]	Sample of <i>Fortune</i> 1000 U.S. firms, 1987–1994	The stock market value of \$1 of IT capital is the same as \$5–\$20 of other capital stock.
Gilchrist et al. [2001]	Sample of <i>Fortune</i> 1000 U.S. firms	IT productivity is greater in IT producer firms than in user firms and in durable manufacturing.
Greenan et al. [2001]	French firms	Gross returns to IT investment are positive and greater than returns to non-IT investment.

### Organizational Complements and IT Returns

Bresnahan et al. [2002]	400 Large U.S. firms, 1987–1994	The effects of IT on labor demand are greater when IT is combined with particular organizational investments.
Brynjolfsson et al. [1998]	Sample of U.S. firms, 1996	Decentralized organizational practices, in combination with IT investments, have a disproportionate positive effect on firm market value.
Ramirez et al. [2001]	200+ U.S. firms, 1998	Firm use of employee involvement and total quality management enhances IT returns.
Francalanci and Galal [1998]	52 U.S. life insurance companies, 1986–1995	Productivity gains result from worker composition (more information workers) and IT investments.
Devaraj and Kohli [2002]	8 Hospitals, over 3 years	IT investment combined with business process reengineering positively and significantly influences performance.
Tallon et al. [2000]	300+ U.S. firms, 1998	Perceived business value of IT is greater when IT is more highly aligned with business strategy.

Source: Jason Dedrick, Vijay Gurbaxani, and Kenneth J. Kraemer, “Information Technology and Economic Performance: A Critical Review of the Empirical Evidence,” Center for Research on Information Technology and Organizations, University of California, Irvine, March 2003, [www.crito.uci.edu; http://portal.acm.org/citation.cfm?doi=641865.64866](http://portal.acm.org/citation.cfm?doi=641865.64866), p.24 for appendix.

