Return on Investment In Information Technology:
A Guide for Managers

Anthony M. Cresswell

Center for Technology in Government
University at Albany, SUNY
187 Wolf Road, Suite 301
Albany, NY 12205
Phone: (518) 442-3892
Fax: (518) 442-3886
E-mail: info@ctg.albany.edu
www.ctg.albany.edu

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Executive Summary

Today more than ever, government decision makers must make the most of scarce resources and at the same time respond to ever-increasing demands for improved performance and new technology. These competing demands generate close scrutiny of proposals for new information technology (IT) investments. What's more, high profile IT system failures have raised concerns about why these investments so often fail to live up to expectations. As a result, many IT investment planning processes now require some analysis of the costs and returns expected from that proposed investment. Unfortunately, public sector managers often lack models that can guide them through such analyses. This Guide is offered to help fill that gap.

The Guide provides that help by presenting a practical approach to understanding what ROI analysis can and cannot do. A meaningful return on investment (ROI) analysis in information technology is a little like saying you want to live a healthier lifestyle. Like lifestyle changes, ROI analysis is not just a single component. Instead, it is a collection of methods, skills, tools, activities, and ideas. They can be combined and used in many different ways to assess the relative value of an investment over time. Applying this collection in a particular situation requires making many choices among the ideas and methods available and conducting an analysis appropriate to the decision at hand.

Different choices will produce different results. Therefore the Guide presents a framework of the key questions that should lead to an appropriate ROI analysis. It then presents a review of the methods and resources needed along with examples of different approaches in detailed case studies.

How extensive should your ROI analysis be?

Once the decision has been made to conduct an ROI analysis, what should it look like?

The choice of how to conduct the analysis should be based on four critical principles pertaining to:

- the strategic objective(s) of the ROI analysis,
- the place (and importance) of the IT investment in the overall enterprise architecture,
- the type of analysis that should be conducted (i.e., what data and methods of analysis are best suited to those objectives), and
- how the ROI analysis fits in the overall decision context for IT investments.

Understanding the strategic objectives of your ROI analysis

Understanding the strategic objectives of an ROI analysis will determine how the analysis is ultimately done and used. A handful of questions like these can help managers decide what the objectives of the analysis should be.

- Is the proposed project critical to the business objectives of your agencies or government?
- What are the risk factors associated with the investment?
- Who will be impacted—positively or negatively—by the proposed project?
- Is an ROI necessary for approval and support of the proposed project?
- Is the proposed project worth the investment of an ROI analysis? And if so, how detailed should it be?

Answering these questions will help identify the resources needed to conduct an ROI analysis, which in some cases can itself be a substantial investment. Extending its level of detail beyond what is needed for effective decision making is a waste of resources. Focusing on strategic objectives keeps attention on the full range of benefits to be expected from the investment, and how to measure them.

Understanding the context of your IT investment

Any IT investment project is embedded in an organization's technology infrastructure (enterprise architecture), relevant business processes, organizational environment, and external relationships.

- **Technology infrastructure.** There are direct costs associated with the technology and services in which you invest, and there will also be costs in terms of its impact on other technology systems already in place. The benefits range from more efficient automation and workflow to improved collection, storage, and access to information.
- **Business processes.** An ROI analysis must not only account for the improvements to relevant business processes, but also for the costs associated with training staff involved in using the proposed technology system.
- **Organizational environment.** Other costs and returns will be linked to the organization, for example through altered resource flows, performance changes, changes in work flows and internal relationships.
- **External relationships.** Linkages with the external environment may be significant as well. Resources may be committed from this environment to support the project and additional costs may be imposed on external persons or organizations by changes in the way services are delivered or other business is conducted.

Choosing the right type of analysis

Choosing and using the various methods of ROI analysis requires sound knowledge and judgment: knowledge about the methods and judgment about how best to apply them. The methods chosen should fit the particular questions asked of an ROI analysis. Different questions require different measurement approaches to fit them. In general, there are four types of questions that prompt or drive an ROI analysis: financial, effectiveness, efficiency, and impact.

Financial: Can we afford this? Will it pay for itself?

An ROI analysis that answers these questions is based on expected savings and revenue increases compared to the dollar cost of all expenditures on the new system. The measures are set by generally accepted or legally mandated accounting standards and practices that apply to the particular government organization. The costs and savings or revenue might be projected over a multi-year time span to show a payback period or to estimate the present value of future returns.

Effectiveness: How much "bang for the buck" will we get out of this project?

The ROI analysis that will answer these types of questions considers how much the investment contributes to achieving program goals and producing the desired results. It considers direct, indirect, and opportunity costs. The indirect costs include such things as training and administration over time. An opportunity cost could be the loss of return or revenue you would have received had you chosen a different alternative. The measurement of returns will be expanded beyond cost savings to include levels of performance relative to program or project goals.

Efficiency: Is this the most we can get for this much investment?

The ROI that tackles this question requires information about the greatest possible value relative to its costs. Efficiency cannot be separated from effectiveness. It is usually expressed in terms of optimizing the value of a return for a given cost or input. Establishing that some particular result is the best of all possible results requires either examining many alternatives or simulating performance in some way that provides a valid picture of what is possible. This can be done for some (but not all) kinds of systems with sufficient resources and data. However to do so can substantially increase the cost and complexity of the analysis.

Impact: Will the benefits to society (our state, our city, etc.) justify the overall investment in this project?

The analysis that answers impact questions will be concerned with the larger social and economic benefits and costs of a project. To define and measure variables that represent social costs or benefits requires more than the typical economic or accounting frameworks. These measures are based on either the specific program results desired by an agency or on general social benefits and improved quality of life. Though not impossible, the breadth and complexity of this kind of ROI analysis is rarely found in IT investment planning.

How does the ROI analysis fit into the overall decision context for IT investments?

Investment decisions in the public sector, whether they involve IT or not, necessarily take place in a context of political and policy influences. No matter how solid or technically sophisticated an ROI analysis may be, it will not likely be the sole determinant of an investment decision. When deciding how to prepare and present an ROI analysis, therefore, it is best to take into account all the potential risks that influence the decision process. Undertaking an ROI analysis should include attention to the risk factors identified below.

Risk factors that can impact investment decision process

Politics and policy factors

- Public exposure to failure
- Divided authority over decisions
- Multiple stakeholders
- Year-to-year budget cycles
- Highly regulated procurement processes

Organizational factors

- Complex program networks
- Misalignment of (or conflicting) internal goals
- Lack of leadership support

Business process factors

- Impact on existing process
- Fear of changing work assignments

Technology factors

- Rapid changes in technology
- Interacting with parallel systems
- Scale and complexity

Most of the risk assessment issues listed here involve problems related to thinking beyond the boundaries of the project, measuring factors, or determining probabilities. Simply recognizing where uncertainty and potential damage may lie is half the battle. Careful risk analysis, based on the best available data and estimates, will surely assist in ROI analysis and improve planning, even if the amount or quality of data is less than ideal.

Considering these various risk factors can help shape the style, emphasis or presentation strategies employed to introduce the analysis into the decision making process. Such considerations as those listed here may also help in recruiting support for the conclusions of your ROI analysis and guiding how the analysis process is positioned when seeking that support.

Conclusion

There is no single “right” way to conduct a return on investment analysis. Nor is there a Consumer Reports for ROI products and services. In determining how to conduct your analysis, the best advice is to focus on the strategic objectives of the analysis along with the goals and business processes of the proposed project. This focus will help guide decisions about the resources and methods to use to conduct a sound and valuable ROI analysis.

Chapter One: ROI and the Need for Smart IT Investment Decisions

> ***"It [ROI] will let us begin to make assessments and decisions about funding a project or developing a new service based upon some true data. That moves you from having emotional debates about projects to having factual discussions."***
> ***Gerry Wethington, Missouri CIO[1]***

Government decision makers must make the most of scarce resources and at the same time respond to ever-increasing demands for improved performance and new technology. Thus the need for wise investment in information technology continues to grow. Growing demand in the face of scarce resources generates hard questions and close scrutiny of proposals for new investments. What's more, the dismal failure record of many government IT investments raises legitimate concerns about the value of these investments and why they so often fail to live up to expectations, or even to work at all. As a result, IT planning processes often include, or even require, a rigorous business case to justify new IT investments. These include ways of assessing the costs and returns to be expected from that investment, that is, return on investment (ROI) analysis. This Guide is designed to help government executives who need to design, direct, conduct, or work with the results of such an analysis to make the most of their investments in information technology.

Growing interest in assessing returns on IT investments has spawned wide interest in methods of return on investment analysis. However, there is little agreement about best practices or specific methods for assessing ROI. Professional publications and consultant white papers present quite a variety of possible approaches. As a result, government executives and decision makers have difficulty choosing or designing a return on investment analysis that is both feasible and appropriate to their needs. To help administrators and decision makers with these choices this guide presents an overview of the purposes and concepts of ROI along with an introduction to basic methods and example cases. It also includes links to other resources for those who wish to explore some subjects in greater depth.

This guide treats ROI analysis as part of the overall decision making process for IT investment. The planners and designers of an IT project can use ROI analysis to help persuade decision makers to support the project. Decision makers can use an ROI analysis, indeed may even require one, as part of an IT investment proposal to aid them in evaluating it. In either case, an ROI analysis will be shaped by the situation in which it is designed and carried out.

Decisions about what sort of return on investment analysis to do, or whether to do one at all, will usually depend on a variety of factors. ROI analysis may or may not fit the larger context of investment decision making. Decision situations driven by very short deadlines or highly specific policy directives may rule out extensive analysis. Scale matters as well. An elaborate ROI analysis would hardly be justified for a small-scale, low-risk project that requires a fast decision. By contrast, large complex projects are typically high-risk propositions for which the added time and cost of an extensive ROI analysis would be fully justified. Even though justified, in some environments ROI analysis is not used at all in favor of best practice reviews or benchmarking to evaluate investment possibilities. Current practices vary

[1] *"Running the Numbers,"* Government Technology, *June 2002, p. 23.*

considerably. In Iowa, for example, the state government has a standard framework for all agencies submitting IT project proposals, including business case and ROI analysis requirements.[2] The US Office of Management and Budget has imposed similar requirements on federal agencies. Agencies and local governments in other states may develop their own internal business case and ROI requirements.

Given the diversity of practice in the IT investment world, this guide takes an eclectic, non-prescriptive approach. It treats the subject of ROI analysis from the point of view of a curious but uncertain decision maker. The key issues facing this decision maker are whether to do an ROI analysis and, if so, how. The guide does not advocate engaging in ROI analysis under all circumstances, nor does it favor any particular technique. Instead it presents an approach to understanding a range of purposes and methods for ROI analysis that can assist that decision maker to move forward with wise and effective IT investment choices.

An approach to understanding and using ROI analysis

Decisions about how to use ROI analysis depend on understanding the nature of the methods themselves and how they relate to the business setting. ROI analysis in general is a rather diverse collection of methods, skills, tools, activities, and ideas. They all may be useful for assessing the relative value over time of some investment. These methods are not, however, a single formula or predetermined calculation that will yield a simple yes-or-no answer to the question of how to invest. ROI is not a silver bullet. Actually designing and carrying out any kind of ROI analysis requires making many choices among the ideas and methods available and conducting an analysis appropriate to the decision situation. Different choices will produce different results.

Consequently, a meaningful analysis of returns on investment in information technology is far easier said than done. Choices about how to conduct an ROI analysis should be based on critical understandings about:

- the strategic objective(s) of the analysis,
- the place of the proposed IT investment in the overall enterprise[3],
- exactly how the analysis should be done (i.e., what data and methods of analysis are best suited to those objectives), and
- how the ROI analysis fits in the overall decision context for IT investments.

This guide will introduce you to these four basic understandings and provide resources for deeper investigation of each.

[2] *The Iowa ROI approach can be found at http://www2.info.state.ia.us/roi/index.html. The Federal business case requirements are found in OMB Circular No. A-11.*

[3] *The enterprise can be a single agency or unit, or something as broad as the education or justice enterprise. The U.S. Chief Information Officers Council defines an enterprise in terms of enterprise architectures, or "blueprints" for systematically and completely defining organizations' current (baseline) or desired (target) environments. See* A Practical Guide to Federal Enterprise Architecture, Version 1.1, *Chief Information Officers Council, February 2001, p. 2. More specifically, the National Association of State Chief Information Officers defines enterprise architecture as an overall plan for designing, implementing and maintaining the infrastructure to support the enterprise's business functions and underlying networks and systems. See* Enterprise Architecture Development Tool-Kit, Version 2.0*, National Association of State Chief Information Officers, July 2002, p. 243.*

Understanding strategic objectives in ROI design

Your understanding of the strategic objectives of an ROI analysis will determine how the analysis is ultimately done and used. The matter of strategic objectives has two related parts. One deals with the objectives and context of the proposed investment. The second deals with the objectives and context of the ROI work itself. An adequate understanding of the first part of the strategic objective must include answers to these key questions detailed below.

What are the programmatic and business goals of the proposed investment?

The value of an investment is directly related to the programmatic goals and business process employing the new technology. For example, the strategic goal of investing in a new financial management system would be to improve the quality of financial decision making and control of resource flows, not simply to produce faster or more complex accounting reports. Attention to the strategic objectives keeps attention focused broadly on the kinds of benefits sought and how to measure them, rather than narrowly on the technology. Focus on the strategic and business objectives will also lead to a clearer understanding of the full range of benefits to be expected from the investment.

What are the needs or interests of the primary customers and other key stakeholders with respect to products or services involved and impacts on business processes?

Stakeholders are critical players in the success of new projects. Ignoring or underestimating the importance of their role puts the success of an investment at great risk and can lead to substantial unanticipated costs or missed benefits. One large organization recently developed an extensive new customer help desk application without the participation of the staff who handled customer phone calls. Those staff members learned of the new system the day before it went live. The result was poor performance and a serious blow to staff morale—lower returns and higher costs.

How extensive is the analysis to be? What range of costs and returns are expected? What resources and frameworks are available or required for the ROI analysis itself?

An ROI analysis can itself be a substantial investment. Extending its scope, level of detail, or complexity beyond what is needed for effective decision making is a waste of resources. Attempting an ROI analysis that is beyond the resources or capacity of the organization will also waste resources. Choosing an appropriate scope for the analysis is therefore a critical part of the process. These choices determine the details of the ROI analysis itself: kinds of data used, whether hard or soft estimates will suffice, the kinds of projections, quantitative or qualitative data that are needed; which financial or non-financial outcomes (customer/user satisfaction, social or political outcomes, improved equity) are all important. The answers to these questions then influence the kinds of personnel, tools, and other resources needed.

What are the risk factors and how might they affect the project's costs and results?

Consideration of risk should always be a part of the ROI analysis. Risk factors arise from the nature of the project itself (complexity, scale, novelty), its organizational setting (conflict, resource constraints, top-level support, time pressures), and the larger environment (political turbulence, crises, and policy shifts). Risk analysis, discussed in some detail later in this chapter, examines the likelihood of risk factors affecting the project and what elements of the project or its results are likely to be affected.

Table 1. IT ROI Questions from the CFO to the CTO[4]

REQUIRED INVESTMENT
How much investment–including capital expense, planning and deployment, application development, and ongoing management and support–will the project require?

FINANCIAL BENEFITS
What are the expected financial benefits of the project, measured according to established financial metrics, including ROI, … savings, and payback period?

STRATEGIC ADVANTAGE
What are the project's specific business benefits, such as operational savings, increased availability, increased … revenue, or achievement of specific … goals?

IT OPERATING EFFICIENCY
How will the project improve IT, such as simplifying management, reducing support costs, boosting security, or increasing IT productivity?

RISK
What are the potential risks associated with the project? How likely will risks impact the implementation schedule, proposed spending, or derived target benefits?

COMPETITIVE IMPACT
How does the proposed project compare with competitor's spending plans?

ACCOUNTABILITY
How will we know when the project is a success? How will the success be measured (metrics and time frames)?

Defining and measuring the costs and returns from IT investments

If an ROI analysis were just one simple thing, then there would be one simple way to measure the costs, returns, and benefits. In practice, however, there can be many different questions asked of an ROI analysis requiring different measurement approaches to fit those questions. How to identify these measures and apply them to analysis are the next parts of the puzzle.

Solving that puzzle requires understanding the differences among the questions asked of an ROI analysis. There are four different but related types: *financial*, *effectiveness*, *efficiency*, and *impact* questions.

Can we afford this? and Will it pay for itself?

Answering these questions requires information about costs and returns in terms of the monetary value of the resources used (inputs), as measured and recorded by standard financial factors. In its simplest form, an ROI analysis based on this kind of question would calculate the return in terms of the expected savings and revenue increases (if any) compared to the dollar cost of all expenditures on the new system. The costs, savings, and revenues might be projected over a multi-year time span in order to show a payback period or to estimate the present value of future returns.

[4] *Tom Pisello, in* Infoworld*, June 10, 2002, p. 47.*

How much 'bang for the buck' will we get out of this project?

Answering effectiveness questions requires information about the costs of the project in relation to how much it contributes to achieving program goals and producing the desired results. The metrics will be more complex, involving unit cost or activity cost calculations. The measurement of returns will be expanded beyond cost savings or revenue increases to include levels of performance relative to program or project goals.

Is this the most I can get for this much investment?

Answering efficiency questions requires information about whether the project will produce the greatest possible value relative to its costs. Efficiency questions pose serious analysis problems. Establishing that a particular result is the best of all possible results requires either examining many alternatives or simulating performance in some way that gives a valid picture of what is possible. This can be done for some kinds of systems with sufficient resources and data, but can substantially increase the cost and complexity of the analysis.

Will the benefits to society (our state or our city) justify the overall investment in this project?

Answering impact questions requires information about the larger social and economic benefits and costs of a project. These questions pose two tough problems. Measuring the broad social and economic costs of an investment requires data far beyond what typical financial systems provide. Measuring, or even identifying the full range of social and economic benefits from some government IT project can be even more daunting. The idea of figuring a cost/benefit ratio is appealing, but seldom feasible. Though not impossible, the breadth and complexity of this kind of analysis means it is rarely found in IT investment planning.

The four types of measurement questions and approaches differ in several ways. The choice of relevant metrics is one critical difference. Some approaches are based on strictly financial metrics (costs or returns in dollar terms), others include production output metrics, such as quality of goods or services, client or customer satisfaction. Metrics may extend to organizational factors such as morale or to social and political outcomes. These can include impacts on quality of life, social equity, social or human capital, or political support. These differences are summarized in Table 2 (page 11).

Understanding the enterprise: technology in the business context

This guide views any IT investment project as embedded in its organization's enterprise architecture and in a context with three major elements: relevant business processes, the organizational setting, and the external environment.[5] These are illustrated in Figure 1 on page 10. The immediate context of any IT project is found in the current business process(es). Some of the costs and returns of the project will be directly linked to business processes, such as training costs for staff involved or the improved efficiency of the overall process resulting from project implementation. Other costs and returns will be linked to the organization, for example through

[5] While a more detailed discussion of enterprise architecture is beyond the scope of this guide, both the mapping and understanding of an organization's "blueprint" are critical steps that any organization should accomplish prior to conducting effective return on investment analysis. Please see the Additional Resources section in Appendix D for several links to enterprise architecture development tools available to federal, state, and local government decision makers and ongoing enterprise architecture initiatives at the state level.

changes in resource flows, performance changes and changes in workflow and internal relationships. Linkages with the external environment may be significant as well. Resources may be committed from that environment to support the project, and additional costs may be imposed on external persons or organizations by changes in the way services are delivered or other business is conducted.

For example, an agency implementing EDI (electronic data interchange) to support purchasing transactions may be imposing costs on vendors who wish to do business with the agency and have to invest in developing their own EDI capabilities. The way Figure 1 below represents investment costs and returns as part of the same context is an important way of looking at ROI. Neither the costs nor the benefits of an IT project begin and end at the project's boundaries. Financial allocations to a new project mean fewer resources somewhere else in the organization or its environment. Changes in one part of a business process may impose costs on other parts that have to adjust activity, retrain staff, or modify other systems. Increased efficiencies in one business process can make resources available elsewhere in the organization, but may also result in changes in other linked processes within the enterprise.

Whether you see something as a cost or benefit of an IT project may depend on whose perspective you take. The expenditure on a new personnel management application is a cost to the agency that pays for it, but it is a benefit to the vendor, who is an external stakeholder. These links make it clear that an analysis of costs and benefits of an investment can require attention extending well outside the project itself into the organization and its environment. Business processes are the critical connection between the project and the rest of the organization. So attention to business process linkages with the project is an important part of the overall ROI analysis.

Figure 1. The Context of IT Investment Projects

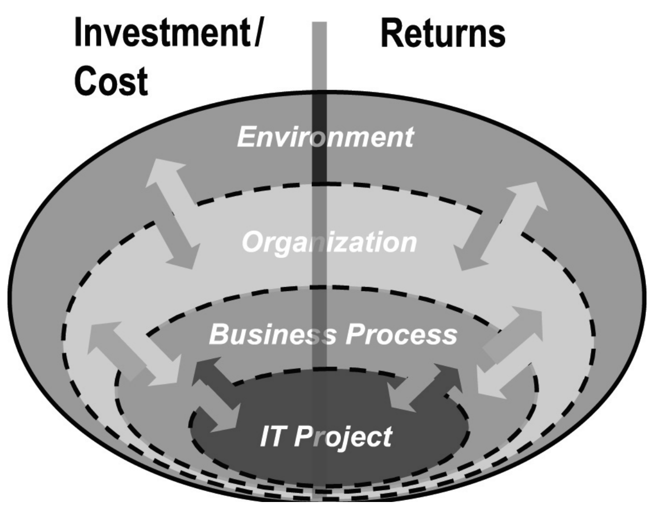


Table 2. Approaches to Cost and Return Measurement

Measurement Question	Measuring Costs	Measuring Returns/Benefits
Can we afford this and will it pay for itself?	Financial metrics; defined by policy and accepted accounting principles; reporting and control-oriented; standards-based or consistent; not linked to business process; ignores important cost factors; short time frame; data routinely collected/reported	Savings as measured in accounting categories; narrow in focus and impact; increased revenues, reduced total costs, acceptable payback period
How much 'bang for the buck' will we get out of this project?	Financial and outcome/quality metrics; operations and management oriented; defined by program and business process; may or may not be standardized; often requires new data collection; may include organizational and managerial factors	Possible efficiency increases; increased output; enhanced service/product quality; enhanced access and equity; increased customer/client satisfaction; increased organizational capability; spillovers to other programs or processes
Is this the most I can get for this much investment?	Financial and organizational metrics; management and policy oriented; non-standard-ized; requires new data collection and simulation or analytical model; can reveal hidden costs	Efficiency increases; spillovers; enhanced capabilities; avoidance of wasteful or suboptimal strategies
Will the benefits to society (our state, our city, etc.) justify the overall invest-ment in this project?	Financial, organizational, social, individual metrics; individual and management oriented; nonstandard; requires new data collection and expanded methods; reveals hidden costs; potentially long time-frame	Enhanced capabilities and opportunities; avoiding unintended consequences; enhanced equity; improved quality of life; enhanced equity; enhanced political support

Understanding ROI decisions in their political and policy context

Investment decisions in the public sector, whether they involve IT or any other expenditure, take place in a context of political and policy influences. No matter how solid or technically sophisticated an ROI analysis may be, it will not likely be the sole determinant of an investment decision. It is useful in deciding how to prepare and present an ROI analysis, therefore, to take into account possible political and organizational factors. Such a consideration of external factors may help shape the style, emphasis, or presentation strategies employed to introduce ROI analysis into decision processes. Such considerations are discussed below and may also help in recruiting support for the conclusions of the analysis and guiding how the analysis process is described or defended.[6] All of these considerations can be classified as different types of risks.

Political risk factors

Public exposure of failure or error. Government's business *is* public business. Most new ideas are implemented in full public view. Any investment-gone-wrong risks not only dollars, but the credibility of an agency and its leadership with legislators, executive officials, and the public. So government tends to reduce risks by relying on the "tried and true." Failure risk can be mitigated by taking care not to over promise the benefits of new projects and to ensure that there is adequate strategic planning to reduce the probability of failure. Undue caution can also risk a different kind of failure: missed opportunities for successful projects.

Divided authority. Public executives seldom have a clear line of authority over agency operations. Their decisions are circumscribed by existing laws, budget and financial controls, civil service systems, political constraints, and a variety of regulations imposed by both legislatures and the courts. These restrictions impede managing the complexities of multi-million dollar IT projects in a rapidly changing technical environment.

Multiple stakeholders. Stakeholders typically have competing goals. Customers, constituents, vendors, service providers, elected officials, professional staff, and others all have some stake in IT projects. Understanding how different choices may affect and be affected by each stakeholder group helps to prevent unexpected problems.

Annual budgets. Government budget cycles increase the uncertainty about the size and availability of future resources. This diminishes government agencies' abilities to adopt or sustain new IT innovations successfully, especially those that have long development periods.

Highly regulated procurement. Regulations in the typical competitive bidding process are ill suited for the experimentation and learning that is often essential for successful IT investments. While promoting integrity and fairness, procurement regulations are often a source of problems and delays. These are especially troublesome when agencies write requests for proposals (RFP's) that depend on the limited information they have been able to gain from inadequate experience and research.

[6] *The content of this section is adapted from Sharon S. Dawes, Theresa A. Pardo, Stephanie Simon, Anthony M. Cresswell, Mark F. LaVigne, David F. Andersen, and Peter A. Bloniarz.* Making Smart IT Choices: Understanding Value and Risk in Government IT Investments. *Albany, NY: Center for Technology in Government, 2003. http://www.ctg.albany.edu/publications/guides/smartit2*

Organizational risk factors

Complex program networks. Government programs are connected in many complex ways to other programs in the same or other agencies, or to non-governmental entities. Sometimes the connections are explicit and formal. Often they are informal or unintended. Changing programs can have unintended consequences for several others, producing additional costs and problems for the investment project.

Misalignment of goals. Some parts of an organization may see the goal of an IT project in narrower, possibly conflicting terms. For example, an IT unit may become enamored with a database or office automation project because of its technical elegance. The end users of the system, however, may want capabilities that are not compatible with the new technology. Without some goal alignment a project is on the path to failure.

Lack of leadership support and organizational acceptance. Top management support for a technology initiative is critically important. Similarly support and acceptance throughout the organization, especially among the people who will use the technology or its products, are equally important, and often more difficult to achieve. Understanding and enhancing support reduces or limits risks.

Business process risks

Reality of the process. IT inventions are embedded in business processes. Failure to understand and account for this reality in project design and implementation introduces major risks. Systems are often created that do not serve business needs, are too expensive for the small productivity gains they provide, or are not flexible enough to meet changing demands.

Technology risk factors

Rapid change. Obsolescence is a risk as soon as a project chooses its technology. The pace of technological change makes it difficult for planners to keep up with the details of new developments and to understand comprehensively how each new technical tool works, or may be superceded. Technology choices guided by long term strategies and strong linkages to business goals can mitigate many of the risks produced by rapidly changing technology.

Technology interactions. A basic concept of system analysis is “you can’t do just one thing.” New technologies interact with old technologies and work processes. The interactions may enhance the value of the older and newer technology, or interfere with both. A careful analysis of these interactions will identify risky situations and provide insights for avoiding problems and errors.

Scale and complexity. Risks increase directly with the scale and complexity of IT projects. Planning an incremental process of development, with careful contingency plans, can mitigate some of these risks and will avoid problems that cannot be anticipated on the path from small to large, complex systems.

Chapter Two: Methods of ROI Analysis for IT

Choosing and using the various methods of ROI analysis requires both good knowledge and good judgment: knowledge about the methods and judgment about how best to apply them to a particular IT project and its setting. This section presents an introduction to the methods. It is intended to impart enough knowledge so that the reader can exercise effective judgment about whether to use a particular method, how and to what extent it may be applied, and where to go for more complete information and resources.

We begin with a discussion of the issues associated with project time frames and scale, then present various approaches to process analysis and measurement. We conclude with a brief overview of risk analysis.

Issues of time and scale

The selection of method will depend to some degree on the time frame and the scale of the project and the ROI analysis. Time frame refers to both the time perspective for the analysis and the overall time period of the project to be included in the analysis framework.

Anticipating the future. ROI analysis is commonly used prospectively. The results of the analysis are intended to inform a decision about a future IT investment. For a prospective analysis, estimates of anticipated cost and performance are based on assumptions about the future that may involve considerable uncertainty. The results of the analysis will depend, to a large degree, on how accurate those assumptions turn out to be.

Learning from the past. A retrospective ROI analysis will show actual performance data about the IT project's costs and returns. The longer timeline and complexity of larger projects can lead to substantially different results. The analyst must take these possibilities into account when evaluating the results of pilot projects. These concerns become part of the risk analysis discussed in a later section.

Importance of scale. Even when there are actual data from such a pilot project, the problem of the accuracy of assumptions remains. There is no guarantee that costs or returns from a small pilot project will accurately predict what happens in a larger effort. The scale of the larger effort can itself lead to different results.

In the case study described in Appendix A (page 28), the analysis combines the two perspectives. The developers created a pilot project, which was a small part of a larger project they planned to undertake. They then used the data gathered from a retrospective analysis of the pilot project to estimate the costs and returns that would result from the full development.

Importance of business process analysis

IT projects can have large and wide-ranging impacts on business processes. These impacts can occur directly in the business processes involved in the project and in other related processes. Methods for the analysis of business processes are too large a subject to cover in detail in this guide, so a brief introduction to these techniques is included in the section on methods below. The reasons for including attention to these methods in ROI work is related to the overall strategic objective of the project and how it fits into the rest of the organization.

The business process perspective concentrates on where an IT project fits within the larger picture of the organization's mission or core purpose. For example, a state department of transportation typically has responsibility for ensuring the safety of the transportation infrastructure. This would usually include responsibility for inspecting bridges on state highway systems and contracting for repairs where needed. The main elements of that business process includes many activities, from decision making about inspection policies and schedules through contracting for repair and construction work. The activities could include scheduling and performing inspections, reporting and analyzing results, then moving into the RFI, RFP development, bidding, contracting, and project supervision. Any change in one part of the IT system in an interconnected business process like this one, would likely have important impacts on other business processes. An IT project that places electronic sensors on bridges that send stress data to the central office will affect more than the inspection process. It will have ripple effects all the way from the employment and training of inspectors to the costs of new construction and the public's perception of bridge safety. These latter concerns are all potential elements in an ROI analysis.

The interconnectedness of IT projects and the overall business process is nicely illustrated in one recent experience with a Web project in New York City. The City government added a section on its Web site reporting the results of its Health Department inspections of restaurants. The IT staff did not anticipate the popularity and high demand for such information. Nor did they understand the effects that demand would have on other linked elements of the business process, which includes both producing and disseminating inspection results. The Web server was initially overwhelmed by hits on the inspection information soon after it was posted; word of mouth communication rapidly spread the news. That problem could be easily fixed with additional server capacity. However, the high-level of public demand for this information and its significant impacts on restaurateurs put new pressures on the Health Department. They were pressed to increase the timelines of inspections and to use more plain language to ensure better understanding of the results. These were substantial cost factors directly related to the Web site project. A narrow focus on the IT component of the project led the planners to miss the effects on linked elements of the business process. The results were both unanticipated costs resulting from down-stream impacts on the business process and unanticipated benefits due to increased service levels to the citizens.

The linkages in this example extend from the specific details of an IT project—new data on a Web site—all the way to the relationship of the organization to its political environment. These linkages and their importance are obvious in retrospect, as are many implications for both costs and returns. The goal of good business process and ROI analyses is to provide the same insights and information for planning and decision making in advance. How that can be done is outlined in the description of methods below.

Benefits of process modeling

Business process models make the implicit assumptions and mental models of individual managers and stakeholders more explicit and open for discussion. They also:

- inhibit premature jumping to a solution because of the way they structure thinking about a problem;
- create an externalized definition of the problem that can serve as a focus of discussion and can help to align thinking about what are root causes of observed problems;
- force managers and analysts to come to grips with the precise logic or causal forces that are causing a problem;

- require attention to decide which key variables to measure;
- allow analysts and managers to communicate their reasoning effectively and efficiently to external audiences;
- can provide a simulation of how the full system will operate within a full context of organizational and human factors;
- push managers to see the implications of a limited prototype when it is expanded to full scale operations, requiring careful attention to technical, organizational, and policy issues; and
- can include financial elements that allow explicit exploration of costs and benefits of proposed solutions.

Sensitivity analyses of models provide answers to "what if" questions about various types of system functionalities and possible organizational and human effects. This helps planners anticipate issues and problems before they are encountered in a real world system implementation.

Methods for understanding the business process

IT investments of any sort must be viewed as part of the business processes in their organizations. Both the costs and returns of the investment are tied to how the new technology fits with and how it alters business activities. The notion of what constitutes IT must be expanded to include not only the chips, wires, and software, but also the activities and interactions that generate the costs and value that results from using the IT (i.e., the enterprise architecture). Failing to map and understand the enterprise invites a badly flawed understanding of how the IT investment will work, and can be a short cut to failure. For example, the U.S. Department of Education recently invested millions of dollars in a Web site for college students to apply for financial aid. The site generated very little use and was closed down. It failed because it ignored the important role of college financial aid officers in the overall process of students seeking and receiving aid. The designers did not understand or ignored the overall business process of financial aid administration.

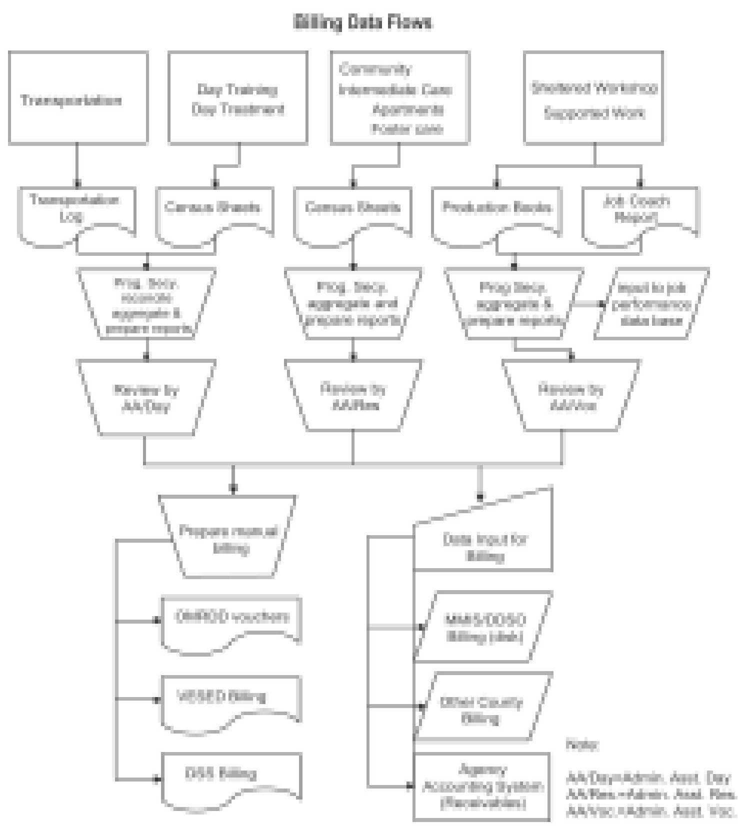
Business process analysis tools and methods range from simple flow and GANTT charts to sophisticated formal and mathematical modeling. Simple flow charts are sufficient to identify the basic elements of most business processes and some of the more obvious dependencies. How far business process modeling needs to go beyond simple diagrams depends on the questions to be answered and the resources available for the work.

The basic components of a business process are activities, flows, controls, and dependencies. Analyzing the business process therefore means identifying the various kinds of activities, what kinds of flows they generate and support, and how the activities and flows are controlled and linked to produce some particular collection of goods or services. Flows can consist of information, persons, resources, control inputs, and work products moving from one activity to another. The analysis consists of gathering information about the activities and flows in as much detail as necessary. Depending on the kinds of modeling to be used, this information can include descriptions of activities and flows in strictly qualitative terms or detailed measurements of resources used, flow metrics, and outcome measures.

Descriptive models

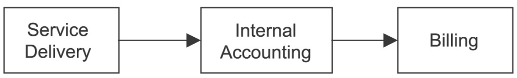
Approaches to process modeling can be grouped roughly into three levels or types: descriptive, analytical, and dynamic. Descriptive models are the most fundamental. They describe the elements of a business process and the relationships among them. A flow chart that describes how travel expense reimbursements are processed, for example, might show how the request originates, how it moves from one work process to another, what actions or decisions take place at each point, and the elapsed time for each step. Descriptive models may involve some measurements, such as personnel time, expenditures, other resources used, and outputs. The flow chart in Figure 2 below illustrates the actual billing information flows for a nonprofit provider of services to mentally retarded and developmentally disabled clients. It shows how information about services delivered is converted into bills submitted to the various government sources of funding for these client services.[7] This flow chart was produced to help understand how a change in the reporting and processing technology for one of the funding agency's would affect operations among the providers who deal with multiple agencies. The IT project was planned by one state agency, but the planners recognized that the business process involved a range of other agencies and local practices. Therefore their analysis of the costs and potential benefits of the project had to include attention to the overall business process, not just what happened within one state agency.

Figure 2. Example of Process Flow Chart



[7] *For example, Medicaid billing goes to the Medicaid Management Information System (MMIS), education related billing goes to the State Education Department, and so forth.*

The level of detail used for such a model is a matter of judgment, in this case dictating a model at an intermediate level of detail. For some purposes, a more highly aggregated model may be sufficient, such as the following.



It might be necessary to examine a much finer level of detail, such as how administrators review service records before approving billing in Figure 2 on page 17. The level of detail depends on the questions that guide the overall effort. A descriptive model influences the choice of what is to be measured and whether more formal modeling will be needed.

Use of analytical or formal models

Analytical or formal models go beyond description to represent the performance of a business process or project in some quantitative or mathematical form. This kind of model has many advantages for analysts and decision makers, along with some substantial problems and limitations. There are at least four kinds of advantages.

- Formal models require making the implicit explicit, and to do so in precise and systematic ways.
- Many formal modeling methods allow exploring "what if?" questions and work with alternative scenarios by simulating the results of using the model of the new system. The planner can thus test ideas and alternatives without risk to real systems, operations, or data.
- The analysis yielded by the modeling can reveal insights into the behavior of persons or organizations that would otherwise be difficult or impossible to detect.
- The modeling process, if done in a collaborative way, produces a shared understanding of the work among managers and stakeholders that can lead to improved decisions about the project and its ultimate implementation.

Because of these advantages, the use of these techniques for process improvement and project planning has grown substantially and spawned an industry producing software applications, consulting, and training in one or more of these methods (see resources in Appendix D).

These methods are not without problems or limitations, the most important of which is that they raise the costs of analysis in several ways. These models typically require more detailed and extensive information, particularly performance and outcome measures, than simpler descriptive methods. In addition, the construction and use of these modeling methods requires considerable time and expertise. Organizations that do not have staff prepared to do the modeling work themselves would have to invest either in extensive training or employing consultants. It is important to review carefully whether the complexity of the project justifies the investment in formal modeling before taking that course of action. The review of alternative methods below is intended to help in that regard.

Types of formal modeling approaches

Agent-based modeling. The basic idea of agent-based modeling is that complex behaviors of collectives (social groups, members of an organization, population) can be modeled by simple computational rules. The rules treat the members of the collective as autonomous agents that follow simple rules of behavior, rules that can be modeled on a computer. What happens to the collective is the result of the individual agents interacting with each other according to the rules. Changes in the rules change the overall results, sometimes in predictable and sometimes unpredictable ways.

One early example of agent-based modeling in the social arena was a model of residential segregation developed in the late 1960's.[8] The model starts with a hypothetical city with a mixed race population randomly distributed over the residential area. Each household either stays or moves according to two simple rules: a preference for living near persons of the same race, and deciding to move if the population in surrounding areas has too low a proportion of such households. There is no rule involving dislike for households of different race or desire to avoid them. Nonetheless, the action of these rules over time produces a city of racially segregated neighborhoods.

In agent-based modeling, the rules are the model or theory. Thus they make explicit the assumptions and motives of the agents and what governs their actions. The value of the model depends on the degree to which the rules produce results that match the actions and outcomes for the actual collective of interest. If rules are developed that reproduce the results of interest, they can provide a powerful tool for understanding how those results occurred and for testing ideas about how to change or improve them. This kind of modeling may be particularly appropriate for information technologies that will involve the activities of large numbers of persons engaged in the same type of activity, such as large numbers of citizens seeking the same kinds of information on a Web site. A valid model of how people will use a system can be a valuable tool for exploring what costs and benefits to expect.

Agent-based modeling is not for the faint of heart, however. It is mathematical, often requiring advanced knowledge of algorithms and computing to implement. There are special modeling languages for developing the computer programs to pursue agent-based work, but they require experienced users or a considerable investment in training. If the rules are sufficiently complex or abstract they may be difficult to communicate to participants in the planning or to key stakeholders.

Operations research and statistical modeling. If the factors that influence a business process can be identified and measured, modeling that process by operations research and statistical methods may be feasible. These modeling approaches use mathematical equations to represent the business process. This requires measurements of the business process itself and of the factors that are thought to influence how the process works. Then the modeling equations are chosen to fit the way the significant elements of the business process are conceptualized.

- If the process is seen as a series of activities that consume resources and occur in particular interdependent sequences, project description tools such as PERT charts or critical path analysis may be used.
- If the sequence of events in the business process is uncertain, or if multiple paths or outcomes are possible, probabilistic methods such as Markov chain models may effectively represent the process.
- If the sequence or path of influence is not known, but some measure of their general effects is available, linear modeling and regression methods may be useful to represent the overall process or predict the results of changes.

[8] *Thomas Schelling, (1971) "Dynamic Models of Segregation,"* Journal of Mathematical Sociology *1, 143-186.*

- If particular combinations of influences are thought to work together to affect the flow and/or performance of the business process, then scenario analysis may be useful.

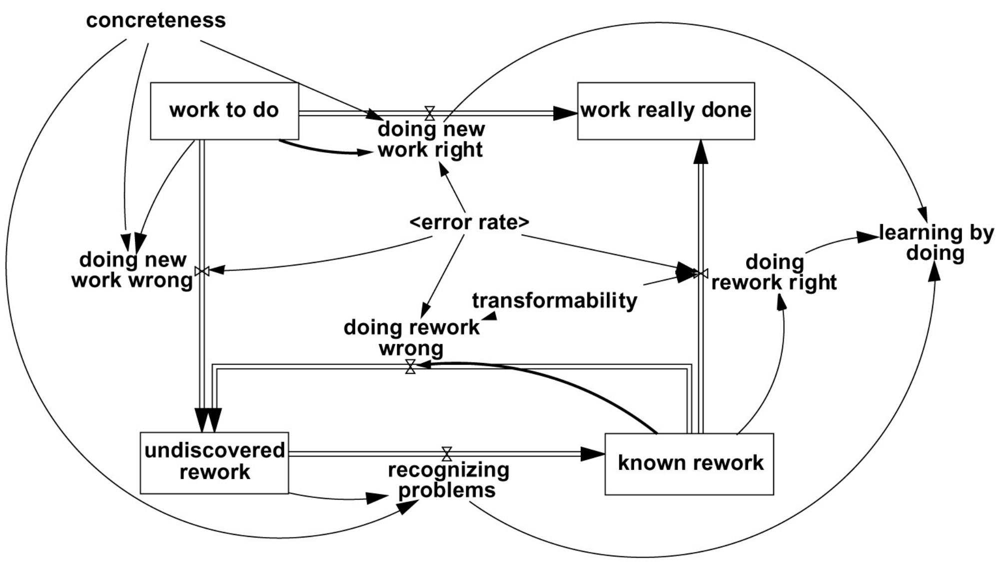
These modeling methods are similar to agent-based methods in that they require measurements. They differ in that they are based less on specific theories or assumptions about the activities that make up the business process. Rather, they use simplifying assumptions about the underlying cause and effect relationships that drive the process. That makes the models easier to use in some respects. Little original theory building is needed. In addition, the methods are supported by commonly available applications, and training in many of the particular methods is typically part of management education programs. Choosing among these alternatives is not a straightforward task and a reasonably high level of expertise is needed. The same applies to interpreting the results and understanding the limiting assumptions that apply to each.

System dynamics modeling. Many business processes involve feedback, that is, chains of effects in which what happens at one point in the process has an impact elsewhere that in turn influences (increases or decreases) the original effect. For example, a new database application may produce a new kind of report that users find particularly valuable. Seeing one possible new outcome prompts the users to request additional kinds of reports that produce more valuable results, and more new requests, and so forth. Any kind of process that can be represented as stocks or supplies that flow from one place to another with either reinforcing or negative feedback can be represented using the methods of system dynamics modeling. These models can provide both a conceptual and mathematical representation of the processes. The conceptual or graphical representation is usually referred to as a causal loop model. These models can be built by analysts working with the staff involved in the process, making use of staff knowledge and insights. The image created is a potentially powerful tool to evoke knowledge about the process and to move the participants to a shared understanding. An example of such a diagram is shown in Figure 3 (page 21). This particular model represents a working theory about how work progresses. Tasks can exist in one of the four following states.

- Work to do
- Undiscovered rework
- Known rework
- Work really done

At the start of work, all tasks are in the stock of *work to do*. As participants perform work, correctly done tasks move to the stock of *work really done*, with a probability of 1- *error rate* (a fraction). The *error rate* is based on the idea that it is impossible to perform all tasks correctly on the first try. Tasks performed incorrectly require rework, so as work proceeds some proportion of the tasks enter the accumulation *undiscovered rework*, according to the probability of an error occurring, *error rate*. Similarly, problematic tasks can be redone correctly (moving from the accumulation of *known rework* to *work really done*) or incorrectly (returning to *undiscovered rework*), based on the error fraction. The concreteness of instructions and transformability of the tasks themselves are shown as affecting the ability to do work right in the first place or to correct errors. With appropriate assumptions and values for the variables and parameters in such a model, a mathematical representation can be built that reproduces the behavior of the process itself. Analysts, who should have appropriate expertise in system dynamics modeling, can change assumptions or values and explore the consequences, yielding new insights into the possible costs and performance of a project.

Figure 3. Causal Loop Diagram of Project Management Processes



Unified Modeling Language (UML) and Use Case Modeling. UML is a programming and modeling language that provides a system for representing and documenting object-oriented software development and the business process in which it resides.[9] It is particularly tailored to analyze the application development process and for use by development teams in that environment. The overall conceptual scheme for use of the UML includes what is referred to as *Use Case Modeling* as a component. A Use Case is a guide for software design based on a behavioral case study of how an application is used in an actual business process. This differs from traditional approaches that specify software requirements in terms of technical needs and goals. For IT projects that are primarily application development, UML can be a very useful and powerful tool for modeling the project itself for management purposes, as well as for its linkages to the business process. However, the UML is highly technical and requires considerable study and programming experience to use effectively.

Investment in the use of UML may be justified, especially for large application development projects that involve multiple teams. As the UML documentation states:

"In the face of increasingly complex systems, visualization and modeling become essential. The UML is a well-defined and widely accepted response to that need. It is the visual modeling language of choice for building object–oriented and component-based systems.[10]"

[9] *"The Unified Modeling Language (UML) provides system architects working on object analysis and design with one consistent language for specifying, visualizing, constructing, and documenting the artifacts of software systems, as well as for business modeling." Object Management Group, p. xi.*

[10] *Object Management Group.* OMG Unified Modeling Language Specification, Version 1.3. *Framingham, MA: Object Management Group Headquarters, 1999, p. 1-4. 13 Office of the New York State Comptroller.* Accounting and Reporting Manual. *Albany, NY (no date), p. 17.*

Workflow modeling. The workflow modeling approach is similar to UML but involves a different focus and approach. Instead of using a programming language to model work processes, workflow methods use generic models of work processes and the relationships among them. The components of these generic models represent business activities, resources, dependencies, and controls. The design of the models is aimed particularly at enhancing coordination by identifying dependencies, failure modes, and problems of handling exceptions. For complex business processes, a flow chart will not reveal the consequences of errors at critical points, unanticipated resource shortages, or missing factors during some point in the process. Workflow models allow these situations to be explored and provide analysis of where processes are particularly vulnerable to failure or waste.

Workflow modeling technologies and commercial products may be useful to analyze an existing business process or re-engineer one. But they are designed primarily to develop automated work processes. These depend on computer-based controls, typically where the flow of information or materials involves networked links among the activities. However, the basic concepts of dependencies, exception handling, and error modes may be applied regardless of the level of automation in a workflow. So the conceptual tools of workflow analysis may contribute to a process model concerned with costs and returns to a new system.

Measuring costs and returns

Financial metrics and government accounting

What is measurable within a government accounting frame is set by the generally accepted and/or legally mandated accounting standards and practices that apply to the particular government organization. Definitions and structures for financial data are standardized and designed to serve specific government purposes. The Office of the New York State Comptroller describes the state framework in these terms:

"The purpose of classifying accounts is to provide a standard format for recording and reporting financial transactions which allows comparisons to be made with others municipalities or other financial periods."

"The classification system serves as a basis for budgeting, accounting, and reporting as well as for administrative control purposes, accountability to the Office of the State Comptroller and the general public, cost accounting, and the compilation of financial statistical data on the state level.[11]"

This framework organizes the accounting data about costs/expenditures and revenues according to general organizational programs, functions or divisions, and by objects of expenditure (e.g., salaries, equipment, etc.). This is sometimes called a function-object accounting or budgeting system. A typical function-object accounting system for a state agency has a highly detailed and structured way of defining what kind of financial information is to be recorded and how it is to be organized.

[11] *Office of the New York State Comptroller. Accounting and Reporting Manual. Albany, NY (no date), p. 17.*

The strengths of a government accounting framework for analysis of costs and benefits are also its weaknesses, namely standardization and rigid structures and rules. Standards and rules make such a frame-work useful for control of finances, generating standardized reports, and overall fiscal accountability. And if the existing categories of accounts happen to provide the particular cost and return data needed for ROI analysis, the frame-work would be readily available and useful. However this is seldom the case, particularly for IT investments. The full value of an IT investment is typically a mixture of many types of expenditures and other costs, the accurate accounting of which is not possible in the traditional accounting system. These systems will usually record the costs of equipment and personnel attached directly and full-time to IT activities. But they seldom record the changes in personnel costs for those who use the technology or the investments in training and learning to operate new systems. Maintenance and supplies may appear in a range of separate accounts, and many managerial and analytical costs are very difficult to estimate or prorate accurately.

Measuring costs and cost-effectiveness

In its most basic economic sense, a cost is whatever you have to give up to get something else. And a return is anything good that you get as a result, whether that good is measured in financial terms or otherwise. This is, of course, a much broader view of costs and returns than is found in most accounting systems. For example, an accounting system would not likely include as part of the cost of a new computer system the amount of time devoted to the purchase decision. Nor would the accounting system record the benefits of increased staff morale from a more functional or reliable system.

A full consideration of costs requires attention both to opportunities and to indirect costs. An opportunity cost framework takes into account what alternative actions or returns would be missed or foregone as a result of a particular investment decision. The path of any IT project necessarily excludes other paths not taken. If opportunities along those foregone paths can be identified and valued, they can become part of the cost calculation. If I choose to implement a new procurement processing system, for example, the staff time spent training for implementing the new system is time unavailable for training in some other area of work skills. If a value can be assigned, this lost opportunity may be considered part of the overall cost calculation. Indirect costs (sometime referred to as imputed costs) are those that are not incurred or measured directly, but are calculated or estimated from other measures. For example, the cost of using existing network cabling for a project could be calculated from the amount of new traffic generated or from some other prorating factor. Similarly, apartment renters do not pay real property taxes directly, but the renter's portion of that tax can be calculated as an indirect component of rent.

These costs are often "off the books" in the sense that typical public accounting and financial management systems do not provide this kind of cost analysis. There are no standard accounting practices to guide the measurement of these costs. An agency may have an existing standard indirect cost factor that is used in budgeting for Federal grants or contracts (e.g., some fixed percentage of personnel expenditures). But these standard factors are based on averages over many projects and are not particularly useful measures for any one particular project. Opportunity costs are even more problematic and are often not included, leading to possibly significant underestimation of overall costs. Underestimating true costs can make an investment's returns look more attractive than they may really be.

Assessing effectiveness requires identifying the outputs of the project and its implementation in business processes or program terms. That means identifying meaningful units of output that can be related to the cost estimates. For example, the effectiveness of a new system to process business permit applications over the Web could be measured in terms of increased numbers of permits processed during a given time. Lower costs per processed permit would be a useful cost/effectiveness indicator. Producing such a cost/effectiveness measure requires detailed data about permit processing and a way of assigning costs on a per permit basis. Without some enhancement, most government accounting systems do not provide the basic data necessary for such a calculation. It may be necessary to do detailed data collection on a sample of permit transactions, for example, to establish a baseline unit cost figure. A business process model could provide the necessary data if so designed. Even if such a unit cost measure is available, it may have problems, such as the distorted assumption that all permits are equally important or costly.

Efficiency measures

Efficiency is a way of describing the effectiveness of a project or system in relationship to costs (or other inputs). Efficiency cannot be separated from effectiveness, since using resources and failing to achieve a desired outcome can be little more than waste; you don't save money by building half a bridge. Efficiency is usually expressed in terms of optimizing the value of a return for a given cost or input, or alternatively minimizing the cost for a given value of result. It is possible, of course, to improve efficiency without necessarily achieving an optimum. As long as it is possible to compare cost/effectiveness or return ratios for alternative systems or methods it is possible to make judgments about efficiency. To demonstrate an optimum result or projection, it is necessary to have a simulation or optimization calculation to provide the data. Some operations research and simulations, such as linear programming or workflow simulations, can generate this type of calculation if the necessary models and data are available. However most IT projects do not have the data or analytical resources to include these methods in an ROI analysis.

Impact measures

The identification of variables that make up a social cost or benefit calculation along with their definitions is broader than both the economic and accounting frames. They are based either on the specific program results desired by an agency or on general social benefits and improved quality of life. These impact measures can come from several sources.

Operational data. Some useful measures of social or broader economic outcomes may be available in the data collected during ordinary program operations. Providers of services for homeless persons, for example, routinely collect data about programs and activities of clients that could be indicators of impact on their quality of life or progress toward independence. Similarly, law enforcement agencies routinely collect crime statistics that can be useful indicators of neighborhood climate or quality of life.

Social and economic statistics. Government agencies collect statistics on social and economic indicators that are relevant to the overall social and economic status of their jurisdiction. These range from the enormous resources of the US Census Bureau to state and regional planning agencies, and include market research statistics available from private sources.

Special studies and evaluations. For large, high cost projects separate data collection activities, such as surveys or field research, may be used to collect and analyze data about social and economic impacts of a project. These efforts may be expensive and time-consuming, but may also be the only way to obtain data about particular outcomes. The case example in Appendix C on Social Return on Investment provides some examples of how this may be done.

How time perspectives change the measurements

Time has important effects on the measurements and calculations. Both the costs and returns of an IT investment extend over time. Moreover, the costs may be incurred long before the returns are realized. So when estimating the money value of costs and returns, it may be necessary to take into account the effect of the time perspective on the value of money. That is, a dollar in hand today is worth more than the promise of a dollar in hand a year from now. How much less that future dollar is worth, known as the discount, depends on the current time value of money, which is usually called the interest or discount rate. Thus if the discount rate is 5 percent per year, then the promise of a dollar a year from now is worth only 95 cents today. The farther out in the future, or the larger the discount rate, the less the present value of the promise of that future dollar. Calculations based on the discounted value of future returns are useful to estimate what size of return is needed to justify the costs of an investment. The typical methods used in this kind of financial analysis are called Net Present Value and Internal Rate of Return calculations. Both methods use an initial cost and some assumed figures for a future stream of returns, along with a reasonable assumption for the interest (or discount) rate. The Net Present Value (NPV) calculation estimates the value today of returns coming in the future, less the cost of the investment. If the NPV result is less than the cost, then the investment does not appear to yield a net gain. The Internal Rate of Return (IRR) calculation yields the same sort of result by a different path. Using the same basic information as the NPV calculation the IRR calculation yields the rate of return for the investment assuming a break even, or NPV of zero. If the IRR is less than the current interest rate, this indicates that putting the investment in an interest bearing bank account would yield a bigger financial payoff than investing in the project. An example of NPV and IRR calculations are shown in Table 3 (page 26). This example is based on a hypothetical investment analyzed over a six year period. It shows that when the time value of future returns is taken into account, the total returns must exceed the total cost by a substantial margin to generate a positive net present value or internal rate of return.[12]

The problem of choosing the project or investment life cycle

Notice that any calculation of this sort requires specifying a time-frame within which the value of the project or investment will be assessed. This time frame is sometimes referred to as the life cycle of the project. Any IT investment is assumed to have a limited useful life, beyond which the returns are not considered, or when the expected returns from some new technology will lead to replacement of the previous investment. For IT investments, the rapid change in technology makes the choice of a reasonable life cycle or planning framework a difficult but necessary part of the analysis.

Risk analysis in the public sector

Risk analysis consists of assessing the importance of threats and how to mitigate or eliminate them. We usually evaluate a threat in terms of how likely it is to materialize and how much damage or cost would result if it did materialize. We know, for example, that a large asteroid could hit the Earth and destroy a continent—an enormous threat in terms of consequences. But astronomers

[12] *The discount rate shown in these calculations was chosen for illustration only.*

Table 3. Net Present Value Calculation[13]

Year	Costs	Returns
1	$ 100,000	$ 15,000
2	$ 5,000	$ 20,000
3	$ 4,000	$ 25,000
4	$ 4,000	$ 25,000
5	$ 4,000	$ 30,000
6	$ 3,000	$ 35,000
Total	$ 120,000	$ 150,000
	Discount Rate	**3.0%**
	Net Present Value	**$ 13,297**
	Internal Rate of Return	**6.0%**

tell us that the likelihood of that happening is very, very remote—therefore, a small threat in terms of probability. Because of the low probability, the threat is seen as small enough that few of us (aside from some science fiction writers and astronomers) take it into account in day-to-day life. The same logic applies to risks in IT investment. Consequently risk analysis can be thought of as having four basic steps:

- identifying the source of threats,
- assessing the extent of potential damage or cost to the project,
- assessing the likelihood of the threat materializing, and
- devising ways to reduce or eliminate the threat (i.e., mitigate the risk).

Threats can be reduced by taking steps to lessen the damage or cost that would occur if the threat materializes and also by reducing the probability that the threatening event or action will occur. For example, a project could call for using the most reliable platform for a critical database application, reducing the probability that the system will experience a failure. The project could also implement a backup system capable of taking over processing if the primary system does fail, reducing the potential damage of a failure.

The overall subject of risk analysis is too large to treat in detail here. However, most of the risk assessment issues described above involve problems of thinking beyond the boundaries of the project, measuring factors, or determining probabilities. This should not discourage risk analysis.

[13] *Calculates the net present value of an investment by using a discount rate (**rate**) and a series of future payments and income (**values**) in each period (**i**) for **n** periods.*

The experience of those involved in IT projects can be a rich source of intelligence and experiential data on which to base reasonable estimates of risk potential and problem sources. The literature on IT investment is another rich source of analyses of successes and failures that provide additional insights into risks and mitigation strategies. Simply recognizing where uncertainty and potential damage lie is half the battle. Careful risk analysis, based on the best available data and estimates, will surely assist in ROI analysis and improve planning, even if the amount or quality of data is less than ideal.

Appendix A: Case 1
Reducing the Cost of Web Site Development and Maintenance

In order to better understand the problems and issues of ROI analysis, the Center for Technology in Government decided to use a form of ROI analysis for one of its own IT investment projects. The Center's mission to build and disseminate knowledge about IT uses in government usually leads to projects with other organizations. But this case provided an excellent opportunity for learning and knowledge building as part of the Center's own internal work. The Center's Web site is a critically important tool in disseminating information and maintaining contact with colleagues and customers.

During the time covered by this case, the Web site consisted of approximately 3500 pages and experienced over 1000 visitors per day. The Web site was supported by a full time Webmaster and part time maintenance and development staff of two professionals and two graduate students who are part of the Center's Technology Unit. The Web site had been in operation for several years and there was a substantial baseline of experience with development and maintenance using the current architecture. Any investment in new Web site architecture would use internal staff and resources. Therefore, it presented a good opportunity to apply ROI analysis to a realistic problem in a situation where data collection, analysis methods, and the results can be examined at close range.

The purpose of the investment was to change the Center's Web site from a static, HTML-based architecture, to a dynamic, XML-based one. The problem to be solved was a real one, namely that the Center's Web site had grown in size and complexity to the point that maintenance and additional development put a serious strain on existing resources. In addition, the static site could not support new formats and capabilities the Center wanted to use on the site.

The Center faced the decision of whether to continue to invest additional human and technical resources in the existing HTML-based static architecture, or change the architecture into an XML-based one that had potentially much lower maintenance and development costs. The change would require a substantial initial investment in tools and staff time to learn how to use XML and related development applications. The ROI analysis would help answer the question of whether the potential returns to be obtained by the use of a dynamic (XML) Web site architecture would exceed the costs of the conversion. The expected returns would consist of savings compared to the costs of maintaining and continuing to develop the existing Web site. Returns would also include the expanded abilities of staff to create enhanced Web site capabilities and features using the new architecture and application tools.

Estimating the potential cost of expanding the staff to maintain the current Web site architecture was very straightforward. However, estimating the conversion costs to a dynamic Web site was a much more complicated problem. A complete ROI analysis should also include an estimate of the savings (if any) to be obtained by using the dynamic architecture. Estimating the savings would require comparison with the costs of maintaining and developing the existing system, so estimating these costs was part of the design.

Advantages of a dynamic Web site

Web sites can be created with either a static or fully dynamic architecture. Static Web sites consist of HTML pages that combine content (words, numbers, and images), logic (how the content is manipulated), and presentation (colors, layout, fonts, and formatting). In HTML, there is only limited capability to manage or change the content separately from the way it is manipulated or presented. Managing and changing the material requires working with content and HTML tags directly within each of the pages. Static sites are usually easier to develop than dynamic Web sites, but can become much more costly to maintain and manage as they increase in size. Dynamic Web architecture, in this case based on XML, provides the ability to greatly simplify the management, evolution, and expansion of a Web site by providing control of the logic and presentation independent of the content. For example, users can be presented with information based upon their individual preferences, such as larger fonts for a visually impaired person. The site can also be made much more interactive. Dynamic Web sites are generally more expensive to develop than static ones, but are cheaper to manage and maintain up-to-date content.

Data sources

The best source of data about the costs and returns for this new Web architecture came directly from the staff's experience. The Center staff needed an estimate of costs and returns for the XML conversion that they could trust as a valid representation of what they could expect in a full-fledged conversion, without actually implementing that conversion. To do this, they chose to develop a few relatively small new Web-based applications as pilot projects using the new methods and architecture. The first was a decision making guide to help organizations design electronic information access programs. The project was called "Gateways." The experience from those efforts provided the necessary information about costs and returns to inform the larger decision.

Technology Unit staff members responsible for Web site development and maintenance consisted of three full-time personnel and two half-time graduate assistants. All were individually interviewed weekly for a period of four months. During the interviews, members were asked to recall the work they had done the previous week. They were asked to identify:

- whether tasks were done in HTML or in XML,
- the amount of time spent in production ("doing" the work) versus learning the new application in order to do the work,
- the benefits of working with XML, and
- the drawbacks.

The data for the study also included information about the operation of the Web site and related activities, such as impacts on routine site maintenance, changes in content development procedures, and coordinating work on this activity with other technical tasks.

Weekly interviews were a low cost and relatively unobtrusive data collection method. They provided enough data so that it was not necessary to observe work directly or have the staff record their work times in activity logs. This method fit one purpose of the case: to be a useful example for others contemplating ROI analyses, employing methods that would be useful in a wide range of settings without requiring highly specialized training or high costs. The staff involved in the work agreed to the interviews and prepared for them as a regular weekly activity.

Cost estimation

One goal of the case study was to establish an estimate of baseline costs for Web site operations. This was complicated by the fact that the CTG Web site is continuously growing with the addition of new and different types of information. The estimated costs for maintenance of the current site (at the start of the study period) were approximately 75 percent of one full-time staff person's effort per week. This was treated as stable over the term of the case study.

The case data also included estimates of the effort devoted by staff members to researching XML (dynamic Web page design), which began several months prior to its initial use by the Technology Unit staff. The director of the Technology Unit had been contemplating moving to XML for quite awhile. This early deliberation was prompted by the rate of growth for maintenance and development efforts on the CTG Web site. The effort devoted to this period of informal research and deliberation was considered part of the initial investment

Baseline costs. The Center's Web site is very extensive, consisting of approximately 3500 Web pages and receiving on average over 1000 visitors per day. Information is continuously updated and new products and reports are introduced frequently. Maintaining the Center's Web site is quite an undertaking. Under the old HTML architecture, a Webmaster was responsible for maintaining site links, updating current materials, adding announcements and new materials, and related tasks. A full-time staff person devoted approximately 75 percent of their effort to maintaining that site (considered nine person-months per year.)

Investment costs. The primary investment cost for this project was staff time to learn the software and develop the skills necessary to build the pilot projects. The software costs for the conversion might have been quite high, since initial research showed most commercial products to be very expensive. However, after a review of available tools the Technology Unit decided on the open source (free) application, *Cocoon*. This tool seemed to fit the needs of CTG and the staff began working with it.

While the software was free, it required the staff to learn new skills. The underlying logic of how the Web site operates was also considerably different under the new architecture. So the development team had to learn to think about its tasks in a new way as well. By contrast, there were zero learning costs for maintaining the Web site with the old architecture and methods.

The initial learning process was a slow one. It took approximately three months for the staff to reach a level of skill necessary to move from using HTML to using XML. At first, as much as 80 percent of their time was spent on learning the XML application and related skills, and 20 percent on production. After a 10-week period, the time devoted to learning dropped to approximately 40 percent of the total, with the remaining 60 percent used in production. Three months into the effort, 20 percent of staff time went to learning and 80 percent to production. The staff found that this latter 1:4 learning-to-production ratio is consistent with the learning-to-production ratio under HTML (prior to the switch to the new technology).

The learning took place in two stages. In the first stage, the team shifted its way of thinking about Web development from the HTML to the XML architecture. The second stage was to learn the technical details of working in XML. After the initial three-month learning stage, staff members considered themselves knowledgeable enough about the language of XML to deal with problems quickly. The second stage included learning to use the *Cocoon* development tool. Since documentation was limited, they used the *Cocoon* listserv for questioning others who use the program. Much of this learning came from applying the new tools to the tasks specific to the pilot projects. This included creating interactive tools that allow users to work with applications on the Web site. The team's learning process was focused and task-specific, the results of which could be applied immediately. The staff avoided exploring unneeded features and functionality of *Cocoon*.

Additional learning costs are reflected in the different amounts of time needed to revise the printed version versus the electronic version of the Gateways decision making guide. The first pilot application developed with the XML architecture was based on that guide. Initial changes to the electronic version of the guide took up to 50 percent longer than print-only revisions because of the time spent learning to apply the new technology in the Web application. Initially the staff found it difficult to use XML data structures. As a result it took considerable time to understand basic concepts and acquire basic skills for solutions that at first often appeared to be quite simple.

Benefits

More efficient development of new features and capabilities. Benefits were seen almost immediately during the learning process. During the first three months the staff were able to see how XML would directly benefit their future work. For example, a separate file of interactive tools was integrated into the Gateways Guide using established style sheets taken from existing components of CTG's Web site. The new technology saved considerable amounts of time. This particular task required only four hours of work instead of the estimated 16 hours it would have taken using HTML.

More efficient content management. In HTML, the content of the page is tied to the format, which makes it difficult (if not impossible) to separate ongoing development and maintenance functions from content revisions. In order to update the content of a page, some knowledge of HTML is required. XML operates differently, separating "content" from "presentation" or "style." Since the content and style are not tied together, the ongoing development and maintenance functions are separable—allowing for division of labor or specialization. Content "owners" or "creators" work only with content while Web designers work with Web coding.

In XML, content changes can be managed by the content creator alone. Changes made to the XML source file will appear in all formats such as Netscape, Internet Explorer, text-only, and PDF. Under HTML changing one word of content typically requires changing that word in all formats. In comparison, XML saves considerable time and ensures consistency throughout the site. More importantly it allows for greater flexibility in managing content. Since changes are more easily made, it is more likely that the information will be updated and changed as needed.

When XML is used, the Web site can be managed quite differently from HTML-based methods. Work in XML and *Cocoon* played to the strengths of the staff members by allowing different components of the Web site (content, logic, presentation) and their related tasks to be kept separate. Individual staff members can concentrate on work at which they are more proficient. Dividing the labor saves time and allows staff members to become "experts" in specific tasks. In an HTML environment, all three components—content, logic, and presentation—are all combined in the individual Web pages. Anyone working on the page must understand and deal with the components together. Small changes in content could require extensive work with logic and presentation factors and involve much more interaction and coordination among content creators and HTML workers. In the XML environment, content revisions and expansion is separate from the other components, which can be manipulated largely independently. Content changes require very little coding or programming resources, and changing or developing new programming capabilities is not constrained by potential impacts on content.

Less maintenance effort. Current Web sites based on HTML use the Web page as the unit of composition; so a 50 page site can be thought of as having 50 separate units of work. These static Web pages combine both content and formatting. As a result, changes in one page have virtually no effect on the others. For a single Web page or a Web site with few pages or minimal updates, working on individual pages may be relatively simple and affordable. However, as the size and complexity of a site increases, the cost of ongoing development and maintenance increases dramatically. It thus becomes increasingly difficult to keep the site consistent and up to date. In addition, some functions, such as forms or databases, are difficult or impossible to do on static sites.

In XML, code and content are easier to maintain since code and content are stored in separate sources. XML allows for the streamlining of ongoing development and maintenance functions because content is stored in one place but propagated in many places. Because of this architecture there are fewer files to maintain (a 50-page site may contain only one content file and 3–5 style files). Less time is required to maintain the fewer files. One of the benefits of employing this new approach, despite the time and resources spent on the learning process, comes from the potential "payback" in greater functionality, easier maintenance, and reduced ongoing costs.

Greater browser support. In XML, Web design is independent of browser capabilities. Changes made to an XML source file will appear in all formats such as Netscape, Internet Explorer, text-only, and PDF. Under HTML changing one word of content would require changing that word in all formats. XML saves considerable amounts of time. More importantly it allows for greater flexibility in managing content. This lowers the cost of adjusting formats for presentation in different browsers. It is difficult and time consuming to craft HTML documents to work consistently in all browsers, since each browser interprets HTML standards differently. However, when a page is created in XML using the *Cocoon* framework, it can easily be made viewable in all browsers. Staff no longer devote time testing to ensure a page is viewable in all browsers, since the inclusion of an XML browser parameter automatically adjusts formatting.

Greater platform support. XML standardizes and universalizes "content" or "data" across platforms. Currently, a majority of Web pages are mainly constructed using HTML. The "content" is tied to the HTML format. The page works on a Web browser, but may not work on other platforms such as wireless devices, cell phones, and PDAs. XML offers greater delivery functionality across a variety of platforms. It allows the Center's staff and customers the flexibility of viewing pages of the Web site on any Web server architecture.

More efficient management of style and presentation. Style and presentation of the Web site are more efficiently managed with XML than with HTML for many of the reasons discussed above. Since the page itself is not the unit of composition, it is easier to maintain consistency throughout the site. Banners and footers, for example, are maintained as single files and can be imported to all style sheets. The separation of "content" from "presentation" allows for division of labor. Since Web design is independent of browser capabilities, Web pages are viewable in all formats.

Summary of costs and returns

The relationship between investment and returns in the Web site conversion is best expressed in terms of shifts in productivity and opportunity. The principal costs of the project are reflected in the opportunities sacrificed and the added personnel costs incurred in order to develop new skills and capabilities. The primary cost component is opportunity costs: staff were diverted from routine work to learn new skills and to begin to use the new techniques. Some additional staff resources, in the form of graduate students, were used as well. The magnitude of that opportunity cost is represented in the comparison between the two charts in figures 4 and 5.

If the project had not been started (Figure 4) there would be available resources during the first three months of the time-frame to maintain routine Web development and to pursue some new opportunities. In the same time period (Figure 5), by contrast, the project began with a much expanded Web development/learning effort that consumed all slack resources and some operational resources. No other opportunities were taken up and ordinary Web operations were reduced. That was a period of substantial investment with little return.

By months 4–5 into the project (Figure 5), sufficient learning had taken place and allowed for exploiting new opportunities. As experience and the stock of usable components grew, the cost of added development dropped rapidly and resources were freed up to undertake even more new opportunities.

Figure 4. Cost Trends

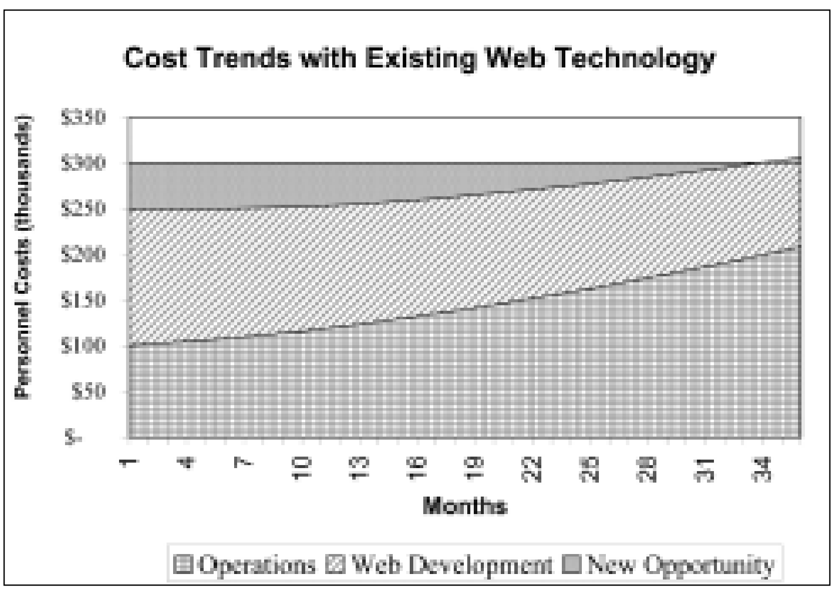
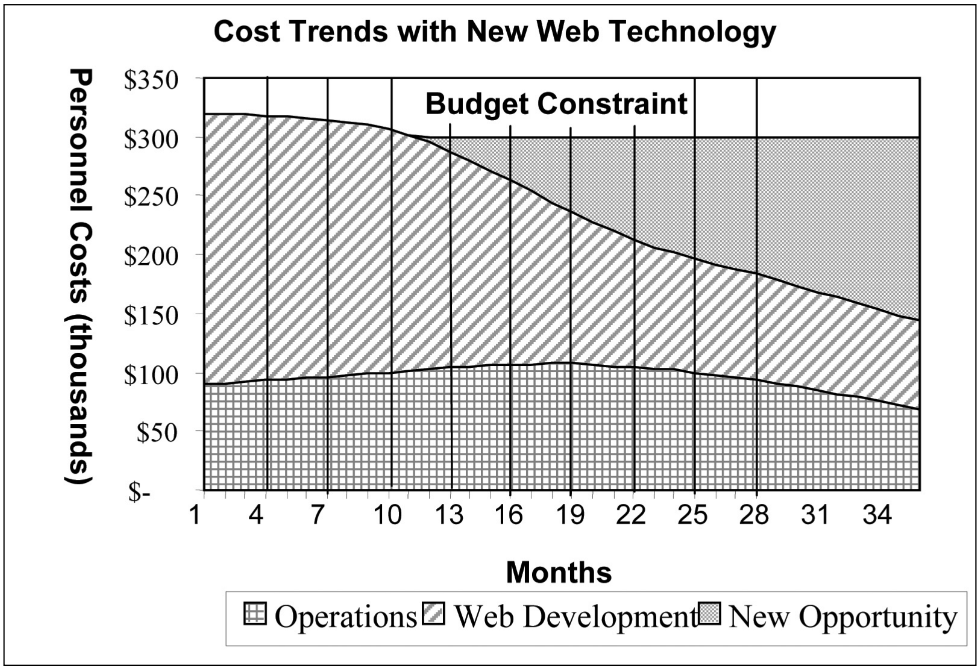


Figure 5. Cost Trends



The cost of ordinary Web operations did grow somewhat during that period due to the normal development of new content. However, the total cost of including new content and making routine maintenance changes in the site is expected to drop, despite increasing volume, due to the increased efficiency of the dynamic architecture. As efficiency in the development and operations of Web site work increase, the opportunities for exploiting new opportunities grow. This can be contrasted with the projections in Figure 4 that suggest the increasing cost of ordinary operations under the old architecture will squeeze out development opportunities and in time will likely exceed the budget constraint.

This kind of opportunity-based analysis can show positive results when relatively little financial data is available, and when the value of new products or capabilities are difficult to determine. There are no savings apparent from this effort unless the analysis takes into account what it would cost to develop these new capabilities and exploit new opportunities under the old technology. However, the expansion of development opportunities over time, in contrast to the baseline scenario, does give a reasonable basis for estimating the returns for an investment such as this in its early stages. Since the projections are based on the early stages of the work, it is possible that the unanticipated problems of increased scale could change the results over a longer term.

Appendix B
Case 2: ROI for Data Integration in Health and Human Services

Project goals and the context of State-Level welfare reform

The information reported here was done for a project designed to integrate information resources used by Iowa agencies in the administration of welfare programs and welfare reform efforts. The project was a response to the changed requirements for the administration of welfare programs resulting from the Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA) passed by Congress in 1996. The Act gave states welfare block grants and increased discretion in the allocation of these welfare resources. Iowa, as did most other states, responded to this major policy shift by creating its own new policies and administrative arrangements. The project analyzed here, the Welfare Reform Related Technology Fund, was one of those responses. The fund supported system developments for the major welfare programs in the State, such as Temporary Assistance for Needy Families (TANF), food stamps, and Medicaid.

Project rationale

In order to use the block grants efficiently and to design their own human service programs, Iowa emphasized accuracy of eligibility determination, benefit distribution, service delivery, and client support. Accurate and timely information is a critical resource for many complex decisions required in administering this mixture of benefits and requirements. Information infrastructure and resources are necessary to make accurate decisions and produce higher quality programs.

In addition to the desire to enhance program efficiency, the PRWORA included financial sanctions for states that fail to comply with regulations or to achieve program goals. Improved information resources and technologies were seen as ways to enhance programs, achieve efficiencies, and reduce the risk of sanctions.

The sanctions can be considerable. If the state did not meet the Federal requirements, future funding for related programs could be threatened. For example, failure to comply with current Health Insurance Portability and Accountability Act (HIPAA) requirements can result in loss of Federal Financial Participation (FFP) of 90 percent, and penalties up to $25,000 per person, annually, in addition to civil penalties. The possible sanctions linked to TANF could amount to as much as $14.8M per fiscal year.

Investment in improved welfare administration

Existing technology allowed the State of Iowa to assist front-line workers in determining eligibility and benefits, to meet some Federal reporting requirements, assist in program evaluation, and to make information available for decisions regarding program and related personnel issues. To improve these information resources, the state allocated a little over $1 million in the 2001 fiscal year to the Welfare Reform Related Technology Fund with the available funding under TANF. These funds were appropriated in the Department of Human Services Appropriation Bill. The IT program was 100 percent funded by the TANF block grant funds.

The funding supported a variety of IT enhancements for welfare administration. They included enhancing application development and system programming, tracking client eligibility, increasing data storage and collection capability, and implementing software updates and changes. One of the expected results of these investments was the capacity to submit accurate and timely reports that comply with the requirements for Federal data reporting to the US Department of Agriculture (food stamps) and Department of Health and Human Services (Medicaid and TANF). The state has to comply with HIPAA requirements as well.

The information issues are large and complex. The needs of each welfare client may involve many agencies, each with its own personnel, mission, and policies. Each agency involved has its own IT systems, producing many barriers to information sharing and integration. None of the staff in any single department was able to access the complete information about an individual client from existing databases. Therefore, the investments of this project were aimed at creating standard protocols for data exchange, a data warehouse, electronic referral systems, resources directories, and related applications.

Sustainable and coordinated hardware and software development was required to reach these project goals and provide customers with better quality services. The technology supported programs that provide benefits and/or services annually to approximately 20,000 families being served by the Family Investment Program, 53,000 households receiving food stamps, and 204,165 individuals receiving Medicaid benefits (monthly averages).

Project methods

The beginning phase of the project was a system evaluation. The goal was to provide decision makers with a comprehensive understanding of the beginning status quo of the program. This would help avoid wasting resources on system components that were already functioning at a high-level.

The system evaluation was followed by a search for existing software that could be customized to meet project needs and goals. The project planners then explored the possibility of consolidating all the information systems onto a single platform to achieve integration and common access. However, the implementation of consolidation was judged to be too costly and time-consuming, and so was rejected as impractical. In order to retain the value of existing legacy systems and infrastructure investments, the planners chose to use middleware as a more effective approach. They required the middleware software to be based on open standards and to extend existing IT investments. The plan also included replacing and upgrading out-of-date hardware and ensuring that the hardware is capable of supporting the new applications and customized software. Continuous staff training was included as a key requirement.

ROI framework

All IT projects in Iowa agencies are required to prepare ROI material in a standard framework as part of any proposal for new IT investment. The state provides a Web site,[14] supporting materials, and applications for agencies to use when preparing their proposals and ROI analyses. The results reported here are taken from those sources.

[14] http://www2.info.state.ia.us/roi/index.html

The Iowa ROI framework requires attention to certain standard components for all proposals. These include the following.

Analysis requirements. Proposals should include:

- use of the Rapid Economic Justification model[15]—to understand the business, alternative solutions, cost-benefit equations, possible risks, and financial metrics;
- cost and benefit measurements—estimation of project costs and benefits in some comparable unit and determination of whether the benefits exceed the cost; and
- achievement of cost avoidance and dollar matching from state sources.

Software. Proposals should deal with all software components including:

- application software;
- operating system software;
- interfaces to other internal and external systems; and
- standard protocols for data exchange, data warehouses, linking software to third party service providers, electronic referral systems.

Hardware/Facility. Proposals should deal with all physical components including:

- additional platforms that accommodate interoperable operating systems;
- adequate storage and physical environments;
- adequate connectivity and bandwidth;
- logical and physical connectivity; and
- major interfaces to other systems, both internal and external.

ROI results for the Welfare Reform Related Technology Fund

The expected benefits of the project were to enhance organizational coordination and reduce duplicate key-in and paper-work. Table 4 (page 38) is the financial summary for the Welfare Reform Related Technology fund for state fiscal years (SFY) 2001 through 2003. Total project cost (Row A in Table 4, page 38) includes items such as personnel, software, hardware, training, facilities, professional services, supplies, and others. Total annual project benefit for the state (Row B) explains how much the state has benefited from the investment of the technology fund by the avoidance of federal penalties. The magnitude of the return on investment was expected to decrease year-by-year. The likelihood and magnitude of penalties would be largest in the first year or two, and would diminish as the accuracy and efficiency of the system improved with experience and refinements. This is a normal example of the operation of diminishing marginal productivity of an investment over time. At any rate, because of the very large impact of trying to avoid Federal penalties, the ROI percentage remains very large. In addition to the financial returns, the project planners expect benefits resulting from more efficient, effective implementation of changes resulting in improved customer service, increased program accuracy, and readily available information for program and field staff to use in making business decisions.

[15] *http://www.microsoft.com/technet/treeview/default.asp?url=/technet/ittasks/plan/sysplan/wwww.asp*

Table 4. Results of the IOWA ROI Analysis for Three Project Years [16]

	SFY 2001	SFY 2002	SFY 2003
A) Total Project Cost	$ 2,024,768	$ 1,468,324	$ 1,556,016
B) Total Annual Project Benefit for State	$5,631,298,200	$529,600,000	$ 30,920,192
C) Total Annual Project Cost for State	$ 760,300	$ 734,162	$ 778,008
D) Project Funds Requested % from State	37.55%	50%	50%
E) Project Funds Requested from State: (A*D)	$ 760,300	$ 734,162	$ 778,008
F) Benefit/Cost Ratio: (B/C)	7406.7	721.4	39.7
G) ROI: (B-C/ E)%	**740568%**	**72037%**	**3874%**
** Some numbers differ from the original report due to rounding.			

Potential risks in benefit estimates

The benefit figures claimed in this analysis appear to be based on a rather optimistic scenario. The biggest return is cost avoidance due to diminished Federal penalties—a very large decrease between the 2001 and 2002 fiscal years. These penalty levels were very high for SFY 2001 and were expected to drop by over 90 percent in a single year due to the introduction of improved information technology. It is not clear from the available documentation how realistic these penalty reduction estimates were. A footnote to the ROI analysis report for the SFY 2001 project description reads:

"Avoidance benefits include $440,992 food stamp penalties, $5,600,000,000 potential Medicaid related losses, and $29,592,824 TANF penalties. Funding for the TANF penalties will be needed in SFY 2002 ($14,796,412) and in SFY 2003 ($14,796,412) plus Federal Match for food stamps and Medicaid in the amount of $1,264,384. There is additional potential for sanctions due to food stamp error rates. The amount of these sanctions is unknown."

The similar footnote in the FY2002 description contains essentially the same estimates for all the other savings, but the potential Medicaid related losses drop from $5.6 billion to $500 million. This suggests that estimates of this sort are subject to considerable uncertainty and may not be the best basis for an investment decision without additional supporting data.

[16] State of Iowa Return on Investment Program, IT Project Evaluation for Department of Human Services; SFY2001, 2002, 2003; http://www2.info.state.ia.us/ROI/index.html

Such optimistic estimates to justify a project proposal are not unusual. In order to win the resource competition, it is tempting for agencies to assume the worst scenario for not implementing the proposed project, compared to the best case prediction for completing the project. That way agencies can show very dramatic and persuasive returns for reviewers. Decision makers have to find a reasonable balancing point between the two extremes. Related information needed to make more reasonable assumptions may not be available in the proposals, if it is not required. Hence, the evaluation process is usually problematic and critical. In this Iowa Health and Human service case, reviewers might need more detailed information about the process of savings calculation in order to make an accurate judgment. That is, the proposers of a new investment may deliberately skew their calculations to make a stronger case than they could otherwise justify. Reviewers may not be able to detect such deliberate exaggerations or unreasonable assumptions unless they have full information about how calculations were made. ROI calculations are products of social, political, and economic interest that are often in conflict with each other.[17] The complexity behind the numbers and calculation processes should always be part of the overall decision making process.

Resources:

1. State of Iowa Return on Investment Program, IT Project Evaluation for Department of Human Services; SFY2001, 2002, 2003; http://www2.info.state.ia.us/ROI/index.html
2. Welfare Reform, Information Systems, and the States, NASCIO; www.nascio.org/publications/welfare1998
3. Government Technology, Case Studies: Health and Human Services; www.govtech.net/govcenter/solcenter
4. Microsoft's Vision for Technology in Health and Human Resources; www.microsoft.com/business/industry/gov

[17] *William Alonso & Paul Starr (editors),* The Politics of Numbers*. New York: Russell Sage Foundation, 1987*

Appendix C: Case 3
Social ROI

The investment philanthropy approach

This example shows the results of an extensive effort to measure a wide range of social and economic outcomes of different investments in social programs, in this case by a private foundation, The Roberts Enterprise Development Fund. The analysis of returns on the Fund's investment is based on impact-type questions. The Fund invests by making grants to nonprofit, community-based organizations in the San Francisco area for the purpose of "creating social value." The Fund refers to this approach as investment philanthropy:

"Investment Philanthropy... is concerned with the value accrued as the result of charitable investments. Within this perspective, social returns (that is, benefits to society) generated by philanthropic investments are the measure of an investment's success. The critical challenge in Investment Philanthropy is to compare the money invested with the value it creates.[18]"

The Fund decided to evaluate the grants to nonprofit organizations on the basis of the social value created rather than on the goals of the grantee or the apparent merits of the organization's efforts. To do so required the development of methods to define and measure that social value. Since many government programs provide funds for nonprofit organizations and the creation of similar concepts of social value is the goal of most government programs, the methods in this case can be instructive.

The social return on investment method

To implement the investment philanthropy approach, the Fund developed methods for measuring the social return on its investments and created an administrative mechanism to ensure that the analysis and reporting information to assess SROI would be available. The method defines social value in a way that can be measured and provides measurement procedures and analysis techniques. The Fund requires its grantee organizations to prepare and submit SROI reports that provide the results of these analyses to the Fund so that it can evaluate the overall value of its investments.

The SROI method uses a definition of value that covers a continuum from purely economic to purely social, with socioeconomic value in an intermediate position:

Economic ▸ Socioeconomic ▸ Social

Economic value is represented by a financial return on the Fund's investment, reported as increased revenue, asset value, etc., from the grantee's accounting report. This financial return is defined and measured according to the techniques for accounting and demonstrating profit creation that apply in the regular capital markets—i.e., the stock markets and private sector accounting methods. The SROI reports prepared by grantees include detailed financial statements equivalent to those produced by publicly traded companies in the for-profit sector.

[18] *Roberts Enterprise Development Fund. SROI Methodology:* Analyzing the Value of Social Purpose Enterprise Within a Social Return on Investment Framework. *San Francisco: The Fund, 2001, p. 10.*

Socioeconomic value is defined by creating methods to assign money values to social outcomes wherever possible. For example, increased employment opportunity for those who work in grantee organizations is a social value. Socioeconomic value is expressed in part by the increased taxes paid by those employed, as well as by reductions in welfare costs. Another social outcome of employment in grantee organizations, reduced criminal activity, is estimated by comparing arrest and conviction rates for employees with similar segments of the population. Reductions in arrests and convictions are monetized by counting the savings to the society of fewer convictions and incarcerations. An example of the calculations for social cost savings is shown in Table 5.

Table 5. Calculation of Average Social Cost Savings Per[19]

	Total Decrease (Increase) in Annual Visits	x	Cost Per Visit/Use	=	Total Decrease (Increase) in Annual Cost	÷	# of Target Employees Responding to Question	=	Average Cost Savings Per Target Employee
Public Assistance Programs*									
TANF	NA		NA	=	$ -	÷	20	=	$ 0.00
General Assistance	NA		NA	=	$ 300	÷	20	=	$ 15.00
Food Stamps	NA		NA	=	$ 3,362	÷	20	=	$ 168.10
SSI	NA		NA	=	$ 5,004	÷	20	=	$ 250.20
Social Service Programs									
Food Banks	1,050	x	$ 26	=	$ 27,300	÷	20	=	$ 1,365.00
Case Management	980	x	$ 41	=	$ 40,180	÷	20	=	$ 2,363.53
Community Clinics	34	x	$ 86	=	$ 2,924	÷	20	=	$ 146.20
Mental Health Treatment	222	x	$ 176	=	$ 39,072	÷	20	=	$ 1,953.60
Housing Services (shelter, trans, housing, grp home)	1,650	x	$ 62	=	$102,300	÷	20	=	$ 5,115.00
Emergency Room	2	x	$ 211	=	$ 422	÷	20	=	$ 23.44
Legal Services	4	x	$1,029	=	$ 4,116	÷	20	=	$ 228.67
Sustance Abuse Treatment	2	x	$8,060	=	$ 16,120	÷	20	=	$ 806.00
MediCal (includes employee and dependents)	10	x	$3,761	=	$ 37,620	÷	20	=	$ 1,881.00
Criminal Conviction Savings									$ 1,327.43
Average Social Cost Savings Per Employee									$15,643.67

[19] *Roberts Enterprise Development Fund. SROI Methodology:* Analyzing the Value of Social Purpose Enterprise Within a Social Return on Investment Framework. San Francisco: The Fund, 2001, p.32.

Social value is defined as the outcomes for society as a whole that are positive, but cannot legitimately be given monetary value. For these measures, alternative methods are used to generate some useful measure of return in nonmonetary terms. For example, a quality of life survey is part of the data collection method for employees and clients of the grantee organizations (see Figure 6 below).

While such a survey does not yield monetized values for an investment return, it does provide meaningful evidence of some social benefit. It has all the usual limitations of survey research data, but can supply evidence of social value creation that would not be available by other means.

Figure 6 - Survey Sample for Social Return Measurement [20]

How I Feel About My Life

	Strongly Agree	Agree a Little	Neither Agree nor Disagree	Disagree a Little	Strongly Disagree	No Answer
There are a lot of people I like to hang out with.	❑	❑	❑	❑	❑	❑
I like to get together with friends as much as possible.	❑	❑	❑	❑	❑	❑
I have people in my life who really care about what's happening to me.	❑	❑	❑	❑	❑	❑
If for some reason I were put in jail, there are people I could call who would bail me out.	❑	❑	❑	❑	❑	❑
If I were sick or hurt and and I needed someone to take me to the hospital, I would have no trouble finding someone.	❑	❑	❑	❑	❑	❑
If I were hungry and had no money to buy food, there are people I know who would give me food.	❑	❑	❑	❑	❑	❑
If I were in trouble and some people were going to try to hurt me, there are other people I could get protection from.	❑	❑	❑	❑	❑	❑

[20] *Roberts Enterprise Development Fund. SROI Methodology:* Analyzing the Value of Social Purpose Enterprise Within a Social Return on Investment Framework*.* San Francisco: The Fund, 2001, p.72.

Measuring value and returns

The SROI methodology employs six stages. The first three deal with measuring value and the last three deal with the index of return.

- Stage 1: Calculate enterprise value (uses standard accounting value measures).
- Stage 2: Calculate social purpose value (assigns monetary values to social outcomes).
- Stage 3: Calculate blended value
- Stage 4: Calculate enterprise index of return.
- Stage 5: Calculate social purpose index of return.
- Stage 6: Calculate blended index of return.

An example of the overall results of these calculations is shown in Table 6 on page 44.

These return calculations and the supporting material are key components of the SROI reports produced by the grantee organizations on an annual basis. The reports include SROI metrics, business data, social impact data, and provide analysis in these areas. Report contents include:

- descriptions of the social purpose enterprise,
- financial analysis of the social purpose enterprise,
- profiles of the enterprise's target employee population,
- SROI metrics and analysis,
- description of the nonprofit agency and its mission, and
- key social impact findings and analysis.

Overall, the SROI Report can be viewed as a nonprofit organization stock report. It provides a standardized way of estimating value and presenting return calculations in a clear and accessible manner.

Limitations in the SROI approach

Some of the comparative indicators available for evaluating for-profit organizations are not available for this SROI approach. There are no comparable industry ratios and analyses for the nonprofit sector, although research in this sector is growing. In addition, the logic of management in for-profit organizations is different in crucial ways. Profit-maximization strategies are not necessarily useful or productive in the nonprofit sector. Consequently, careful attention should be given to assessing the appropriateness of the standard financial measures to this alternative use.

It is useful to consider the Fund's description of lessons learned over the course of applying the SROI methods.[21]

The SROI analysis process is resource intensive. The average practitioner must be aware of the financial and human resources necessary when conducting an SROI analysis of their social purpose enterprise. Considerable resources were provided to support the work in the grantee organizations.

Engaging the practitioner is essential. This is not a "top down" process. It is imperative that practitioners themselves drive the process of identifying and setting the social indices by which they will assess the value of their life's work and the returns generated by the investments they receive.

[21] *Roberts Enterprise Development Fund. SROI Methodology:* Analyzing the Value of Social Purpose Enterprise Within a Social Return on Investment Framework*.* San Francisco: The Fund, 2001, p.62

Table 6. Social Return on Investment Results [22]

SROI Results		
		1999
SROI Metrics		**Index of Return**
Enterprise Value	$411,906	0.93
Social Purpose Value	$20,861,055	47.14
Blended Value	**$21,222,960**	**47.96**

Investment to Date	$442,543

Social Purpose Results (Per Target Employee)	1999
Public Savings	$15,644
New Taxes	$1,815
Wage Improvement	$12,097
Financial Improvement	$9,849

Enterprise Financials	1998	1999	2000P
Sales	$233,004	$537,789	$708,957
Gross Margin	70%	69%	65%
Operating Margin (Before S&S)	5%	-4%	-4%
Operating Margin (After S&S)	82%	10%	0%

Projected Values	(1999 into Perpetuity)
Total Projected Investment	$575,775
Total Projected Social Savings and New Taxes	$22,434,361
Total Projected Social Expenses	$1,573,306
Total Projected Contribution to Parent	$0

[22] *Sample SROI results accessed from Roberts Enterprise Development Fund's Website at www.redf.org/pub_sroi.htm#methodology.*

Appendix D
Additional Resources

Enterprise architecture

Enterprise Architecture Development Tool-Kit, Version 2, National Association of State Chief Information Officers, July 2002. https://www.nascio.org/hotIssues/EA/.

The Business Reference Model, Version 1.1, Federal Enterprise Architecture Program Management Office, 2002. http://www.feapmo.gov/feaBrm.htm.

State-specific Enterprise Architecture initiatives
- Connecticut: http://www.doit.state.ct.us/policy/domain/index.htm
- Kentucky: http://www.state.ky.us/kirm/arcstand.htm
- North Dakota: http://www.state.nd.us/ea/

Stakeholder analysis

Making Smart IT Choices. Center for Technology in Government. University at Albany-SUNY. http://www.ctg.albany.edu/resources/abstract/absmartit.html.

John M. Bryson. *Strategic Planning for Public and Nonprofit Organizations, Rev. Ed.* San Francisco: Jossey-Bass, 1995.

Business process analysis and modeling

Business Process Resource Center, University of Warwick, UK
http://bprc.warwick.ac.uk/umist1.html, http://bprc.warwick.ac.uk/index.html#BPRCTOP.

The Workflow Handbook 2002. Published in association with the Workflow Management Coalition (WfMC) Edited by Layna Fischer. March 2002, 428 pages. ISBN 0-9703509-2-9.

Workflow And Reengineering International Association http://www.waria.com.

Workflow/BRP application vendors: http://www.waria.com/databases/wfvendors-A-L.htm.

Business Process Management Journal: http://www.emeraldinsight.com/bpmj.htm.

Formal modeling

Agent-based modeling

Center for Computational Analysis of Social and Organizational Systems
http://www.casos.ece.cmu.edu/home_frame.html.

Gaylord, R.J. and D'Andria, L. (1998), Simulating Society: A MATHEMATICA Toolkit for Modelling Socioeconomic Behavior. Springer: New York, NY.

Ilgen, D. R., & Hulin, C. L. (Eds.) (2000). Computational modeling of behavior in organizations: The third scientific discipline. Washington, DC: American Psychological Association.

Michael J. Prietula, Kathleen M. Carley & Les Gasser (Eds.), (1998) Simulating Organizations: Computational Models of Institutions and Groups, Menlo Park, CA: AAAI Press/The MIT Press.

Thomas Schelling, "Dynamic Models of Segregation," *Journal of Mathematical Sociology* 1 (1971), 143-186.

Thomas Schelling, Micromotives and Macrobehavior. New York: WW Norton & Co. Inc., 1978.

UML modeling

Object Management Group. *OMG Unified Modeling Language Specification, Version 1.3*. Framingham, MA: OMG Headquarters, 1999.

Doug Rosenberg, Kendall Scott (Contributor). *Use Case Driven Object Modeling With UML: A Practical Approach (Addison Wesley Object Technology Series)*. New York: Addison-Wesley, 1999.

Workflow modeling

Thomas W. Malone, et al. Tools for inventing organizations: Toward a handbook of organizational processes. *Management Science* 45(3) pp 425-443, March, 1999.

MIT Sloan School Center for Coordination Science. http://ccs.mit.edu.

Workflow Management Coalition. http://www.wfmc.org.

INSEAD Workflow Site.
http://www.insead.fr/CALT/Encyclopedia/ComputerSciences/Groupware/Workflow/.

Operations research

Michael Trick's Operations Research Page. http://mat.gsia.cmu.edu/
INFORMS: Home Page: Institute for Operations Research and the Management Sciences. www.informs.org/.

Operations Research Society. www.mors.org/.

MIT, Operations Research Center. http://Web.mit.edu/orc/www/.