Making Smart IT Choices

A Handbook

Center for Technology in Government

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September 1996

Sharon S. Dawes
Kristine L. Kelly
David F. Andersen
Peter A. Bloniarz
Anthony M. Cresswell
Thomas J. Galvin, Editor

This report was made possible by a grant from the Ford Foundation.

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Center for Technology in Government
University at Albany
Albany, NY 12222

phone: (518) 442-3892
fax: (518) 442-3886
email: info@ctg.albany.edu
www.ctg.albany.edu

Introduction

This handbook is designed to help you and your organization to work through the complex and challenging process of analyzing an information problem or need, identifying and evaluating possible technology-based solutions, and ultimately selecting the information technology or combination of technologies that will respond to the need in the most cost-effective and satisfactory way. The book was produced by a group of six University at Albany faculty and research staff who are associated with the University's Center for Technology in Government.

Established in 1993, the Center pursues innovative ways of applying computing and communications technologies to the practical problems of information management and service delivery in the public sector. Its focus is on using information technology to increase productivity, reduce costs, increase coordination, and enhance the quality of government operations and public services. Its work is project-centered, and emphasizes the formation of effective system development partnerships among government agencies, the University, and the private sector.

This handbook offers a detailed approach to information technology project planning. It begins with a consideration of the special characteristics of the public sector as an environment for making management decisions and information technology choices. Next, we describe nine evaluation products, culminating in final problem analysis and choice of an optimal IT solution to an information problem or need. Chapter 3 presents nine proven evaluation methods that can be employed in combination to realize the critical products that are essential to sound decision making. Chapter 4 illustrates a variety of actual uses of these evaluation products and methods in the context of three recent Center projects, which are presented as case studies, and represent agencies of different size and character, with widely varied missions. The concluding chapter offers a number of exercises designed to enhance the reader's ability to apply the methods and create the evaluation products that are the book's central focus.

In introducing this array of evaluation products and methods, each subsection follows a consistent pattern, explaining in turn what the product or method is, its value, some of its major limitations, and where to find more information. For some of the less familiar techniques, such as modeling and simulation, the presentation offers step-by-step guidance through the process.

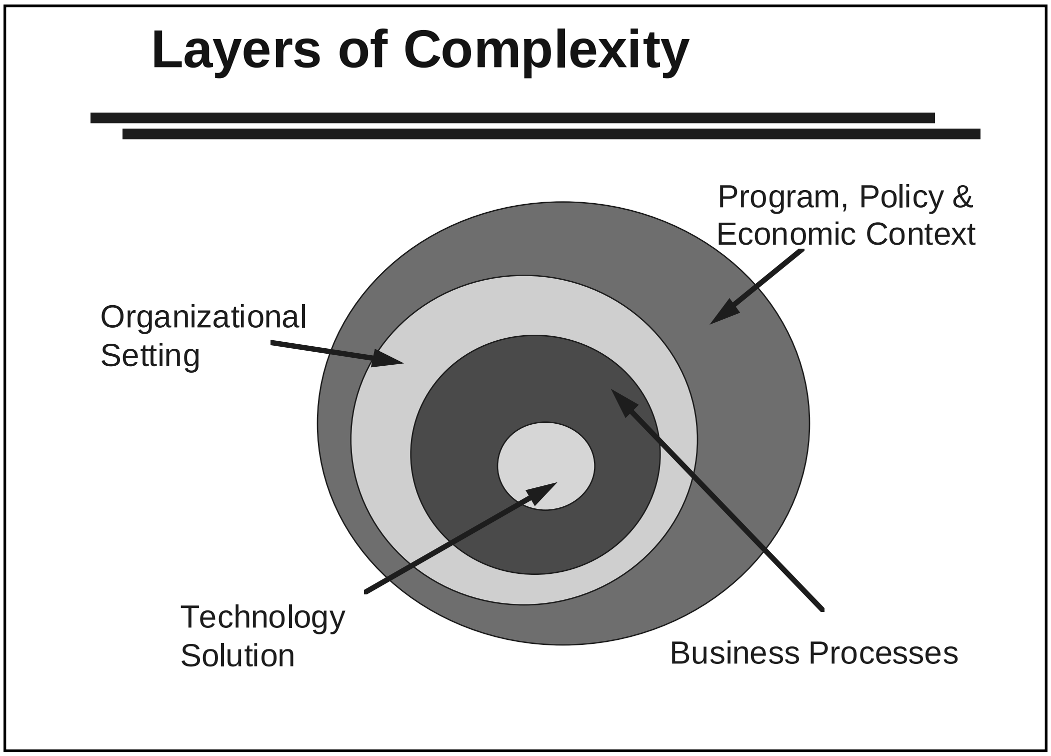
This handbook was designed to support tutorials and group workshops offered by the Center for managers and staff of government agencies. It can, however, also be used independently as a guide to proven methods of analysis by any group of agency personnel who must address and resolve an information-related problem.

Astute public managers do not need to be cautioned about the risks associated with information technology choices and commitments in government today. A recent study by the Standish Group of both public and private sector organizations in the United States reports that "one third of all [information] systems development projects are canceled before they are ever completed," and that "only sixteen percent of all IT projects were considered successful." Yet the return on taxpayer investment in well planned, soundly executed information systems development projects can be phenomenal in terms of the enhanced capacity of government agencies to provide more and better service to more citizens, often at lower transaction costs.

No formula can guarantee success in developing and implementing a new IT application. But this handbook does offer a tested approach to reducing the risk of failure. One key is to apply the familiar first principle of modern architecture — that form follows function. The initial focus of IT systems planning needs to be on the underlying business processes and service objectives of the organization, rather than on the technology itself. The best technology will not correct bad management practices or poorly designed business processes. A second principle of sound planning is to carefully and creatively identify all of the stakeholders, both within and outside the agency, and to understand clearly the different system performance expectations of each stakeholder group. Each stakeholder group needs to be taken into account in identifying and considering IT options in terms of the costs and potential benefits. Modeling, system simulations, and especially rapid, small scale prototyping are among several techniques described in this handbook that are useful in making the best choice among an ever-expanding array of IT options and potential combinations, as well as in anticipating problems in advance of full-scale implementation of a new system. One important lesson that can be learned from the experiences of the organizations that are the subjects of the case studies in Chapter 4 is that there are often options that lie between "all or nothing," and that the most cost-effective solution to a service problem or need is not necessarily to install the most sophisticated electronic information technology. Finally, a sound IT project plan will incorporate within it specific, objective, system performance measures as a basis for ultimate project evaluation.

We acknowledge with thanks the active collaboration of the state and local government agency managers and technical staff who have participated as full partners in the Center's projects. Without their willingness to open their programs to study, to experiment with new approaches to problem analysis, and their strong commitment to improving government services through creative IT innovation, the work that we describe here could not have been accomplished. We hope that by sharing the experience of the Center for Technology in Government and its agency clients through this handbook, other public sector and governmental organizations that are trying to address similar information problems and needs will be empowered to make better technology decisions and sounder, smarter IT choices.

Chapter 1. Overview: Why Evaluate IT Choices?



Why evaluate information technology (IT) choices? Because IT innovation is risky business in every organization. Organizations of all kinds abandon IT projects because they fail to accomplish the objectives they were intended to meet. In both the public and private sectors, IT innovation is limited by several common risk factors. Government seems to have even more trouble than the private sector in successfully applying new technology. The public policy choices and public management processes that are part of government make it an especially difficult environment for IT managers. This environment adds several risks that are unique to the public sector. These layers of complexity present a daunting challenge to public managers who are responsible for choosing, funding, and building IT innovations.

Risks Inherent in the Public Sector Environment

- ❑ **Extreme risk aversion**

Government's business is public business. This means that most new ideas have to be implemented in full public view. An innovation-gone-wrong risks not only dollars, but the credibility of an agency and its leadership with legislators, executive officials, and the public. It's not surprising that government tends to rely on the "tried and true."

- ❑ **Divided authority over decisions**

Executive agency managers do not have a clear line of authority over agency operations. Their decisions are circumscribed by existing law, the limits of current appropriations, a civil service system, other political constraints, and a variety of procedures mandated by both legislatures and the courts. These restrictions do not blend well with the complexities of managing a multi-million dollar IT project in a rapidly changing technical environment.

- ❑ **Multiple stakeholders**

Government programs are characterized by a multiplicity of stakeholders who often have competing goals. Customers, constituents, taxpayers, service providers, elected officials, professional staff, and others all have some stake in most programs. Understanding how different choices may affect each stakeholder group helps to prevent unexpected problems.

- ❑ **One year budgets**

Since most government budgets are handled on an annual cycle, uncertainty about the size and availability of future resources weakens the ability of government agencies to adopt new IT innovations successfully.

❑ **Highly regulated procurement**

Most decisions to adopt emerging technologies are made through the traditional competitive bidding process, a one-shot technique that is ill suited to the experimentation and learning that should appropriately accompany such large investments. While the goals of competitive procurement are goals of integrity and fairness, the processes are often a source of problems and delays, especially when agencies write requests for proposals (RFPs) that depend on the limited information they have been able to gain from inadequate experience and research.

❑ **Many links between programs and organizations**

Few government programs stand entirely on their own. Most are connected in some way to other programs in the same or other agencies, or with non-governmental entities. Sometimes the connections are explicit and formal. Often they are informal or unintended. Changing one program often means that some other program will be affected.

Organizational Risk Factors

❑ **Lack of alignment between organizational goals and system objectives**

The goal of IT adoption should be to enhance or improve an organization's ability to carry out its main mission or business objectives. It should improve customer service, reduce inventories, speed production, increase revenue, prevent errors, or reduce costs. An IT organization that becomes enamored of a database or office automation project without understanding how real people use information to accomplish real work is setting itself up for failure.

❑ **Lack of organizational understanding, support and acceptance**

Much has been written about the critical importance of top management support for a technology initiative. But support and acceptance throughout the organization, especially among the people who will use the technology or its products, is equally important, and often more difficult to achieve.

Risks Associated with the Work to be Done

❑ **Failure to evaluate and redesign business processes**

Meeting the needs of customers, employees, and decision makers means carefully analyzing, evaluating, and improving business processes. The analysis needs to include information flow and work flow. Analysts need to separate the value-added steps from the ones that simply add time and expense to a process. Without this initial process redesign step, 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.

Risks Associated with Technology

❑ **Failure to understand the strengths and limitations of new technology**

Information technology is constantly changing and improving. No one is able to keep up with the details of new developments or to understand comprehensively how each new technical tool works. There are many technology choices for most jobs and these need to be evaluated. Add to this the fact that most new technologies must work in tandem with others, or must be incorporated into existing older systems, and the potential for trouble mounts rapidly.

In short, government managers need to evaluate IT choices because these are among the most complex and expensive decisions they are expected to make.

There are three ways to mitigate the risks inherent in these complex decisions:

- thoroughly understand the problem to be solved and its context
- identify and test possible solutions to the problem
- evaluate the results of those tests against your service and performance goals

This handbook is devoted to helping you to understand and carry out these three critical tasks. It is designed to help any government manager follow a well-tested methodology for evaluating IT innovations before deciding (with greater confidence) to make a significant investment.

Overview of Evaluation Products and Methods

It is a well-established principle in IT management that successful applications of technology flow from aligning the technology with the programmatic objectives of an organization. Often technology enables the creation of new products and new processes that are substantial improvements in terms of quality and cost over other ways of doing the job. In order to reap the benefits of such strategic technology applications, it is necessary to take a comprehensive look at the technology and the environment where it will be applied. The purpose of this handbook is to present to you a suite of tools and products that can be used to gain such a holistic perspective on a proposed application.

The methodology presented in this handbook includes nine evaluation products that can be developed using several combinations of nine evaluation methods. The products can each be achieved by more than one approach or method. They are not a prescribed set of ordered steps because they can be, and often are, used iteratively. You will often learn something in one activity that will lead you to return to an earlier one in order to improve your evaluation.

Some of the tools are well within the skills of any competent manager. Others require the help of an expert. Some evaluation activities are critical in every situation. (Fortunately, these are the less expensive and time-consuming ones.) Others are optional depending on your needs and resources. Most of the evaluation activities are accompanied in this handbook by an illustrative example and/or an exercise to help you learn to use it. We also guide you in many cases to sources for more information.

None of the products and methods described in the handbook is a new invention. Each has been used countless times by competent managers in evaluating proposed projects both in information technology and more generally. What is unique about the approach suggested in this handbook is the synergistic effect of combining these techniques and products into a powerful analytic method. By using a series of different tools, each individual tool builds on the perspective gained from earlier steps in the evaluation, and provides additional insight more powerful than if used alone. The result is a multi-faceted analysis of the proposed project that has a high likelihood of accurately predicting success.

Overview of Case Examples

Throughout this handbook we will refer to three case studies to illustrate the use of these evaluation tools. All are based on real projects conducted at the Center for Technology in Government (CTG) during 1993-96. The first case is about the Adirondack Park Agency (APA) and its need to manage information and improve customer service related to land use permits. The second is about the Office of Regulatory and Management Assistance (ORMA, now the Governor's Office of Regulatory Reform) and its quest to provide entrepreneurs with information about permits needed to start or expand a business venture. The third is the Internet Services Testbed project which involved seven state and local government agencies in a process of defining, designing, and building information services on the World Wide Web. All three projects were successfully concluded with formal evaluation data that helped these agencies to make "smart IT choices." The cases are summarized very briefly here and described more fully in Chapter 4.

Case 1: An Electronic Reference Desk for the APA

Program Mission: balance economic development and environmental protection in the 6 million acre Adirondack Park; administer a statutorily defined permitting process for development projects on privately owned land

Problem: inability to respond in a timely manner to requests for jurisdiction and permits; rapidly growing data stores in a variety of physical formats

Technologies Used: GIS, document imaging

Evaluation Concepts Illustrated:

- Stakeholder analysis using group decision conference
- Prototype of a geographic information and document imaging system
- Cost and performance measures development using group decision conference

Case 2: A Voice Response System for ORMA

Program Mission: help entrepreneurs identify and complete the permits needed to begin or expand a business

Problem: only 16% of calls being handled by the current telephone assistance system

Technologies Used: speaker-independent voice response system

Evaluation Concepts Illustrated:

- Measuring costs and benefits using group decision conference
- A process model of the business permits problem
- A simulation model of potential solutions
- Measuring system performance with an experiment

Case 3: Internet Services Testbed

Program Mission: seven agencies seeking to develop and deliver services on the World Wide Web

Problem: little experience, new technologies, uncertainty about costs and benefits

Technologies Used: Internet protocols, hypertext, email, graphics, multi-media

Evaluation Concepts Illustrated:

- Strategic framework using group decision conference
- Finding best practices through electronic Internet searches
- Assessing performance barriers with a survey

Organizing Framework

The products, methods, case examples, and exercises are summarized in the table below. This is the framework for the rest of the handbook.

Organizing Framework for Making Smart IT Choices			
Why?	**Understand the problem & its context**	**Identify & test solutions**	**Evaluate results & make smart choices**
What?	♦ Stakeholder analysis ♦ Strategic framework ♦ Models of problems	♦ Best practices research ♦ Models of solutions ♦ Prototypes of systems	♦ Cost & performance measures ♦ Final analysis & choices
How?	♦ Group decision conferences ♦ Interviews ♦ Surveys ♦ System simulations	♦ Group decision conferences ♦ Literature reviews ♦ Prototype development-Interviews ♦ Surveys ♦ System simulations ♦ Technology awareness	♦ Group decision conferences ♦ Interviews ♦ Surveys ♦ Experiments
Cases and Examples	♦ APA stakeholder analysis ♦ ORMA process model ♦ Internet services strategic framework	♦ APA prototype ♦ ORMA group decision conference ♦ ORMA simulation model ♦ Internet services best practices	♦ APA cost-performance measures ♦ ORMA experiment ♦ Internet services survey
Exercises	♦ Strategic framework ♦ Model of a problem	♦ Process model ♦ Prototype	♦ Interviews ♦ Surveys ♦ Experiments

Chapter 2. Evaluation Products

In this chapter, we describe nine different evaluation products that can contribute to defining a problem, identifying and testing possible solutions, and making a sound choice among possible different information technology options. As the summary indicates, most are critical to problem analysis and solution.

Evaluation Products	Critical or optional?	Example
stakeholder analysis	critical	APA
strategic framework	critical	INTERNET
models of problems	critical	ORMA
best practices research	critical	INTERNET
models of solutions	optional	ORMA
prototypes	optional	APA
cost & performance measures	critical	APA, ORMA
final analysis & choices	critical	APA, ORMA

Stakeholder Analysis

Too often, information system projects are defined in terms of only one stakeholder — the agency that will build it. This can result in a very myopic view of the costs, benefits, and other effects of the project. More often a project will be defined in terms of two stakeholders — the agency and the direct customer of the service. This is better, but still ignores a whole host of other factors that can impinge on the final result. There are many stakeholders in the environment of a government program, and most innovative information systems have multiple features or products that will affect these different stakeholders in different ways. Some will see increased access to services, or better quality service. Others may experience higher costs or more competition for scarce resources. In short, some will win and some may lose, and it is important to try to anticipate these effects before a full-blown system development project gets underway. A stakeholder analysis is a simple evaluation product that gives system planners and reviewers a rough, but fairly robust, picture of how a proposed system might affect the variety of customers and other players. A stakeholder analysis can be prepared by one knowledgeable person and then reviewed and refined by others. It can also be prepared in a facilitated group decision conference, where consensus decisions are made about impacts and estimates.

❑ What Is It?

A structured analysis of the main logic of a program or systems initiative. Objects of analysis fall into two groups: stakeholders and features of the innovation. The first group includes all kinds of stakeholders, including direct customers, units of government, and others who will be affected in any significant way by a program initiative.

A programmatic assessment. The analysis seeks to identify the effect each product or feature will have on each stakeholder group. Which will benefit, which will be hurt? In what ways?

A business case. By attempting to quantify these effects, you can begin to understand what kinds of investments might lead to different outcomes. At a minimum, you should be able to understand how far you have to go before you really understand these effects.

❑ What Is It Good For?

Specifying the possible results of an innovation. What, specificallly, do you expect a program or systems initiative to achieve? The stakeholder analysis forces you to be specific about how various elements of a proposal will affect customers and other stakeholder groups. It helps you move from very general descriptions to more specific and measureable ones.

Understanding the external environment of an agency or program. Most organizations are better at understanding internal dynamics than external ones. The stakeholder analysis pays little or no attention to the internal dimension and forces you to look outside your organizational boundaries to estimate the impacts and outcomes of a new initiative.

Discriminating among stakeholder groups. You should be able to specify how your initiative will affect different stakeholders and estimate the magnitude of those effects.

Identifying the highest priority combinations of features and stakeholders. Once you understand the different ways that your proposal will affect different stakeholders, you should be able to see which areas are the ones that should receive priority attention.

Making a rough assessment of data available and data needed for a more complete evaluation. You will seldom be able to quantify all effects. Often even baseline data will be unavailable. The stakeholder analysis helps you see where your data is weak.

Choosing a "good" problem. A "good" problem is one worth the time, effort, capital, and commitment it takes to solve it. Good problems may have a number of uncertainties about them, but their main components should be readily understood. They should not be too narrowly constructed (this makes you tend to leave out important factors), nor so broadly defined that they are far beyond your ability (in terms of skills, resources, or authority) to influence or solve.

❑ Some Limitations

Makes assumptions about causal relationships and processes. Since you have imperfect data, you need to make some educated guesses about what causes or influences what. Keep testing these assumptions as your project proceeds.

Mixes qualitative and quantitative impacts. Not every effect can be reduced to a number. Sometimes qualitative measures are the only ones that make sense. The stakeholder analysis allows for both, but don't take the lazy way out by stating an unmeasurable qualitative measure, when a quantitative one would be better.

Does not gather or generate enough data to draw solid conclusions. This is a first cut analysis to give you a rough understanding of an issue or objective. If done well, it will gather and generate some useful information, but it won't carry the weight of an entire project. You need to delve deeper. Some of the other tools presented in this chapter help you do that.

❑ How to Complete a Stakeholder Analysis

Stakeholder Analysis

Project:____

Agency:____

	Stakeholders								
	Direct Customers			Units of Government			Other Stakeholders		
Products & Features									

Codes used in the cells to indicate the effect of a product or feature on a stakeholder: IQ- Improve Quality; IA - Increase Access; EP- Enhance Productivity; GS - Generate Savings; GR - Generate Revenue; EB- Extended Benefit

To complete a stakeholder analysis, take these steps:

1. Enter the system features or expected products in the first column of a spreadsheet like the one illustrated above.

2. Enter the names of the key stakeholder groups at the top of the remaining columns.

3. In each cell where a stakeholder will be impacted by a product or feature, enter a descriptive phrase and one or more of the following codes:

    - IQ: improves the quality of services to that stakeholder
    - IA: increases access to services for that stakeholder
    - EP: enhances the productivity of that stakeholder
    - GS: generates savings for that stakeholder
    - GR: generates revenue for that stakeholder
    - EB: offers an extended benefit to that stakeholder (e.g. creates a new service)

4. Note: If any of the impacts is negative (e.g. generates new or higher costs rather than savings), place the corresponding positive code in parentheses. For example, if a system feature will generate higher costs for stakeholder A, show the code this way: (GS)

5. Based on your understanding of the importance of each stakeholder, and any other assumptions (be sure to state them explicitly), select the five highest priority cells. These are the areas where you expect your investment to yield the greatest return (or loss) or have the greatest positive (or negative) programmatic impact.

6. For each high priority cell, describe the impact in a word formula. Then translate each of your formulas into quantitative terms (e.g., number of transactions per year x time saved per request x hourly salary & benefits per employee=salary savings). If the data needed to make the estimate is unavailable, describe the missing data and explain how it would be used if collected. If only a qualitative impact can be described, describe it briefly. If you need more data, decide how you will get it. If you had to make more assumptions, be sure to add them to the list you started in step 5.

7. Continue to refine your estimates as you acquire better data.

8. Your final product includes:
   - a completed matrix,
   - a statement of assumptions,
   - a set of quantitative impact estimates,
   - a set of qualitative impact estimates, and
   - a statement of unavailable data and how you accounted for it.

❑ For More Information

See Chapter 4, Case 1, Example 1A for a stakeholder analysis for the Adirondack Park Agency.

Strategic Framework

A strategic framework is another structured way to understand a project proposal. Like the stakeholder analysis, the strategic framework considers customers and other stakeholders. But it also helps you to identify resources, partners, and innovations that might help you achieve project goals. To be most effective, the strategic framework should work with one project-specific objective at a time. Strategic frameworks can be devised by one person and then presented to and reviewed by others, or they can be created through a facilitated group decision conference.

❑ What Is It?

An analysis of the internal and external factors that a public organization must consider to achieve a program or service objective. A strategic framework leads you to an initial identification of potential resources including partners and to a closer look at potential uses for information technology and other innovations.

❑ What Is It Good For?

Taking a high-level view. The framework lays out the full array of internal and environmental factors that can support a particular service objective by:

- Identifying potential partners to help achieve those objectives
- Identifying information and other resources that will be needed
- Identifying innovative products and services that might be relevant
- Getting more specific about the customers of the service

Thinking "outside the box." Its focus on resources, partners, and innovations pushes you to think more broadly about what is possible.

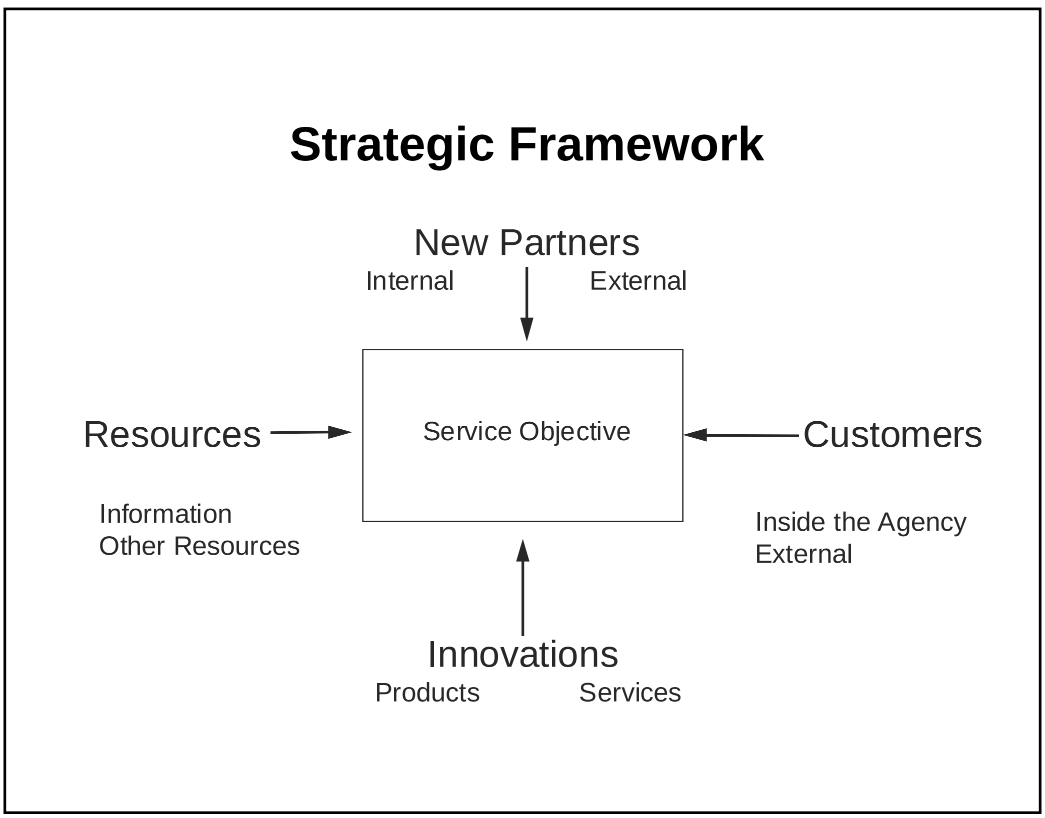
Refining objectives in light of what the environment has to offer. Understanding your environment better may lead you to narrow, sharpen, or expand your service objectives.

❑ Some Limitations

Focuses on "enablers," but ignores barriers. You are more likely to identify barriers through modelling, prototyping, and best practice reviews.

Lacks the detail needed to craft a project plan or design a system. Most importantly, this tool does not deal directly with the availability or cost of identified innovations, resources, or partners. It focuses your attention on what is possible rather than what is practical.

❑ How To Construct a Strategic Framework



Complete a strategic framework by following these steps:

1. State your service objective as clearly as possible in the center box. If you have more than one objective, create more than one framework.

2. Then fill in the factors that are important in achieving that objective.

   - Who are or will be the customers of the service? Are they external, internal, or both?
   - What information and other resources (human, material, financial, political) will you need?
   - What innovative service approaches, technologies, or other products might be useful?
   - Who might be your partners in this endeavor?
   Note that the same people or organizations can appear several times in different roles (a customer might also be a resource supplier, for example).

3. Look at the results and ask yourself the following questions:

   - Who needs to be on the development team?
   - Do we have or can we get the required resources?
   - Is there a good match between our customers' capabilities and the technologies we propose to use?
   - How will we engage in partnerships?
   - Have we pushed ourselves to think broadly about each factor, or are we staying with what we already know best?
   - Does this picture make sense?

4. Based on your answers, refine your approach and decide when and how to proceed with your project.

❑ For More Information

See Chapter 4, Case 3, Example 3A for a completed strategic framework for the Internet Services Testbed project, and Exercise 1, Using a Strategic Framework to Define a Problem.

See also David F. Andersen, Salvatore Belardo, and Sharon S. Dawes, "Strategic Frameworks for IT Innovation in the Public Sector," Public Productivity and Management Review, XVII (4), Summer, 1994.

Models of Problems

A common outcome of an IT systems development project is that after the system is designed, built, and installed, management discovers that it solves only a part of the initial problem or that the problem was poorly understood to begin with. This can occur because different stakeholders identified in the initial stakeholder analysis can have differing mental models or images of what the problems are and how they should be remedied. A formal model of the problem makes these implicit mental models clear by creating a small scale simplification of the problem being addressed, usually in the form of a system diagram, a set of equations, or a computer model (the simplest of these can be a spreadsheet model), that can be manipulated to do "what if" analyses.

A key feature of these models is that they embody a collective vision of the problem to be solved that is distinct from the mental models and perceptions of any of the individual stakeholders. Sometimes this external vision may be a diagram of how clients or services flow through the system, a PERT chart that shows estimated times to complete a series of tasks, or a process map that shows the many steps involved in a complex business operation. In all of these examples, key stakeholders can see how their own assumptions and views of the problem fit into a larger view that is shared by all of the stakeholders.

Another important feature of models is that they can be related to measurable outcomes in the system being studied. Indeed, a good model can reproduce, within its own flow chart or equations, the essence of the problem that needs to be solved. Being able to represent a problem in a formal model is an assurance that the problem is understood well enough to begin investing resources in framing, testing, and evaluating solutions.

❑ What Are They?

A formal model of a problem is not one single thing. Rather it is a collection of products that work together to create a precise description of a problem to be solved. Although there are many different types of formal models, most of them share a number of common features including:

Verbal accounts or "stories" of how the system being studied works and what is wrong with it. These accounts typically reflect many different points of view. They can be gathered either through a group process or individual interviews.

Lists of proposed solutions. Ironically, many managers define problems in terms of their solution (e.g., "the problem is that we need more memory on the mainframe"). By collecting lists of what managers think the solutions ought to be, the problems implicit in those solutions can be defined more clearly.

Common pictures of the service delivery system that needs fixing. These pictures are based on the verbal accounts and usually take the form of structured system flow or business process maps.

Numbers and other measures of key variables. Because models should be able to reproduce problems, they need to be explicit about which measurements are key indicators of the problem.

Analyses of logical or causal forces that produce the problem. These logical reasons for a problem, often manifest in the common picture of the system, can be extracted from the verbal accounts of the system, and lead to measures of system performance that reproduce the problem.

Equations or computer simulations that tie it all together. These can be as simple as a spreadsheet or as complicated as a system simulation with hundreds of active equations. But in each case, the equations operationalize the logic of the flow chart and show the consequences of assumptions (often over time). Sometimes, models can be run to make predictions about the present or future state of the service delivery system under various conditions. These quantitative predictions can then be compared to actual measures of current system performance.

❑ What Are They Good For?

Making the implicit explicit. Modeling makes individual managers' implicit assumptions and mental pictures explicit and open for discussion.

Inhibiting prematurely jumping to a solution. Models impose a structure on a team's thinking about a problem that helps prevent premature conclusions.

Creating an commonly understood, externalized definition of the problem. This can serve as a focus of discussion and can help to align thinking about what the root causes of observed problems are.

Forcing managers and analysts to come to grips with the precise logic or causal forces that underlie a problem. It's often very hard to get a model to reproduce an observed problem.

Calling the question on how to measure a problem. Modeling pushes the team to identify which key performance variables really count.

Enabling managers and analysts to do "what if" analyses. Models help participants see how problems get better or worse under different sets of possible circumstances.

Communicating with external audiences. Allowing managers analyzing a problem to communicate their reasoning effectively and efficiently to external audiences who need to be involved in solving the problem.

Enhancing collective understanding about where the problem comes from and what are possible paths toward a solution. This is accomplished by tying together implicit assumptions about how the system works together with explicit measurements of system performance and with formal structured analysis.

❑ Some Limitations

Models are expensive and time consuming to build. Some approaches to modeling a problem (or its solution) may require specialized knowledge and techniques that are hard to find or expensive to apply to a problem.

Level of complexity. Sometimes the models themselves can get so complicated that they cannot easily be understood. Overly complex models don't help to illuminate the core of a problem. Sometimes the models are too simple and fail to capture the full complexity of a problem under study.

Bias. Sometimes the modeling approach that a team chooses has a subtle and biasing effect on how they will look at the problem. For example, spreadsheet models emphasize the financial aspects of a problem, whereas stock-and-flow models tend to look at client flow and outcome features.

Validity. Models can be wrong. When this happens, you have a whole group of people aligned around a view of the problem that won't yield solutions. Fortunately, this probably occurs less often with models than without them.

❑ How to Get Started on Modeling a Problem

Because there are so many different approaches to modeling a problem, there is no single way of getting started that always works. However, a number of common sense steps can get you far enough down the path to decide whether you can finish a problem-centered model yourself, or need to call in some expert help.

1. Gather Points of View. The first step in almost any modeling effort follows directly from the stakeholder or strategic framework analysis just described. These formal products of analysis identify key stakeholders, products, and often barriers to problem solution. Using interviews or a structured group process, a modeling project begins by getting key stakeholders' points of view out on paper (or on flip charts or white boards).

2. Create a Common View of the Problem. An early step in most modeling processes is the creation of a system flow diagram, business process map, or some other explicit picture that captures the essence of many points of view in a common vocabulary, usually involving use of icons or symbols. Most modern modeling software packages have these icon sets built into a conceptual "front end," and can be used directly by managers to construct this initial common view of a problem. In addition, there are group techniques that allow modelers to interact directly with groups of managers.

3. Use the Common View to Decide What's Important. Once a common view (often a diagram) of the problem has been constructed, use it to elicit discussion about what is and is not important in the system. These discussions help a group agree on key performance metrics for a proposed service delivery system. Different measures may be important for different customers and stakeholders in the system.

4. Get Some Numbers. Much of the problem definition to this point has been a largely qualitative discussion of how the service delivery system works, what is important, and what various stakeholder's assumptions are. Now is the time to get some numbers to help tie the emerging model back to the real system. Getting numbers can be as easy as using group process and expert judgment to calibrate key variables in the system or as complex as using extensive surveys, interviews, experiments, and data analysis exercises to measure critical aspects of system performance.

5. Do "What If" Analyses to Test the Robustness of Your Emerging Model. Once you have a common view of the problem tied to some preliminary numbers, you can begin to test the model by changing some of the numbers to see what those changes would do to the overall service delivery system. For example, you can

make an extreme change in some resource available to the system to see if it really matters — hire a thousand operators in the model to see what it does to customer response time, fire all the operators in the model to see what that does, etc.

6. Decide Whether You Need to Contact a Modeling Expert. You can find yourself down one of two paths after you have created a common view, gathered some numbers, and started to manipulate them. If you and your team have arrived at a coherent and complete view of the problem you need to solve, and if the model you have developed seems adequate, then proceed toward designing a solution. If, however, your preliminary analyses are turning up questions that lack answers, if members of the team are arguing about the details of the model, or if a clearly defined problem is not emerging, then you may need to enlist the help of someone with more experience in modeling problems. You may have hit upon one of the many complex issues in the public sector that requires detailed analysis at the early problem-finding stage.

❑ For More Information

For a more detailed discussion of approaches to modeling a problem, see Edith Stokey and Richard Zeckhauser, A Primer for Policy Analysis (Norton, 1978). Chapter 2 is a quick and neat discussion of models in general. Chapters 4 through 12 outline briefly nine popular types of models frequently used in the public sector.

For an example of how the six steps for getting started on a model of a problem work, see Exercise 2, Using a Model to Define a Problem. Case 2, Example 2B illustrates the use of a process model for problem definition.

Best Practices Research

It is often the case that problems being addressed in a project have been dealt with, in whole or in part, by other government agencies, private and non-profit organizations, or academic researchers. Identification and evaluation of the solutions developed by these other organizations or individuals is an important early step in project planning. There is an abundance of information and expertise in the IT community, as well as elsewhere in the public sector, that can contribute to solving problems that are common to similar organizations. In particular, there is a lot to learn from those cases where things did not go as well as expected. Best practices research involves learning both what works and what does not work, based on the relevant experience of others.

❑ What Is It?

An organized attempt to learn from the experiences of others. Best practices research may take many different forms, but the ultimate goals are the same — to learn from the experience of others and to avoid "recreating the wheel" or replicating mistakes that others have made. Best practices research should be conducted during the start-up phase and continued over the life of the project. It involves the identification and consideration of various solutions to the problem, or the components of the problem, that a project is intended to address.

❑ What Is It Good For?

Developing an understanding of a problem and possible solutions from multiple and varied perspectives. This includes identifying individuals and organizations that have solved or tried to solve similar problems, in order to learn from their experience, and to gain feedback on proposed and ongoing project activities; identifying methods and mechanisms for evaluating IT solutions that may be suitable for your purposes; and identifying sources of relevant technical expertise and technology that you may want to explore for your project.

Identifying all relevant components of a problem. This helps you avoid the trap of "treating the symptoms" of the problem, instead of the problem itself. The time you spend reading and talking to experienced people helps you identify and understand underlying causes.

❑ Some Limitations

Assumptions are needed. You must make assumptions as to the appropriateness or relevance of others' experiences to the problem at hand.

Willingness and availability are limited. This kind of research relies on available published data and the willingness of others to share what they know.

Good News vs. Bad News. Organizations and individuals are more likely to share their successes than their failures.

❑ How to Conduct Best Practices Research

Best practices research seeks to identify the best possible set of solutions for a given problem. It can take a variety of forms depending on the context of the problem. There are however, several standard components:

Context Related Materials and Sources — This research focuses on specific agency business objectives to identify how they have been addressed in other places, how successful those efforts have been, and the advantages and disadvantages they offer to a given project. This is different from the academic and professional best practices research described below, in that practical solutions are identified. This research is centered on solutions that have been successfully implemented and evaluated.

Technical Best Practices — This research also explores the range and variety of technical solutions that may suit the needs of the project. Here, technical materials are sought out and reviewed, costs of hardware and software are identified, and the feasibility of an implementation is analyzed. During this process, you may want to contact information technology vendors, system design consultants, and other organizations that have implemented the various technologies, in addition to reviewing written and electronic sources.

Academic and Professional Best Practices — This research segment focuses on resources that derive from universities and professional associations. Much of this information is obtained through written and electronic publications, including conference proceedings, peer reviewed journals, Internet-based searches, and books. Project staff often find it helpful to attend relevant conferences early on in a project to become familiar with current trends and to make contact with individuals doing similar or related work.

Some of the methods typically employed for best practices research include:

- Internet-based searches
- Literature reviews via library catalogs and CD-ROM databases
- Interviews with academic experts and expert practitioners in relevant fields
- Subscriptions to and communication via Internet-based discussion groups
- Site visits to places with implemented solutions
- Technology demonstrations
- Conference and workshop attendance

All IT projects need a best practices research component and therefore we offer some best practices advice on how to do best practices research:

- Start early — much of the information obtained by best practices research is most valuable early in a project. The results of the research can have a substantial impact on how the project is approached. Mistakes can be avoided by learning from the failures of others and conversely great achievements can be realized by gleaning the successes of others.

- Define the focus narrowly — defining the scope too broadly makes the search very frustrating and inefficient. It may be most effective to start in the topical area of the problem context with organizations that are similar to your own. This is not to say that crossing lines is fruitless, but initially, it is best to key the research to applications of technology in a related field or industry before exploring those in other fields or types of businesses.

- Formally plan and organize the effort — don't proceed with a simple "let's pick up the phone and see what I can find" strategy. First, define in a few sentences exactly what you're looking for. Second, write down key questions for contacts. These questions should be reviewed by everyone on the project team to ensure that they are appropriate and will provide the most critical information. Third, define the framework for the 'deliverable.' In other words, identify the scope of the research and the levels of detail and specificity required before you start. And evaluate the search continuously during the information gathering process.

- Use the most cost-effective resources first — methods such as postings to relevant listservs can reach a wide audience in a very cost-effective way, while others, such as interviews should be deferred until the scope of the research is more focused and the level of detail and specificity have been determined.

❑ For More Information

Chapter 4, Case 3, Example 3B describes the use of an Internet search for best practices research.

Models of Solutions

Before an aerospace firm builds a working prototype of a new aircraft, they first create scale models of the plane and its component parts and test them in a wind tunnel. Even before scale models are built, aeronautical engineers create computer models of the new aircraft that are then "flown" in flight simulators. The logic of this complicated process is that one should never risk the life of a test pilot nor the company's dollars on a design that hasn't been tested as completely as possible. When the stakes are high and uncertainties are great, build a model, and test it in any and every way that you can. Only when the process "flies on paper" in the modeling stage should you consider moving toward a fully functional system, whether pilot or prototype.

Building IT systems for government agencies, just like building aircraft, is an expensive and risky business. By modeling solutions before they go into production, managers can more clearly think through the solution and how it will impact on overall organizational processes. Of course, just because a proposed system "flies on paper" does not mean that the actual system will be a success. Building models of system solutions however, and testing them thoroughly before going to full production is an effective way to both hold down system development costs and minimize risks.

❑ What Are They?

Extensions of a formal model of a problem. Review the earlier section of this handbook on "Models of Problems," because solution models share many features with problem models.

Equations and relationships that represent how the new IT system will function. These are added to the base model of the problem. The solution model shows how the new system will function within the whole organizational context. Relationships within a model of a solution are based on data gathered from a prototype, on published baseline or best practice surveys, or on the expert judgment of managers and technical experts.

Representations of organizational and customer-oriented effects. These representations are just as critical as the ones that show how the proposed IT system itself will function.

❑ What Are They Good For?

Simulating how the full system will operate within a robust context of organizational and human factors.

Seeing the implications of a limited prototype when it is expanded to full scale operations. Managers are forced to think through technical, organizational, and policy issues in designing these models.

Allowing managers to explore the costs and benefits of proposed solutions by including an explicit financial sector within the model.

Allowing managers to ask "what if" questions about various types of system functionalities and their possible organizational and human factor effects. By asking "what if" questions, managers can anticipate issues and problems before they are encountered in a real world system implementation.

❑ Some Limitations

Models of solutions are no better than the data and relationships upon which they are built. If managers can not think through accurately the consequences of a new system, the model will not be able to forecast accurately the impacts of the new system. Notice that in this case, the new system probably should not be built anyway.

Expense. These models can be expensive and time-consuming to build.

Often need outside experts. Models of solutions may require specialized expertise not readily available within all organizations.

❑ For More Information

Eric Wolstenholme's book, Evaluation of Management Information Systems, (Wiley, 1993) provides a complete view of how to create and test models of solutions with system simulation models.

Chapter 4, Case 2. Examples 2A, 2B, and 2C illustrate how a model of a problem evolved into a model of a solution, and eventually into a system simulation.

Prototypes of Systems

Often an information system project involves a relatively new technology or combination of technologies with which the agency has little familiarity and even less expertise. This is especially true in state and local government agencies which have, for the reasons stated in the first chapter, tended to stick with tried-and-true technologies that may be several generations older than the proposed technology. To apply the new technology successfully in a cost-effective manner, all project participants — from end users who are specifying system functionality to developers who deliver the ultimate implementation — need to be thoroughly familiar with the potential benefits and risks inherent in the technology. Only by understanding the proposed technology fully can an organization hope to reengineer its processes successfully in order to take maximum advantage of the new system.

The purpose of developing prototype systems is to help educate end users, managers, and system developers about potential applications of the technology, and how it can help solve their problems. Prototypes are powerful tools used to bridge the gap between what project team members currently know about the new technology and what they will need to know to apply it successfully.

❑ What Are They?

"Quick-and-dirty" implementations of a portion of a potential technology solution. Its primary objective is to build awareness and educate. Consequently, the focus is on the interaction of the proposed system with other parts of the organization: agency users of the system, technical support staff, mainframe or other existing information systems, and external constituents (both human and electronic) that may interact with the system.

An emphasis on certain parts of the technology. The emphasis depends on the technology, and on where the gaps in knowledge are among the project participants. Typically, end users and managers have the least awareness of a technology's potential because they may not have been exposed to it through their day-to-day activities. Bridging the gap with these users is critical to developing a system that meets their objectives. Therefore, prototypes typically emphasize the user interface portion of the system. Prototype development may also address data preparation costs, maintenance requirements, technical support requirements, end-user training requirements, and infrastructure needs.

How extensive your prototype needs to be depends on a number of factors, principally the amount of learning and enhanced awareness that are needed. System prototypes need not be developed from scratch, and may not need to be developed at all. Depending on the application, off-the-shelf solutions from vendors may provide the functionality needed to educate the project staff. If commercial systems are not suitable, it may be possible to use custom applications developed for another purpose as they stand, or to modify them to provide a meaningful approximation of the intended system. Custom prototypes that focus on the user interface in a relatively short time frame can be developed using rapid application development environments (see Chapter 3, Evaluation Methods, Prototype Development).

Prototype systems are different from pilot systems. In a prototype, the focus is exclusively on the participants, because the purpose is to show prospective end users how the system will work so that they may think creatively about the potential of the new technology. In a pilot, the system is used in a limited real-life setting to get additional experience about the technology. While both are useful, pilots are much more costly than prototypes to build, since they have to work well enough not to hinder the activity of people who have to get real work done. This requires an attention to quality control and performance that typically drives the cost of development up substantially.

❑ What Are They Good For?

Educating projects participants. The primary value of a prototype is to educate the project participants in order to enhance the validity and effectiveness of the other activities proposed in this handbook. Unlike pilots, prototypes should not be thought of as ends unto themselves. Prototypes are intended solely to support other evaluation activities.

Stimulating both imagination and realism. A prototype can push people to dream of potential innovative applications of the technology. At the same time, seeing the technology in the concrete leads to a more realistic assessment of costs and benefits. Seeing a mock-up of the application helps guide the analysis to factors that are relevant and not just based on a vision of how such a system "might work." Interviews, model-building, surveys, experiments all become more accurate if the participants have personally experienced how the system might work. The prototype itself can be used to gather data on the likely impact of the information system under consideration.

Setting the stage for implementation. Prototyping activities can be aimed at all levels of staff. If the system being prototyped is ultimately procured, training and other costs may be lower because of staff experience with the prototype.

Assessing risk. The reactions that people have to a prototype help you assess the risks involved in the project. Risks may be inherent in any of the internal or external factors that could affect the success of the project. These may include such potential risks as staff and client resistance to change, immaturity of a new technology, personnel limitations, expected changes in the technical, political, or management environment, technology failures, and the like.

❑ Some Limitations

Because a prototype model is only part of the system, it won't work like the real system. Users need to be aware of this as they extrapolate to the behavior of their intended system. The limitations of the prototype may not be apparent to naive users, and their experience needs to be moderated by expert counsel. Opinions about the prototype need to be distinguished from opinions of the real system.

Expense. Depending on the educational needs of the project and the technologies involved, developing a prototype may be a costly proposition. If custom development is necessary, you may need someone experienced in particular rapid application development environments. Specialized hardware and software may be necessary to support even a small prototype.

❑ For More Information

Software Engineering, Fourth Edition, by Ian Sommerville (Addison-Wesley, 1992) contains a good chapter on the use of prototypes in the standard software development cycle, and on approaches to building prototypes.

The section on "Prototype Development" in Chapter 3 should be read in conjunction with this discussion.

Case 1, Example 1B in Chapter 4 illustrates how a prototype helped the Adirondack Park Agency understand the potential effects of a new information system in supporting customer services. Exercise 4 in Chapter 5 will provide experience in prototype definition.

Cost and Performance Measures

Once you have a description of the information system, service, or product that you want to create, and the beginnings of a plan for developing it, it is essential to ask the question "Will it be worth doing?" More accurately, since the future usually unfolds a bit differently than we expect it to, the questions are "Do we think it will be worth doing?" "Can we afford to do it?" and "How will we know whether it was worth it when we're done?"

To answer these questions, you need to be able to predict the costs of the project, and to specify what you think its benefits will be. You need to assess the environment in which the system will operate. To prepare, you first need a clear description of your goals and objectives, and a realistic plan for getting there. Once those are completed, it's time to estimate costs and benefits.

❑ What Are They?

Detailed breakdowns of all of the costs associated with the proposed new information system. Typically the cost analysis focuses on the direct costs of implementing the service; other costs such as political costs or the costs to others who will use the service, are included in the performance side of the equation. The cost estimate should include the costs of developing and maintaining the system, preparing the agency computing infrastructure to support it, and training staff and other end users to use it. It should also include the cost of all of the staff time involved in the planning, decision-making, and training for the service. Both one-time costs and ongoing costs should be included.

Enumerations of expected benefits. The performance estimate includes a list of the expected benefits of developing the system. As much as possible, think in terms of outcomes and results rather than outputs. Define your expectations in terms of the impact your efforts will have on your customers.

Typical benefit categories include "faster," "better," and "cheaper." You should describe how it will be better, how much faster or cheaper it will be. The analysis includes not only a list of expected benefits, but a statement of how each benefit will be measured to see if it has been achieved. Some measures will be relatively easy to describe in quantitative terms, especially those in the "cheaper" and "faster" categories. Others that we usually think of as qualitative (e.g. "client satisfaction") can be translated into empirical measures that can be quantified through the use of such techniques as surveys and interviews.

❑ What Are They Good For?

"Bottom line" analysis. Cost, risk, and performance analyses are important products on which a final decision about whether to go ahead with the project will be based. The project plans and expectations will have been fine-tuned by developing the other evaluation products described in this chapter. Now, before a final implementation decision is made on the project, the costs and benefits need to be anticipated and fully understood by the ultimate decision maker.

Project evaluation. After the project is completed, these measures can be used to evaluate whether it actually achieved its goals within its expected budget. This assessment is an important factor in planning for future activities.

❑ Some Limitations

A comprehensive analysis of the impact of a project may be difficult to prepare because of the complex environment in which public-sector programs reside, and the many factors that may affect the intended outcomes of the project.

Project managers are often more experienced with cost analyses, and it may be easier to develop "cheaper" and "faster" categories. While these are no doubt important, many innovative applications address the "better" category, which typically requires more resource-intensive methods to assess.

❑ How to Conduct a Cost Analysis: An Example

1. Begin your cost analysis by making a comprehensive list of the components of project cost. For example, in developing the Internet Services Testbed project (see Chapter 4, Case 3), this framework was used:

		One-time Cost	Annual Cost
Organizational Readiness			
Planning for Internet Presence	1		
Training for Technology Awareness	2		
Access for Agency Staff and other users			
Hardware for End Users	3		
Software for End Users	4		
Network and Internet Access for End Users	5		
Other Vendor Services	6		
Human Resources			
Start-up Process for Equipment Procurement	7		
Establish and Manage Vendor and ISP Contracts	8		
End User Support			
Vendor Services	9		
Human Resources			
Establish and Manage Vendor and ISP Contracts	10		
Development and Delivery of User Training	11		
User Time in Training	12		
Help Desk for Users	13		
Content Development and Maintenance			
Hardware for Content Developers	14		
Software for Content Developers	15		
Network and Internet Access for Content Developers	16		
Other Vendor Services	17		
Human Resources			
Start-up Process for Equipment Procurement	18		
Establish and Manage Vendor and ISP Contracts	19		
Development and Delivery of Staff Training	20		
Webmaster	21		
Content Creators/Providers	22		
Content Coordinators	23		
Web Site Design and Development	24		
Editorial Review	25		
Program Area Liaisons	26		
Database Administration	27		
Other Management Support	28		
Other Clerical Support	29		
Host of Site-Infrastructure			
Hardware	30		
Software	31		
Network and Internet Access	32		
Other Vendor Services	33		
Human Resources			
Front-end Research and Technical Evaluation	34		
Start-up Process for Equipment Procurement	35		
Establish and Manage Vendor and ISP Contracts	36		
Development and Delivery of Staff Training	37		
Network Administrator	38		
Systems Administrator	39		
Server Manager	40		
Operations Staff	41		
Programming Staff	42		
Clerical Staff	43		
HUMAN RESOURCES SUBTOTAL			
INFRASTRUCTURE AND OTHER SUBTOTAL			
TOTAL COSTS			

2. Next, make a best estimate of the costs for each expense category. It may be helpful to estimate costs for alternative levels of implementation — from minimal to moderate to elaborate. Leaving those options open at this point enables you to assess which alternative is most cost-effective.

3. Performance measures are developed in a similar way. In the Internet Services Testbed project, some of the categories used were:

   Cheaper:
   - Reduce duplication in areas such as data collection and program development
   - Generate revenue
   - Savings in non-personal services: telephone, printing, mailing
   - Savings in personal services

   Faster:
   - Reduce the number of steps in a process
   - Staff get access to information in more timely manner
   - Citizens get access to services in a more timely manner

   Better:
   - Improved responsiveness to citizen need through 24-hour access
   - More satisfied clients because information is more accurate and consistent
   - Ability to reach more customers with existing services

Be as specific as possible in defining expectations for system performance: "90% of telephone inquiries will be completed on the first call," or "the number of clients replying 'Highly Satisfied' or 'Satisfied' on the customer satisfaction questionnaire will increase by 50%." While this may prove difficult to do at first, quantifying system performance expectations will help to clarify project goals and objectives, and provide a basis for evaluation when the project is completed.

❑ For More Information

A methodology for approaching risk in software development can be found in, Barry W. Boehm, "A Spiral Model of Software Development and Enhancement," (Computer, May 1988, pp. 61-72).

Final Analysis and Choices

All of the evaluation products and methods described in this handbook have a common goal: to generate useful information for decision making. The suite of tools you use should be the one that is best suited to the situation you are trying to understand. Different projects call for different evaluation skills and tools. Some projects call for process models, because work processes are at the heart of the problem to be solved. Others call for customer surveys or interviews, because customer satisfaction is a key measure of performance. The point is to make a good match between your project objectives, your skills as an analyst or evaluator, and the tools you use. You also need to take into account who your audience will be. You should expect to distill weeks or months of work into a single document and a brief presentation designed for a particular kind of decision maker. You need to be armed with all the data, but you also need to present your findings and recommendations in a cogent, convincing, and interesting way.

❑ What Is It?

A summary package of information and recommendations designed for use by a decision maker. It should have the following features:

- A summary statement of the problem to be solved, with key data to illustrate its significance to the organization, as well as its severity and complexity.
- A description of customers and other stakeholders and how they are affected by the problem.
- A statement of assumptions, estimates, and other weaknesses in your underlying data.
- A presentation of the options available to the decision maker, with a comparison of features, costs and benefits, and stakeholder impacts for each option.
- A recommended course of action, with a justification that presents both strengths and weaknesses.
- An oral presentation with appropriate supporting media (handouts, slides, prototype, etc.).

❑ What Is It Good For?

Integrating information from a variety of sources into a single comprehensive assessment. The final analysis is mainly an opportunity to integrate information. You probably looked at the problem and potential situations from many points of view using several tools. Now is the time to ask what, collectively, they have to say. What are the main findings and conclusions that emerge from the entire body of data?

Generating and comparing solutions. The final analysis helps you see what can be done to achieve the goals of your project. There are bound to be several reasonable approaches. This is the stage where you define what they are and how they compare with one another along important dimensions such as cost and acceptability to key stakeholders.

Improving the confidence level of decision makers. Decision makers seldom have all the information they need. They have to act on the basis of available data. The information you present at this stage needs to be the best quality you can make it—and you need to share your honest assessment of its weaknesses as well as strengths so that decision makers act with their eyes open.

Justifying recommendations and proposals. Usually one or two of the possible solutions seem better to you than the others. The analysis you conduct at this stage needs to use the full range of data to justify why you think a particular course of action is preferable.

Grounding an action in empirical information. Too often, decisions are made based on what someone "thinks" or what happened in the past. Empirical data based on actual experience and direct observation are usually a stronger basis for action. This kind of information and analysis helps you use that data to decide exactly what to do in order to achieve your goals.

❑ Some Limitations

Data quality. The most important limitation of any analysis is the quality and completeness of the data on which it is based. Bad data can't be improved by powerful analytical tools or fancy presentations. Be sure to pay attention to assumptions, estimates, and just plain guesses and to be honest with yourself and others in revealing what part they play in your analysis.

Matching tools, skills, and problems. Match analytic tools to the skills of the analysts assigned to the problem. Don't, for example, attempt to build and assess the results of a system simulation if you have not been trained in this work. On the other hand, don't shy away from basic statistics or narrative description just because they seem simple. These are often appropriate and easy for readers and listeners to understand.

Selective vs. exhaustive presentation. Presentation of information, options, and recommendations is both an art and a science. The best analysis can be entirely misunderstood if the presentation is disorganized, overly technical, or too mired in detail. Decide what the key points are and build your presentation around them. You can always add detail (since you've done such a thorough job) in response to questions.

Every analyst has biases. Try to identify yours and counter balance them through solid analysis of the data.

Decision makers often rely on multiple sources of advice and information. Your analysis may be comprehensive, persuasive, and accurate, but it will probably not be the only basis for the final decision.

❑ How to Prepare a Final Analysis

1. Gather your evaluation findings together and review them all. Even if you were involved in all parts of the project, you will often find that new information and insights emerge only when you step back and look at all the evidence together. Look for patterns, reinforcing information, conflicts, and gaps. Try to state the main findings in a few sentences or bulleted key phrases to create a framework for the final analysis and recommendations.

2. Get all the people on your team together to discuss the findings and share their assessments and insights. Together, decide how best to present your findings and recommendations. Your presentation to decision makers will need to answer questions like these:

    - What are the characteristics and dimensions of the problem to be solved or initiative to be undertaken?
    - What alternatives are available for action and how do they compare to one another in terms of cost, feasibility, effect on stakeholders, and other key criteria that matter to decision makers?
    - What course of action do you recommend and why?
    - What are the one-time and ongoing costs of implementing your proposed solution? Can these be offset by new revenues or by reducing current operating costs?

- What are the expected benefits of solving this problem or taking this initiative (in other words, what is the expected return on investment)?
- What are the drawbacks in your recommendation?
- What are the next steps?

3. Decide what format or formats your final recommendations or report will take: formal written report, oral presentation only, different presentations for different stakeholders, etc.

4. Don't delay! Close out your analysis while the results and your understanding of them are fresh.

Chapter 3. Evaluation Methods

In this chapter, we present nine methods or tools that you can employ to help create the evaluation products that are needed to make a sound assessment of a proposed new information system. Some of these evaluation methods require little or no specialized expertise, while others are more sophisticated and may require expert help, as this table indicates:

Evaluation Methods	Degree of special expertise needed	Examples
group decision conferences	modest to high	APA, ORMA, INTERNET
literature reviews	none	INTERNET
technology awareness	none	APA, INTERNET
prototypes	high	APA
interviews	modest	APA
surveys	modest	INTERNET
experiments	high	ORMA
system simulations	high	ORMA

Group Decision Conferences

"Decision models are intellectual tools that have been developed to make unwieldy problems more manageable by structuring the thought process, clarifying interrelationships, and handling complex data" (Reagan-Cirincione et al, 1991).

A group decision support system can be broadly defined as an application of information technology that supports the work of groups. The distinguishing characteristic of group decision conferencing is the on-the-spot construction by a group of an explicit quantitative model. Conducting an effective and useful decision conference is no easy task and may be confounded by such things as the complexity of the problem, the initial degree of alignment in the group, the availability of baseline data, as well as the number of processes or operations to be considered. Decision conferences are almost always more effective when planned and conducted by a skilled facilitator who has no personal stake in the outcome of the decision.

❑ What Are They?

Intensive, often computer-supported, working meetings, typically held over a one to two-day period. Group decision conferences focus on improving group decision making. They are characterized by the use of structured decision processes. Decision conferencing allows for a rapid elicitation and combination of expert judgment and baseline empirical data from multiple sources and multiple points of view.

Decision conferences are often held off-site to avoid the interruptions and distractions of the workplace. Expert agency staff are included in the group because they share a stake in either addressing an organizational problem or in responding to an attractive opportunity. The product of a group decision conference is usually a formal management or decision science model of the phenomena under study.

Facilitated group activities. Another distinguishing feature of decision conferencing is the use of teams, commonly made up of three or more facilitators, who provide extensive, expert support to the group. The primary facilitator, who should be expert in the techniques of group dynamics and decision modeling, interacts directly with the participants and is responsible for the quality of the group interaction process and for moving the group toward closure and completion of its agenda. This requires considerable skill in focusing discussion, managing interpersonal conflict, and enhancing the patterns of group communication.

A second facilitator usually acts as the decision analyst, transferring the decision model from whiteboards or flip charts to a PC. The decision analyst periodically provides feedback to the group from the analysis through large-screen computer projection or hard-copy handouts and updates the model based on changes in group understanding or judgment.

A third facilitator works as a correspondent and records, either electronically or on paper, the important details of the group discussion so that comprehensive documentation of the deliberation is available at any time during the meeting and as a printed report by the end of the conference.

❑ What Are They Good For?

More efficiently identifying and combining many different points of view within a group rather than collecting data from individuals. A group as a whole has more information than any one individual has, and groups are better at catching errors than are individuals who propose ideas. Most important, the group process requires that participants come to agreement on the definition of key terms and concepts before formulating judgments.

"Triangulating" judgment with structural and baseline data. Decision conferences can be used to develop a variety of management science models including: cost-benefit models, resource allocation models, and multi-attribute judgments as well as simulation sketches and process maps. Rohrbaugh (1992) lists some of the more common purposes of a group decision conference as:

- Defining organizational goals and priorities
- Making budget allocations
- Establishing five-year strategic plans
- Redesigning service delivery systems
- Developing new methods for performance appraisal
- Evaluating alternative reorganization plans
- Clarifying staffing assignments and priorities
- Predicting long-term effects of financing options
- Determining and allocating office space needs
- Identifying new products and markets
- Planning information systems

Planning new information systems. Group decision conferencing can be an ideal method for identifying and selecting processes for automation, conducting stakeholder analysis, process mapping and process improvement activities, identifying levels of system investment, identifying required system features and functionality for different levels of automation, estimating costs for the various levels of automation, estimating potential cost savings associated with the various system levels, and identifying potential effects on customer turn-around time.

❑ Some Limitations

Cognitive and judgmental biases. Group decision conferences are subject to known cognitive and judgmental biases such as anchoring or truncation of divergent thinking. Much research has shown that individual thinking usually generates more and better ideas than group conferencing does. Therefore, the conference should include some time devoted to individual issues or idea generation as an important part of the group process.

Blind spots. Decision conferencing may also be hindered by cognitive "blind spots." Depending on the composition of the group, individuals may be less willing to be candid with respect to issues and opinions than they might be if their anonymity were ensured through some other type of issue identification process.

Sabotage. A decision conference can be sabotaged by one participant or a subset of participants who are either uninterested in the problem being addressed or unwilling to consider the potential solutions being discussed.

Participants may lack the information required to complete the task successfully. In decision conferences where the agenda is centered on information systems planning or evaluation, participants may have difficulty envisioning interactions between units of a system and a full system, or assessing the levels of effort that will be required for system and information development and maintenance.

Many of the potential limitations of group decision conferencing can be overcome by effective, expert conference planning, careful attention to selection of participants, and skilled facilitation. Others can be overcome by preceding a group decision conference with the kinds of technology awareness and prototyping activities that are described elsewhere in this handbook.

❑ For More Information

See Chapter 4, Case 1, Examples 1A and 1C, Case 2, Example 2A, and Case 3, Example 3A for descriptions of a variety of group decision conferences.

Reagan-Cirincione, P., Schuman, S.P., Richardson, G.P. and Dorf, S.A. (1991). Decision modeling: Tools for strategic thinking. Interfaces 21, 52-65.

Rohrbaugh, J. (1992). “Cognitive Challenges and Collective Accomplishments” in R.P. Bostrom, R. Watson, and S.T. Kinney (eds.), Computer augmented teamwork: A guided tour. New York: Van Nostrand Reinhold.

Literature Reviews

Many information management problems and proposed IT solutions to them are not unique. Organizations and project teams can benefit greatly from the experience of others in both government and in the private sector.

❑ What Are They?

Systematic searches of print and electronic sources. Their purpose is to identify, review, analyze, and evaluate the recorded experience of others who have dealt with an information problem similar to the one facing your organization, or who have used a technology similar to the one you are considering.

❑ What Are They Good For?

Identifying best practices.

Assessing the current "state of the art."

Obtaining objective evaluations of the performance of a given technology.

Anticipating mistakes and potential pitfalls in system design or implementation, so as not to repeat them.

Identifying potential partners and vendors.

Identifying organizations and individuals whose experience you can draw on for advice or consultation.

Locating organizations where you may be able to see in operation the particular technology, or combination of technologies, that you are considering.

❑ Some Limitations

Time lags. There is often a substantial time lag between the completion of a document or report and its appearance in print. For scholarly journals, this can be as long as 24 to 36 months between submission of the finished manuscript and its appearance in print.

Just the good news, please. In reporting on their experiences, individuals and organizations are likely to highlight their successes and minimize their problems and failures.

Basic research skills are needed. The organization of indexes, abstracting journals, library catalogs, etc. is complex, and the inexperienced searcher can easily overlook relevant material or sources.

❑ How to Conduct a Literature Review

Much has changed since the days of the library's card catalog. There are now a variety of newer technologies that can be used to search for relevant publications and documentation. While traditionally you would conduct a literature review almost exclusively at the library, today you can also gather enormous amounts of information through the Internet. If you don't have access to the Internet at home or at work, do not despair. Many libraries offer access to the Internet.

One of the keys to effective and efficient literature reviews is identifying an appropriate search scope and key words. Starting too narrowly is often more effective than starting too broadly. If the scope is too narrow and nothing can be found, you can easily make your search less specific. This is far preferable to wading through hundreds of potentially unrelated documents in hopes that one or two relevant items will surface.

There are a number of approaches that you can take in identifying literature relevant to information technology in the public sector. For example, if a technology solution has been proposed, you might search the literature on the technology itself, to identify other private or public sector organizations that have implemented applications. Another approach might be to focus on the business problem or functional area of interest. For example, you might be interested in identifying information technology applications that address tracking clients and services through a human service agency. In this case, the search might focus on the service or business process rather than on a specific technology.

Library-Based Searches

Libraries are the most obvious place to start a literature search and one of the most valuable resources at a library is the librarian. A quick consultation with a reference librarian at the outset will help you focus the search, identify the most relevant print and electronic access tools, be sure that you aren't overlooking any new information sources, (either print or electronic) and increase the efficiency of the search.

Most modern libraries support electronic searches of their holdings. Additionally, many libraries offer an array of other search options. For example, many databases are now available either on-line or in CD-ROM, covering such topics as public administration, business, information and library science, and health and human services. These databases can be searched by keywords, author, title, etc., and often contain abstracts, suggestions for related material, and in some cases may identify where in the library the reference may be found. Databases containing newspaper articles are also available in many places. While some on-line searches are available free of charge, others require an access fee. The government documents section of a library may also be quite valuable. There exist several references that identify people and organizations in other states by government function. From these sources, individuals working in the same or a similar field in other states may be identified for follow-up.

Internet-Based Searches

The Internet is also a valuable source and may actually yield more useful information than a library search in terms of identifying people and organizations working on IT implementations or specific business problems. Information found on the Internet may also be more current than those references that have gone through a lengthy review process. A number of search tools, such as Alta Vista, Lycos, and Excite can be used to identify relevant sources of information on the World Wide Web. Additionally, many Web pages provide direct email access to the source of the information, so that correspondence with the individuals providing the information is just a mouse click away.

Another effective way to search for information is to subscribe to, and participate in a relevant listserv. A listserv is a moderated electronic mailing list where individuals who share similar interests can post and respond to messages. Listservs exist for every topic you can imagine — from document imaging, to health care information systems, to the reproductive habits of brine shrimp in North America. Relevant listservs and their respective subscription instructions can be identified through Web-based searches. A posting to a listserv asking for information on a specific business problem or technology is a very effective and low-cost way of reaching a large targeted audience.

Lest you be unfamiliar with the codes of conduct in using listservs, either subscribe to the list and watch for a while before your first posting, or refer to one of the many new books available that discuss 'netiquette.'

❑ For More Information

Chapter 4, Case 3, Example 3B describes the use of an Internet search to identify best practices.

Technology Awareness

Typically, one of the most important activities in a project is to increase awareness among the participants of the possibilities and potentials that are inherent in the technology that is being considered for use in the project. Best practices research aims at discovering innovative approaches to a problem or objective, often using technology. The results of best practices research are augmented by technology awareness activities aimed at educating the project staff about the capabilities of the technology, so they can begin to think creatively about how the new technology could be used to transform the way in which the agency operates.

❑ What Is It?

Activities designed to acquaint project staff with the capabilities of a candidate technology. It can be accomplished in several ways: reviewing the relevant literature in both trade and technical journals, visiting trade shows, hearing presentations by organizations with exemplary systems, visiting organizations that have installed similar systems, arranging vendor demonstrations, or developing and demonstrating one or more prototype versions of a proposed system.

❑ What Is It Good For?

Understanding the capabilities and limitations of a technology. In order to use a technology effectively to reengineer a business process or develop a new product, it is necessary to understand thoroughly the capabilities and limitations of that technology. Technology awareness activities are designed to accomplish that purpose. The amount or kind of educational activities that are needed in a project depends on the size of the gap between the staff's current knowledge and optimal familiarity with the proposed technology.

❑ Some Limitations

This is only an introduction. Becoming educated about anything new is inherently a slow process, especially for program staff whose main job is focused on issues other than evaluating and applying technology. Understanding and adapting to a new technology is often a slow and difficult process for a number of reasons — reengineering processes commonly requires cultural, organizational, and inter-organizational changes on the part of an organization.

In addition, there is a difference between "knowing about" something and actually experiencing it. Some of the benefits and limitations of a technology can only be appreciated after years of experience by an organization.

❑ For More Information

See Chapter 4, Case 1, Example 1B for an illustration of the role of technology awareness in prototype development, and Case 3, Example 3B for an illustration of how technology awareness and best practices research can be combined in a single activity.

Prototype Development

One of the most powerful educational experiences for project participants is to get their hands on an actual working system that solves the problem or addresses the need that they have. The ideal would be to create an actual working system that the agency could "test drive" for a period of time before it develops its own. Since that is usually not possible, the next best activity is to have participants use a product or a technology that is similar to the one they are considering.

❑ What Is It?

A rapid full or partial implementation of a proposed technology solution. A number of approaches may be used to develop prototypes. These include:

- using a commercial off-the-shelf technology,
- using, either directly or with modification, an application developed for another purpose,
- developing a specific prototype using rapid application development (RAD) tools.

Rapid application development (RAD) tools include any of a number of tools designed to develop part of an application quickly. These include environments such as Microsoft's Visual Basic and Borland's Delphi that allow for easy development of the user interface in a program. Tools such as Powersoft's PowerBuilder, Perl, and operating system shells are often used to develop a prototype of a proposed new application, so that interfaces with existing systems and databases can be explored.

❑ What Is It Good For?

Experimenting with different options for implementing the intended system. In an ideal situation, the prototype developers would be in a position to demonstrate a series of possible implementations as the other members of the team are coming up with ideas for the proposed system.

Getting quick feedback on possible application options. Providing prospective end users with an opportunity to try out a proposed technology makes it more likely that a system will be devised that actually meets their needs.

Reducing the risks of full system implementation. Prototypes help developers and users communicate about what seems right and wrong about a given solution. Mistakes and misunderstandings are inevitable — at the prototype stage they add value, at the implementation stage they spell disaster.

❑ Some Limitations

Prototype development requires skilled technicians and a specialized development environment. These may not be universally available, especially in smaller agencies, and may require the use of outside experts.

❑ For More Information

For an example of a prototype development, see Chapter 4, Case 1, Example 1B. See Chapter 5, Exercise 4, for practice in prototype design.

See also the section on "Prototypes of Systems" in Chapter 3.

Interviews

The full range of performance of an information technology system can seldom be assessed by measuring only hardware or software operations. As important as technical standards and benchmarks can be, they are not likely to capture all the critical evaluation data, especially the human side of system interactions. The most valuable information needed to assess a technology project or system may be in the form of impressions, experiences, ideas, beliefs, and attitudes held by those involved. Often reactions to, or interactions with, the system cannot be measured with stop watches or oscilloscopes. In some cases, standards or benchmarks for the human side of the interaction may not exist. Or it may not even be clear in advance which are the important interactions or outcomes. In some cases, the kinds of information needed may involve subjective judgments or strictly qualitative descriptions of events. For some kinds of systems and some assessment situations, it may not even be possible to know in advance all the important questions or kinds of data that should be collected. For these reasons, the data collection process may have to be more of a conversation between the data collector and the respondent, in other words, an interview.

❑ What Are They?

Face-to-face or telephone conversations with system users or clients in which they answer questions about how the system works and their experiences with it. The answers are recorded in written or electronic form for later analysis and interpretation.

Structured interviews follow a pre-set series of questions and are designed for consistency in the wording of questions, their order, and in the kinds of information collected.

Unstructured or free-form interviews allow the respondent to determine much of the order and content of answers, and are designed to collect data which reflects the respondent's point of view, rather than the point of view of the analyst.

Questions may be closed-ended, allowing only a limited range of answers (such as Yes or No, Agree or Disagree, etc.), or open-ended, allowing the respondent to supply the language.

A group interview, in which all persons are asked and respond to the same open-ended questions, is usually called a focus group. It is used to gather data about both individual answers, and how the members of a group interact with others in discussing the same material.

In some instances, especially face-to-face interviews, it may be desirable to assess the non-verbal behavior of the person answering questions, such as nervousness, enthusiasm, hesitancy, etc.

❑ What Are They Good For?

Collecting complex verbal data and process descriptions, especially when these are not well understood in advance. Interviews allow for discussing and explaining questions and answers and work well in situations where all questions cannot be fully planned or known in advance.

Allowing respondents to express more fully their points of view, ideas, and experiences. The interview setting, with its person-to-person contact, encourages participation, establishes rapport, and reinforces cooperation.

Observing and evaluating non-verbal behavior. A skilled interviewer can learn a great deal by observing the way people speak, react, and behave during an interview.

❑ Some Limitations

Expense. Interviews are often more expensive and time consuming to conduct than other data gathering processes such as surveys.

Client cooperation. Interviews require considerable client commitment and involvement.

Special skills are needed. Conducting good interviews, especially unstructured ones, requires training. Transcribing and analyzing interview data can be complex and expensive.

Interviewer influence. Results can be influenced by the interviewer's actions, appearance, or relationships to the respondent (e.g., boss/subordinate, etc.).

Interview results are often difficult to quantify or generalize. The data generated by interviews is rich in detail, but generally there will be too few observations to support general conclusions.

❑ For More Information

Two useful books on interviewing are Michael Quinn Patton, How to Use Qualitative Methods in Evaluation (Sage Publications, 1987), and Herbert J. and Irene S. Rubin, Qualitative Interviewing: The Art of Hearing Data (Sage Publications, 1995).

A good source for software to analyze interview and other qualitative data is Qualitative Research Management, 73-425 Hilltop Road, Desert Hot Springs, CA 92241 (phone: 619-329-7026; fax 619-329-0223; email: hallock_hoffman@mcimail.com).

See Chapter 5, Exercise 5, for an example of applying these principles to an interview situation.

Surveys

When data is needed from a fairly large number of persons, and can best be collected directly by asking them questions, the usual method of choice for data collection is a survey. Surveys are such an efficient and useful method for such a wide variety of inquiries that responding to questionnaires and phone interviews has become a commonplace part of daily life. The efficiency and utility of surveys certainly applies to a number of issues or types of inquiry that emerge in information technology planning and decision making. Some projects may require market-type research exploring client needs, preferences, or satisfaction with services. Surveys may be useful to gauge the opinions, attitudes, or preferences of a particular user group or stakeholder population. Surveys may also be used to describe the characteristics or actions of some clients or system users, especially to explore how these characteristics relate to their needs, actions, or attitudes. And surveys can be used in evaluating a system by collecting data about how users and other participants assess its performance.

❑ What Are They?

Structured, predetermined questions asked directly of persons or groups, usually employing short, simple, often pre-coded answers. For factual questions, such as respondent's age, fill-in-a-blank is typically used. For assignment to classes or groups, checking of boxes can be used, such as own vs. rent housing, or education level. Scales are often employed for attitude and opinion questions, such as how strongly a respondent agrees or disagrees with a statement of opinion or political position.

A survey may present questions by using self-administered questionnaires distributed by hand, mail, fax, or email, or by interviews conducted face-to-face or over the phone. The relatively low cost of mail or electronically distributed, self-administered questionnaires makes them attractive for reaching large numbers or widely scattered populations.

A method for studying attitudes, opinions, personal judgments or beliefs, and gathering facts about the persons involved (such as age, gender, or income), as well as self reports of their actions, makeup of their household, work situation, etc.

Large population studies using data gathered from relatively small, scientifically chosen samples. A public opinion poll is an example of this kind of survey. By careful sampling and questioning, it is often possible to draw useful and highly reliable conclusions about large populations from small samples without the time and expense of surveying large numbers.

❑ What Are They Good For?

Gathering information from and about users, clients, and stakeholders:

- preferences, service needs, and demands,
- opinions and evaluations of how well a system performs,
- actions, choices, or intentions with respect to use of a system or service,
- demographic descriptions.

Providing quantitative data that can be the basis for statistical analysis of results. By using scales, surveys can yield quantifiable results for statistical analysis of such subjective material as attitudes and opinions.

Controlling costs of gathering data from a large group, especially by sampling from a population. Surveys can also minimize the time, cost, or level of commitment required for respondents to answer the questions.

Preserving the anonymity of respondents. When it is desirable to assure respondents of the anonymity and/or confidentiality of responses, it is much easier to do so with a self-administered instrument than with interviews. This is especially true when asking questions about potentially sensitive information, topics, or issues.

❑ Some Limitations

Surveys require relatively complete and detailed advance knowledge of what questions to ask and how to ask them. The survey designers must impose a structure on the information prior to collection, and must make choices about what is included, excluded, and highlighted.

Questions must be carefully designed and field tested. If not well designed and tested, questions may be confusing or ambiguous, or may be stated in a way that leads or biases the responses to them.

Surveys provide little or no opportunity to discuss, elaborate, or explain answers. Respondents who don't understand a question may answer improperly. Or important qualifiers or exceptions may be ignored or missed because they're not allowed in the structure of the question.

Surveys are typically not useful for studying complex processes, for describing complex classifications, or the details of a natural setting. For example, a survey would not be useful to collect detailed descriptions of how different respondents solved a problem. Some classifications may be too complex or problematic for simple questions, such as ethnic identity or job classifications.

Point of view. Answers to a survey can reflect the questioner's frame of reference and assumptions, more than the respondent's.

Uncontrolled conditions. It is often difficult, especially in a mail survey, to control the conditions under which the answers are given, or to assess the level of candor of the respondents. The surveyor must depend on the diligence and honesty of the respondent, often without direct knowledge of the person or the circumstances under which the answers were recorded.

Analysis requires special skills. Quantitative analysis of survey results requires technical training, and can be time consuming and costly. The analysis of survey results is a substantial area of study in its own right. Therefore a thorough understanding of the analytical issues and methods involved is necessary for a valid and appropriate analysis and presentation of results.

Sampling problems. Biases or flaws in a sample can make it difficult or inappropriate to generalize about the larger population. Such flaws may result from selecting the sample improperly, or if the pattern of responses departs from the original sample in important ways, such as if the sample were designed to equally represent women and men, but a much higher proportion of women responded.

❑ For More Information

Three useful books on surveys are:

Louis M. Rea and Richard A. Parker, Designing and Conducting Survey Research: A Comprehensive Guide. (Jossey-Bass, 1992).

Linda A. Suskie, Questionnaire Survey Research: What Works. (Association for Institutional Research, 1992).

Herbert F. Weisberg and Jon A. Krosnick, An Introduction to Survey Research, Polling, and Data Analysis, Third Ed. (Sage Publications, 1996).

See Chapter 4, Case 3, Example 3C for an illustration of the use of a survey to identify performance barriers, and Chapter 5, Exercise 6 to gain experience with a survey instrument.

Experiments

The essential purpose of an experiment is to learn about what influences the way some process or activity actually works. In a survey or interview, the data consists of some persons' reports of how they think or act. In an experiment, the data is typically a result of direct observation of behavior, albeit in a contrived and controlled situation. Thus experimental data are one step closer to understanding what might happen in a natural setting. The experimental setting is an approximation of the natural setting. The experimental setting is contrived and controlled because the events in a natural setting are influenced by many interacting factors. This combination of many interacting influences makes it very difficult to sort out the independent effects of one factor or another. So an experiment is designed to control enough of the factors to allow an assessment of the impacts of the specific ones that are of greatest interest or importance.

For an information technology system or prototype, an experiment can become part of testing or evaluating system performance. The experimental design would have to provide for the system or prototype to function in an essentially natural way, while either eliminating or accounting for the influence of all the important factors. For computing systems, these experiments often take the form of running a set of highly standardized and tested procedures or software routines that simulate actual use in a controlled way. The experimenters can apply the same procedures under systematically varied conditions, such as running the same simulation on varying hardware configurations. Experiments may also involve hypothetical work or service delivery situations. In such an experiment, carefully selected persons perform a standardized set of actions on a system under controlled conditions. The experimenter can thereby observe and record the results of realistic work behaviors or client transactions. If well designed, such experiments can yield highly useful data for assessing systems and prototypes.

❑ What Are They?

Artificially constructed and controlled situations designed to study what affects the performance of some system or process. On occasion, a so-called "natural experiment" can be useful as well, as when a change in the natural setting occurs which works in the same way as a deliberate experimental manipulation of the situation. For example, if an organization changed a work procedure, but kept the workers, technology, incentives, and work setting constant, a comparison of productivity before and after the procedural change would be a kind of natural experiment.

A situation designed to allow direct observation and/or measurement of service delivery, system performance, etc., under controlled conditions. Experimental controls eliminate or account for the influence of all but the most important or critical components of a system. This allows direct testing and evaluation of these high priority components.

❑ What Are They Good For?

Observing and measuring the activity of users, clients, and system components under realistic, controlled conditions. These include:

- Assessing how system performance may be affected under conditions of significantly increasing scale of operations.
- Providing benchmark data for use in evaluating system performance in natural settings.
- Repeating activities and assessing performance under consistent conditions to test system reliability and performance stability.

Assessing the influence on performance or system behavior of some critical component or operational factor. By controlling for, or eliminating the effects of, other, low importance factors, an experiment can illuminate the role of the most critical components in overall performance. Experiments also allow you to assess a system's performance under low-frequency or extreme conditions.

Assessing the reliability and stability of a system or prototype. The experimenter can apply varied tests or operations systematically to evaluate performance under a pre-determined set of circumstances.

❑ Some Limitations

Experiments can be very costly to design and conduct. The construction of realistic, controlled conditions may require extensive laboratory facilities, equipment, or similar resources. Materials and protocols must be carefully designed. Participants must be recruited and prepared. The observation, recording, and analysis of experimental data may be very complex and time consuming as well.

Accomplishing the necessary controls may require some unrealistic assumptions. These can compromise the validity of the resulting observations. For example, experiments often call for participants to assume particular roles, such as business owner, or teacher, so as to include the necessary range of transaction or clients. The ability of the participant to accurately play that role may be quite limited, and the resulting behavior may not be truly typical of people in that occupation.

What can be done in an experiment may be limited by ethical constraints. For example, in some designs the only way to obtain realistic behavior would be to deceive participants in an unethical way. Other designs may be prohibited because they involve unacceptable costs or risks for participants, such as divulging sensitive or potentially damaging information, or being subjected to highly stressful or potentially harmful conditions.

The validity of experimental data depends directly on the effectiveness of the controls. That is, all potential influences on the outcomes must be taken into account or provided for in effective ways. This requires detailed and extensive knowledge of the processes involved, and all the components of the experiment itself.

❑ For More Information

Earl Babbie, The Practice of Social Research, Seventh Ed, especially Chapter 9. "Experiments." (Wadsworth Publishing, 1995).

Thomas D. Cook and Donald T. Campbell, Quasi-Experimentation: Design and Analysis for Field Settings. (Rand McNally, 1979).

David L. Morgan, ed. Successful Focus Groups: Advancing the State of the Art. (Sage, 1993).

See Chapter 4, Case 2, Example 2D for an experiment designed and conducted to evaluate the performance of a proposed system by comparison with an existing system.

See Chapter 5, Exercise 7, for an opportunity to apply the principles of experimental design that are presented here.

System Simulations

In the world of IT planning and design, the word "system" is often used to refer to a technical system — a collection of electronic components that function together. Another use of the word "system," however, refers to the collection of human actions and interactions that create the social and managerial systems within which technical systems operate. These social systems are often characterized by a high degree of complexity, variability, and uncertainty.

In social systems, complexity arises because many actors in the system understand one sector or component of the overall system. But it may be that no one person really understands the whole system of interactions. Often actions taken in one or several sectors of the system create decision situations in other sectors. In turn, decisions made in these other sectors feed back to create new decision situations in the first decision-making sector. Hence, decision making becomes characterized by feedback loops of circular causality. Known as feedback complexity, this phenomenon is notoriously difficult to analyze.

For example, one manager understands in great depth one or several steps in an overall process designed to serve an agency's customers. His decisions are framed by decisions made in other units of his own agency, in other agencies, or at other levels of government. In turn, his actions define the decisions that may have to be made at another level or in another unit. When inter-governmental or cross-agency programs are involved, it may be that no one really knows how the entire system functions. It is often difficult to diagnose why problems exist (or even what the problems are), or to forecast what the ultimate effect of implementing an IT-intensive system to address those problems will be.

System simulations provide a structured approach to analyzing and understanding how complex social and managerial systems give rise to problem behaviors, as well as what types of solutions might be applicable to those problems. In systems characterized by feedback complexity, what initially seem to be good solutions can be shown to be unworkable because of the complexity of the system. Often a "best " technical solution can cause the system to exhibit worse behavior temporarily, until the better solution takes hold. Conversely, improving system effectiveness in the short term can sometimes result in worse overall performance in the longer term, as other actors (the clients themselves, for example) adjust their behavior and decision making in response to the new system.

An entire field of specialized study, called system dynamics, helps management teams to complete systems thinking exercises and to use system simulations to understand feedback complexity in social and managerial systems.

❑ What Are They?

Structured, computer-based, analytic approaches to describing and understanding feedback complexity in social and managerial systems. System simulation models are constructed using specialized simulation software such as STELLA or VENSIM. Modern software packages have icon-oriented front ends that facilitate the development of such simulation models.

Explicit models of multiple decision-making domains, client behavior, and the circular paths of causation that connect decision making at various levels within an agency, across several agencies, or across levels of government. System simulation models are constructed using an explicit theory of feedback systems that helps to clarify complexities in social and managerial environments. Recently, techniques have been developed to use group processes and group decision conferences to facilitate the construction of system simulation models by management teams.

Time plot simulations that can predict the future behavior of a system under a wide variety of circumstances. System simulations explicitly model delays in system functioning as well as feedback loops of circular causality.

❑ What Are They Good For?

Creating models of a problem or a solution when the level of social complexity surrounding a system is high.

Identifying patterns of inter-agency or inter-governmental decision making that are causing or contributing to a problematic or undesirable pattern of behavior.

Helping a project team understand how a technical system will fit into, and function within, a complex social or managerial system. Often, the simulation can help to identify forces within the social system that will cause the technical system to perform poorly. This can lead to redesign of the technical system or to a redesign of the business processes that support the managerial system.

Understanding the root causes of a problem, and how one or more proposed solutions may (or may not) act over time to solve or to ameliorate that problem.

Helping members of a management team understand how their decisions contribute either to the creation of problem behavior within a system or to a solution to those problems.

❑ Some Limitations

Expense. System simulations can be expensive and time-consuming to construct. System simulations require specialized expertise to construct and analyze.

Mixes hard and soft data. Because system simulation models integrate a diversity of data sources, ranging from hard time series to softer and more qualitative estimates of human factors, the output of such models can be confusing. Is the output a hard prediction of a time series or is it the qualitative extrapolation of softer human factors and decisions?

Requires high involvement of key actors. Usually all of the key actors in a system need to be involved in the construction of a system simulation. Bringing all the key people together for the amount of time that is required to build a system simulation as a group exercise may be logistically impossible or prohibitively expensive.

❑ How to Know if the Time and Expense of a System Simulation Are Justified

Because system simulations require assistance from a skilled modeler, and because they are more complicated and expensive to mount than some other analytic processes, it is useful to have some criteria for knowing when such modeling efforts are warranted. Here are some indicators of when the benefits of such an exercise will probably outweigh the costs:

- When the problem is an important one that has attracted the interest of top management.
- When the costs of making a mistake in implementation are unacceptably high.
- When the predicted impacts of a system on organizational performance are uncertain or when risks are involved.

- When feedback complexity is involved. This usually means that decisions in one sector impact on decisions in another sector which, over time, feed back to impact on the original decision making sector. This occurs very frequently in inter-agency or inter-governmental systems.

- When actors from different parts of the system do not readily agree on what is the root cause of the problem(s) being examined nor on what the solution might be.

❑ For More Information

A very readable introduction to the theory of systems thinking and why it is important for the management of complex systems is contained in Peter Senge's book, The Fifth Discipline (Doubleday, 1990).

The STELLA User Manual (High Performance Systems, 1990) is a fine introduction to modern systems simulation software as well as a good introduction to the field.

Eric Wolstenholme's book, Evaluation of Management Information Systems (Wiley, 1993) presents a complete view of how to create and test models of solutions for system simulation models.

Chapter 4, Case 2, Examples 2A, 2B, and 2C illustrate how a process model of a problem turned into a model of a solution and eventually into a system simulation.

Chapter 4. Cases and Examples

Case 1: An Electronic Reference Desk for the Adirondack Park Agency (1993)

❑ Mission

The six million acre Adirondack Park encompasses 12 counties and 105 towns in upstate New York. Whiteface Mountain, Lake Placid, and vast stretches of wilderness share the park with towns and businesses, sportsmen and women, vacationers, and year-round residents. The Adirondack Park Agency (APA) plays a pivotal, often controversial, role in the life of north country communities. Its mission is to maintain the delicate balance between environmental quality and economic vitality in the region.

❑ Problem Statement

As regulator of land use over the 3.5 million acres of privately owned land in the Park, the APA maintains tens of thousands of records about real property, natural resources, and physical and civil infrastructure. These records are kept in filing cabinets, map trays, microfiche jackets, film canisters, boxes, closets, and a few computerized databases that, together with 50 headquarters staff, fill every inch of the APA building from basement to attic. Staff depend on these records every day to give advice or to make decisions about proposals to buy land, construct buildings, or carry on other development projects. The information is important to lawyers, realtors, landowners and developers, researchers, and federal, state, and local governments. Organizing, finding, and using effectively so many different kinds of information has become a critical problem for both the agency and its customers.

Assembling the information needed to give an answer or make a decision often consumes much more time than the analysis of the request itself. Gathering existing information, rendering geographically oriented data into a consistent scale, and moving files among different staff specialists take much more time. As a result, it takes APA several days to respond to a phone inquiry, weeks to make a jurisdictional determination, and months to issue a permit.

❑ **Potential Solution**

Combine document records and geographic data into a unified "electronic reference desk" that allows agency staff to point at a land parcel displayed on an electronic map and summon legal documents, other maps, project plans and related information about the property. Parcels may be identified by owner's name, tax parcel ID, or simple map location.

❑ **References**

David F. Andersen, et al, Balancing Environmental Quality and Economic Vitality in the Adirondack Park. CTG Project Report 95-3. Center for Technology in Government, 1995.

Peter Bloniarz, Anne Miller, Eliot Rich, Using Technology to Change Work: Technical Results from the APA Prototype. CTG.APA.014. Center for Technology in Government, June 1995.

David F. Andersen, et al. Evaluating the APA Prototype: Prospects for Providing Cheaper, Faster, and Better Services to APA's Customers. CTG.APA-015. Center for Technology in Government, October 1995.

❑ **Examples of Evaluation Products and Methods Used in the APA Project**

1A. Stakeholder Analysis Using Group Decision Conferences

1B. Prototype of a Geographic Information and Document Imaging System

1C. Developing Cost and Time Performance Measures Using Group Decision Conferences

Example 1A.
A Stakeholder Analysis Using Group Decision Conferences

The APA stakeholder analysis was conducted very early in project planning. It consisted of four products which are reproduced in part below.

> Components of the APA
> Stakeholder Analysis
> - Statement of assumptions behind the analysis
> - Matrix of stakeholders, products, impacts
> - List of data variables used, noting which have "unknown' values, and how they will be accounted for
> - Explanation of expected impacts (text & tables, hard & soft data)

❑ Statement of Assumptions

- Automated information search and retrieval will produce significant efficiencies for APA and its customers.
- Governments within the Park have similar information needs and want to share data.
- Compliance with permits and regulations will improve when APA becomes more responsive to customer needs.
- A solution that integrates permit information, land use data, and maps will have broad application and transfer value for both state and local governments.

❑ Matrix of Stakeholders, Products/Features, and Impacts

Stakeholder Analysis Integrated Electronic Reference Desk Adirondack Park Agency									
	Stakeholders								
	Direct Customers			Units of Government			Other Stakeholders		
Products & Features	General Public	Realtors/-Attorneys	Landowners/-Purchasers	APA	Other state agencies	Local gov'ts in the Park	Developers		
Standardized Land Information		IQ (5)	IQ (5)		EP	EP	EB		
Reduced Paperwork									
More consistency in decisions		EB	EB						
Faster transactions for customers		IQ (1)	IQ (1)	EP, IQ (2)					
Reduce duplication of effort				EP					
Improved info for economic development				EB (4)		EB	EB		
Possible revenue from fees for remote access				GR					
Better compliance with regulations				EP, IQ (3)					
Codes used in the cells to indicate the effect of a product or feature on a stakeholder		IQ - Improved Quality IA - Increased Access		EP - Enhance Productivity GS - Generate Savings			GR - Generate Revenue EB - Extended Benefit		

(N) Numbers in parentheses indicate the top five priorities for the project.

❑ Formulas

Priority (1): Reduce transaction time for customers

(number of requests per year) x (time saved per request) x (value of citizen's time per hour) = (reduced time cost to customers)

Priority (2): Reduce agency staff time spent on customer transactions

(number of requests per year) x (staff time saved per request) = (staff time available to reduce backlog or offer other services)

Priority (3): Reduce number of enforcement actions

(number of enforcements per year) x (% reduction in enforcements) x (average staff time spent per enforcement) = staff time available to attend to other services)

Priority (4): Generate revenue from fees for remote access to support service enhancements

(number of requests per year) x (% of requests that could be handled by remote access) x (user fee) = new revenue for service enhancements

Priority (5): Improve the quality of service to customers by standardizing data sources used by different government agencies

(number of government agencies involved in a typical transaction - 1) x (value of citizen time per hour) x (average number of hours spent at each agency) = (reduced time cost to customers)

❑ Data Needs

Variable	Value	Data collection method
New permits per year	400	
Permit requests per year	550	
Percent that could be handled by remote access	not available	review literature
Estimated fee for remote access	not available	review literature
Average backlog of requests	150	
Average response time per request		
jurisdictional advice	60 days	
minor permit	35-45 days	
major permit	80-90 days	
Average administrative cost per request	not available	conduct cost study
Number of governments involved per request	not available	conduct process analysis
Expected reduction in response time to customers	not available	survey customers
Expected reduction in staff time per request	not available	conduct process analysis
Average staff time spent per enforcement action	not available	conduct process analysis
Expected reduction in enforcements	not available	review literature
Value of citizen time per hour	not available	estimate from census data
Citizen hours spent at each agency involved	not available	survey customers

❑ Narrative Discussion

The narrative summary of the stakeholder analysis should be prepared after all possible data has been collected or estimated. It should cover the following points:

- priority service goals
- features of the proposed system that will address those goals
- who the stakeholders are and how they will be affected
- a quantitative analysis of the five or so most important effects, including a discussion of estimates and missing values where hard data is not available
- a qualitative assessment of the strengths and weaknesses of the proposal

❑ An Excerpt From the APA Stakeholder Analysis Narrative

The agency proposes a project to develop and demonstrate a rapid document and map retrieval system for agency records related to real property including thousands of current and historic permit and legal records needed by the public in order to carry out real property development activities in the Park. The system would combine digital imaging, database, and geographic information system technologies to create an “electronic reference desk” to provide immediate response to agency and public inquiries. The project will investigate methods of data retrieval that may eventually include external distribution of databases or remote electronic access for external users . . .

. . . APA’s direct customers would be most affected by the service. Land owners, realtors, attorneys and others involved in development projects would see faster more consistent land use decisions. Local governments will benefit from better data available from APA. The agency itself expects to reduce costs, improve productivity and improve public compliance with land use regulations . . .

. . . there is only a little business performance data available from the agency to document the time and cost of current operations, although there is ample evidence from public hearings and other sources that the length of time it takes to complete agency decisions is unacceptable to both the agency and its customers. . . A baseline data collection effort should be undertaken to document current operations and set performance improvement targets. . .

. . . the proposal has a number of strengths including the use of mature technologies (GIS and imaging) that have been used successfully to streamline operations in other settings. It responds to well-documented public criticisms of agency performance and approaches those criticisms with real committment to improve service. . .

Example 1B.
Prototype of a Geographic Information and Document Imaging System

At the time of the project, the APA staff had relatively little experience with the technologies necessary to support the "electronic reference desk" that they wanted to create. Moreover, no commercial off-the-shelf system that combined features of both a geographic information system (GIS) and a document imaging system was available for them to try. As a consequence, it was necessary to provide a series of activities that would bring the agency staff to a point where they could think realistically and creatively about the potential costs and benefits of the proposed system.

A series of activities designed to increase technology awareness was conducted. Geographic information systems were of greatest interest to the staff because of their potential to support analytic activities already being done by the professional staff. Initially, one of the corporate partners involved in the project (Computer Sciences Corporation) demonstrated for several key APA staff members a GIS application that had been developed for the Federal Emergency Management Agency to assist in planning hurricane relief activities in Florida. Although the application was quite different from what APA was proposing, and did not include document imaging, this demonstration was nonetheless quite effective in getting staff to envision system features, buy into the project, and build enthusiasm for further exploration.

Two prototype applications were subsequently developed and demonstrated to the agency. The first consisted of a work station that ran both a geographic information system and a document management system, but lacked any explicit linkage between the two. Although this was far from a working prototype of the full proposed system, seeing the capabilities of each of these subsystems helped the staff to define the most essential characteristics that would need to be included in the real system. It also helped them define more accurately those aspects of the proposed system that they wanted to have included in the second prototype. Their areas of concern included the ease of data entry and organization, the comprehensiveness and seamlessness of the functionality that would be made available to agency staff, and integration with the agency's existing database systems, and workflow. Although the second prototype had to be simplified a bit because of resource limitations, agency staff obtained a substantial appreciation for the potential of the technology through training on this second prototype.

A key issue was to estimate accurately the difficulty and likely cost of populating the proposed electronic system from the paper and microfilm documents that comprised the bulk of the agency's current data store. Because of the volume and variety of data needed to support their applications, it was not possible to create an electronic version of the data for the entire Adirondack Park. In the process of dealing with this reality, the agency faced the issue of which electronic data subsets would provide them with the greatest benefit, an issue that was addressed through the group modeling activities in the project. In the end, it was decided that the prototype should include all necessary data from one county to give staff the most realistic picture of how the ultimate system would work.

The modeling activities in the project were supported by the availability of the prototypes at the agency. The fact that the agency staff had been trained on and worked with the prototypes provided a more realistic basis for their cost, time, and process modeling than could have been obtained from their more diffuse expectations before being exposed to the technology.

In the end, the agency was very satisfied with the prospects of the prototype, and expanded the prototype into a pilot system that was installed at APA. This prototype is currently in use at the agency for those areas of the Park for which electronic data are available.

Example 1C.
Developing Cost and Time Performance Measures Using Group Decision Conferences

Two performance modeling conferences were conducted as part of the APA project evaluation process. Both used the services of a professional facilitator. The first, a cost-performance modeling conference was conducted to estimate the potential savings that would result from full system implementation. The second, a time-performance modeling conference, was to estimate the reductions in customer turnaround time that would result from a fully operational system. The cost-performance modeling conference sought to identify aspects of “cheaper” — would the agency be able to do the same work at lower cost if a system were implemented? The time-performance modeling conference focused on the notion of “faster,” — changes in agency performance from the perspective of its customers,. How much faster would the agency be able to respond to a customer inquiry?

These two modeling conferences are best understood in the context of the overall prototype evaluation process outlined below. Both were held following demonstrations to staff of the features and functionality of the initial prototype. Staff, therefore, had some sense of what the proposed system could do and how they would use it in completing typical agency business transactions.

Components of the APA Evaluation Process

- Initial Prototype Demonstration
- Cost-Performance Modeling
- Prototype Delivery & Staff Training
- Staff Interviews
- Time-Performance Modeling
- Data Modeling
- Synthesis

❑ The Cost-Performance Modeling Conference

The cost-performance modeling conference sought to compare the cost of a fully implemented system with expected productivity benefits. Its goal was to estimate full-system costs and those benefits that took the form of reduced agency costs. The participants represented all key customer transactions, as well staff responsible for data and system development activities. The group had enough agency expertise, as well as enough exposure to the prototype, to be able to envision how a fully implemented system could support work processes.

Rather than using only one possible system to estimate costs and cost savings to support a "go or no go" decision, the group compared two implementation options with the current system: a limited or minimal system, and an expanded or full system, as shown in Table 1. Table 2 shows the three system levels with their associated data groups. Estimates for the total cost of each implementation level were elicited from the group, as were potential savings in staff time. Both are shown in Table 3.

Table 1. Alternative Sets of System Features			
Functions	**Current System**	**Minimal System**	**Expanded System**
Access to Base Maps/ Basic Hardware	Update some maps on a 2 year cycle/ Unix Station in 2 locations with land class real time	A limited DOS network with 5 access points 2 dedicated Unix stations (some queuing problems)	Eliminate queuing problems with DOS network plus 4 dedicated Unix stations Windows PC's on every professional's desk
Identification of Related Documents	JIF, Enforcement, Wetlands, Project, pre-existing subdivisions indices, but no images in the system	Pull up JIF and project files and indices on a Park-wide basis	Integrated ORACLE system for permits and text on a Park-wide basis/Password protected security system for greater access
Review Documents for PSO Folders	Actual files	Images are sent to printer for hard copy file	Additional Development work with ability to scan in documents and document tracking - Electronic Files - Keep work in progress together as a package: collate archival folders
Map Preparation and Printing	Present Level of Cartographic Services	Color land use, topographical, and tax maps	Total of three color printers
Archiving	Manual and Microfiche	Microfiche only	Full electronic archiving of maps and document images
FAX Output	Manual	Manual	Computers with FAX cards
User Interface	Tax Map Lookups Existing Data Bases in different locations	Off-the-shelf interfaces developed with in-house support	APA staff more fully develop their own user interfaces-more in-house development work
Session Manager	None	None	An electronic visit/call log throughout building
Updating and Moving Documents Around	Manual	Limited cut and paste on clipboard	Update, correct, adjust, and cut & paste all documents/ critical dates can be tracked by the system
Modeling, Research, and Analysis	Word Searching/Index Searching	Adjacent mail addresses function added to the system	Revision "terrain" graphics, view shed definition, automatic calculation of distances, expert system prompting, GPS/Ecological lookup, extension of ecological look-up system
Management Functions	Activity Reports	Same as current	Customized tracking of work and scheduling

Table 2. Alternative Levels of System Functionality			
Data Population Strategy	Current Mostly Manual System	Automate Minimal Functionality	Automate Expanded Functionality
Digitize Groups 1,2,3			**Expanded Future System**
Digitize Groups 1&2			
Digitize Group 1 only		**Minimal Future System**	
Current Mixture of Paper and Digitized Data	**Baseline**		

Table 3. Comparison of Costs and Benefits								
	Dollar Costs(Thousands)					Dollar Benefits (Thousands)		
	One Time System Costs (1)	One Time Data Costs (2)	Total One Time Cost	Annual Staff Costs System Admin.	Annual Staff Costs Data Mgmnt.	Annual Staff Saving	Other Annual Savings	Total Annual Savings
Limited System with Data Group 1	$317	$206	$523	$30/yr.	$30/yr.	$142/yr.	$2/yr.	$144/yr.
Expanded System with Data Groups 1-3	$627	$220	$847	$60/yr.	$60/yr.	$237/yr.	$21/yr.	$258/yr.

(1) Includes Estimates for hardware, software, system development & staff training(
(2) For details see CTG.APA-009-009

This conference measured only those savings associated with current agency services. It did not consider the possibility that the system might provide the same services in a more timely manner nor that a higher level of quality might be achieved with a new system.

❑ Time-Performance Modeling Conference

In addition to anticipated benefits related to agency cost savings, it was also expected that a fully operational system would have a positive impact on customer response time. In fact, this was the primary impetus for the project. The second facilitated conference was designed to estimate how much less time a given customer would have to wait for the agency to complete each major type of transaction.

Preliminary data on customer transactions and agency data types required to support them, derived from staff interviews, was quickly modified to reflect the collective viewpoints of the participants. The analysis focused on eight transaction types where staff felt that productivity and turn-around time improvements were most needed, and where an automated system was expected to have the most impact. These represented approximately 80% of APA staff's current work load. For each transaction type, the group examined work flow details to identify which associated sub-processes could be expedited with the use of a new system. The results are summarized in Table 4.

Table 4. Estimates of Customer Service Improvements

Transaction Type	Transactions Per Year	Base Turnaround Time (days)	Limited System Time Saved		Expanded System Cumulative Time Saved	
			% Reduction	Days	% Reduction	Days
Major Projects	160	60	1%	0.5	3%	1.5
JIFs	900	20	25%	5	40%	8
Minor Projects	240	21	2%	0.5	5%	1
Phone Inquiries	4500	3	99%	2.99	99%	2.99
Public/Political Inquiries	30	5	10%	0.5	20%	1
Map Seeking	500	14	46%	6.5	46%	6.5
Local Planning Referrals	240	15	33%	5	67%	10
Resolved Enforcement (1)	200	90	6%	5	17%	15
Total Transactions	6770					
Avg. % Decrease (Weighted by number of transactions)			74%		78%	

*Limited System includes data set 1, Expanded System includes data sets 1-3

(1) One half of total enforcements are resolved in 90 days. Half remain unresolved.

These examples show how group decision conferences can be used to capture useful estimates of costs and benefits related to providing services cheaper and faster. While the same information could have been gathered in other ways, the group decision conferences accomplished this more efficiently than collecting the information from individuals. They also helped to build staff consensus and agreement on estimated costs and benefits. The conferences did not attempt to capture any benefits related to improvements in quality of customer service, the “better” aspects of the system. These were identified during the staff interviews and in a survey of agency staff.

Case 2: A Voice Response System for the Office of Regulatory and Management Assistance (1993)

❑ Mission

Each year, more than 33,000 people receive business permit assistance over the phone from the Office of Regulatory and Management Assistance (ORMA). To answer the variety of questions posed by callers, ORMA permit coordinators rely on a database describing nearly 1,200 permits issued by more than 40 different New York State agencies. Between 1979 and 1992, the Permit Assistance Program responded to more than a quarter million inquires from every state and 25 foreign countries. On the basis of a telephone interview about the kind of business the caller wants to start, the coordinators assemble customized Permit Assistance kits and send them to callers.

❑ Problem Statement

ORMA instituted a voice information processing system in 1990 to help direct incoming calls. That system acted primarily as a phone attendant, providing callers with only very basic information, usually related to which state agency was responsible for what kinds of activities (such as taxes or employer responsibilities). Callers seeking business permit assistance had to wait to speak with a permit coordinator. In addition, the existing voice system could respond only to callers with a touch tone phone. Those without touch tone service, or who failed to use it, always had to speak to a coordinator, even when their inquiry was not permit-related. The number of permit coordinators had been reduced from seven to four. As a result, by 1993, increasing demand and decreasing funding for the Permit Assistance Program combined to produce a serious customer service problem: only 16% of incoming calls were being answered on the first try. The rest received a busy signal.

❑ Potential Solution

Use more sophisticated voice response technology to meet the needs of customers. This new technology would enable callers to prepare their own business permit assistance kits by accessing ORMA's permit assistance database directly, using their own telephone equipment as an input device. Callers could use touch tone signals or spoken responses to reply to a structured set of questions about their business activities. Their answers would trigger automated preparation of the appropriate kit, which would then be mailed or faxed to the caller. Permit assistance coordinators would still handle unusual or very complex situations.

❑ References

David F. Andersen, et al. Reviewing the Performance of ORMA's Voice Response System for Automated Business Permit Information. CTG.ORMA-10. Center for Technology in Government, March 1995.

David F. Andersen, et al. Voice Information Response System for Business Permit Assistance. CTG Project Report 95-1. Center for Technology in Government, May 1995.

❑ Examples of Evaluation Products and Methods Used in the ORMA Project

2A. A Group Decision Conference to Estimate Full System Benefits and Costs

2B. A Process Model of the Business Permits Problem

2C. A Simulation Model of Potential Solutions

2D. Measuring System Performance With an Experiment

Example 2A.
A Group Decision Conference To Estimate Full

While the ORMA prototype was being constructed and tested, the project team decided to use a one day group decision conference to get some of the numbers necessary to complete a cost benefit analysis for the full system. The conference results were surprising and led to a more formal process-mapping exercise, and eventually to a full system simulation model. The initial attempt to model the full ORMA voice response system is described here, organized into the six steps recommended for getting started on a modeling project in Chapter 2.

❑ Step One: Gather Points of View

This step had already been completed in the ORMA stakeholder analysis. The project team believed that they understood who the ultimate customers for the system were, what the system was supposed to do, and what would be appropriate measures of benefits and costs. Internal stakeholders included the operators who actually ran the present system, the managers of the ORMA division that provided permitting information, and the financial managers of ORMA, who were interested in controlling costs and making wise technology investments.

❑ Step Two: Create a Common View of the Problem

The decision conference participants were the team of CTG researchers and senior ORMA staff representing all the internal stakeholders for the automated permitting system. The group convened with a clear purpose and a common view of the problem — the conference was designed to elicit the estimated costs of the proposed new system in terms of hardware, software, and data entry, as well as miscellaneous expenses such as postage, copying, and faxing permit information packets to callers. The conference was also designed to estimate the current costs of providing this same information through human operators. An important conference goal was to estimate the time it would take to serve a caller through an automated system versus a human operator.

❑ **Step Three: Use the Common View to Decide What's Important**

The team expected that the numbers elicited during the conference would provide a cost benefit justification for a full-blown version of the prototype automated system, but the results were not so clear. They suggested instead that the alternative of simply adding ports to the existing telephone response system also needed to be examined. The participants proposed that a more complete simulation model of the automated permit assistance process be constructed and analyzed, because the simpler model developed at the conference did not create an acceptable common view of what ORMA needed to do next.

❑ **Step Four: Get Some Numbers**

The decision conference centered on estimating key numbers that could cost justify the full system. These numbers were integrated into a simple spreadsheet model to calculate time and cost savings as well as costs associated with system acquisition, Under the leadership of a skilled facilitator the group followed a two step process.

1. Volume Elicitation. The first task involved determining the overall number of calls received, and how many were being served by human operators and by automated response in the present system. Special attention was paid to call volume in the "top 5" and "top 20" business categories.

2. Time Savings and Cost Estimates. For major types of customer calls, the group estimated the amounts of time that human and automated responses would take. 95% confidence intervals were elicited for most expensive (in terms of operator time) and least expensive calls. Table 1 is an example of the product from this task. The group worked for several hours using both available data and their own detailed knowledge of operator performance to develop these numbers.

Table 1. Service Time Average Estimates for ORMA Response System

		Operator	Automated
Most Complex (restaurant)	Average 95% Int.	11 min per call 2-20 min.	12 min. per call 5-20 min.
Least Complex (gift shop)	Average 95% Int.	6 min. per call 2-10 min.	8 min. per call 4-15 min.

❑ **Step Five: Do "What If" Analysis to Test the Robustness of Your Emerging Model**

Using these numbers, a simple spreadsheet was built to provide a complete picture of the comparative costs of the current system and of a full implementation of the proposed automated system. Table 2 shows the final estimates for the costs and savings associated with the automation of the top 20 categories of calls. The "bottom line" shows that the automated system would cost an estimated $69,800 per year, but would save the agency only an estimated $49,900 per year. These figures needed to be interpreted with caution because they did not include a full system-wide analysis of the impacts of the automated system.

Table 2.
Group Estimates of 5 year Savings & Expenditures Associated with Implementing ORMA Pilot (Assuming Consistent 36,000 calls/yr.)

	Expenditure(a, $)		**Savings(b, $)**	
Top 5 (2340 call) [10 min./call]	equipment script/voice S&E (packets)	28.0k 2.0k 1.6k	operator time (11.1 wk) follow-up time (8.3 wk)	$8.9k 6.6k
Top 6-20 (4660 calls)	script/voice internal staff S&E (packets)	30.0k 5.0k 3.2k	operator time (22.2 wk) follow - up time (16.6 wk)	17.8k 13.2k
Short Answer (additional 3000 calls) [3 min.,/call]			operator time (4.3 wk)	3.4k
First Year Total		**$69.8k**		**$49.9k**

(a) First-year expenditures have been divided by 5 and projected over 5 years.
(b) Staff costs have been estimated at $800 per week including fringes.

❑ **Step Six: Decide If You Need to Contact Modeling Experts**

This preliminary analysis suggested that the costs of the new system would exceed its benefits. The group spent two or three hours puzzling about why the costs were so high and the benefits so relatively low from this exercise. Was it a mistake in the analysis? Or were the team's initial and fairly clear assumptions about costs and benefits that far off? The team decided to return to step two and create a larger common view of the problem. This exercise highlighted the fact that high volume areas of call-ins did not involve complicated permit assistance, and that providing complex permit assistance help was actually a low volume activity. Indeed, a more complete model would have to take into account the performance of the agency's 800-service lines as well as the volume of the front end of the system initially answering calls (measured in ports). The team decided that these interactions were too complex to be described adequately in a one day decision conference and opted instead for a more complete process modeling exercise.

Example 2B.
A Process Model of the Business Permits Problem

As a next step, the project team decided to create a more detailed visual process map of how the full scale ORMA voice response system would operate. This would include performance of operators, clients, a simple call screening system, a complex permit assistance program, the incoming phone line management, and the dynamic allocation of computer ports to incoming calls. This process mapping took a system modeling consultant several days to complete after interviewing all of the participants and managers in the ORMA permit assistance program. The result is shown in Figure 2.

Figure 2 shows how a call to the existing ORMA phone system was processed. A caller received a busy signal if there was no line available. (The number of telephone lines determines the number of calls the system can process simultaneously, whether by operators or by voice service.) Callers who received a busy signal and did not call again were considered "lost calls." If the line was available, the phone system checked for port availability. (The number of ports determines the maximum number of calls the voice service can process simultaneously.) If a port was not available, the caller had to wait for an operator to respond, as did callers who did not have a touch tone phone.

The then-current voice response service could not process a call requesting information on business permits. These calls were transferred to an operator. Automating business permits would enable the voice response service to process calls for business permit information, without the caller having to wait for an operator. Calls for other kinds of information would also be handled by the new voice service. Callers not satisfied with the voice service would wait for an operator.

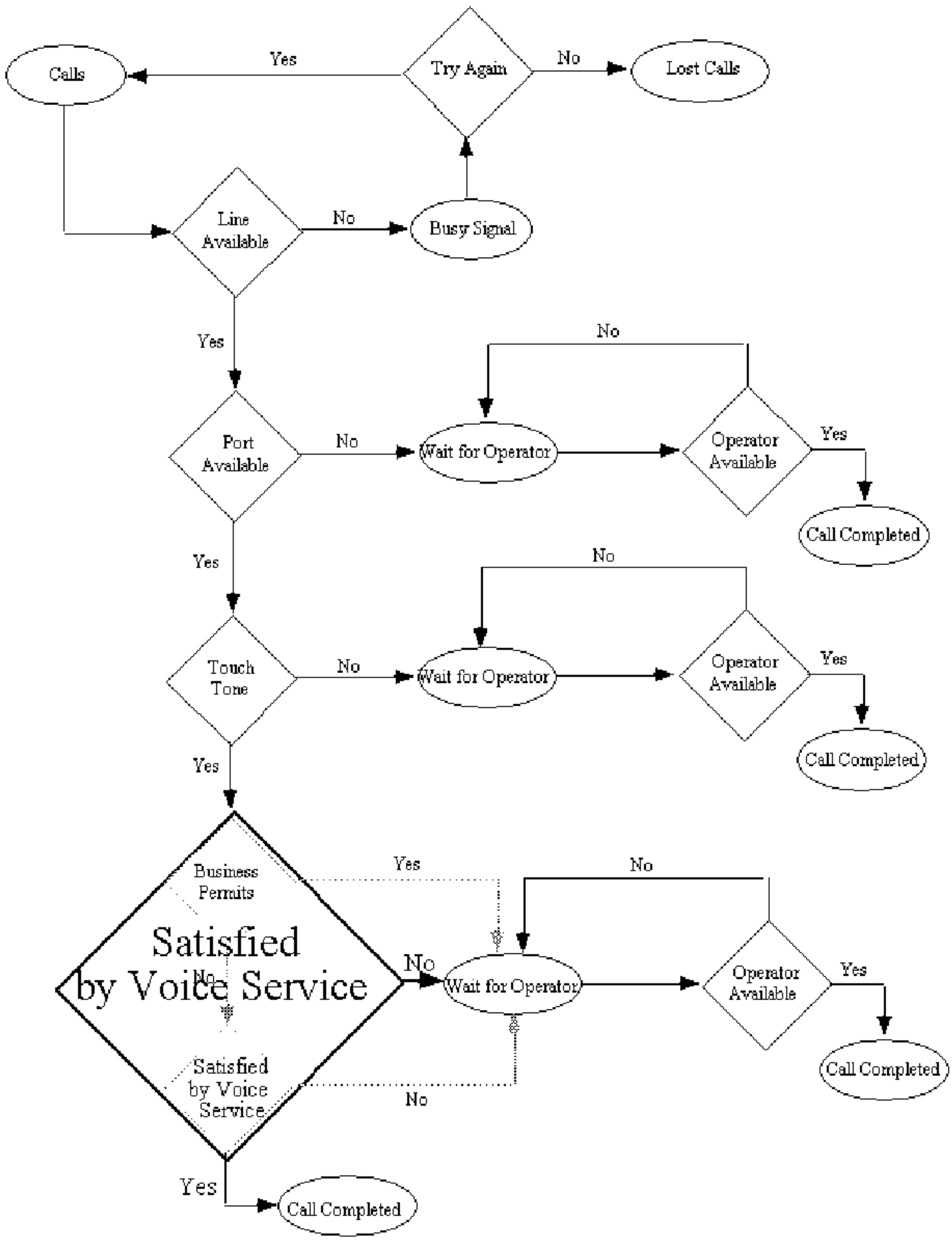


Figure 2: Logical Flowchart of Call Processing and The Effect of Automating Business Permits

Example 2C.
A Simulation Model of Potential Solutions

A cursory examination of the process map convinced the project team that the number of variables involved in thinking through the full benefits and costs of the system could not be handled by a group sitting in a room, eliciting numbers, and plugging them into simple spreadsheets. A more complex modeling effort was called for.

Over a four month period, CTG staff constructed and analyzed a system dynamics simulation model of ORMA's complete permit assistance program. It simulated incoming calls, including call backs, pre-screening by the automated system, forwarding to an automated permit assistance program, forwarding to human operators, and operators' client service activities. Within a simulated environment, this model made it possible to explore the consequences of hiring more operators, adding more telephone lines, or adding more ports to support the voice response and automation system. The model permitted exploration of the implications of adding these various types of capacity in the face of constant customer demand for information, as well as a doubling or tripling of demand. The simulation was capable of analyzing operator utilization, client waiting times for services, total call volume, estimates of number of lost calls, plus other variables relevant to the operation of the permit assistance program. The model relied on data from the prototype, as well as from ORMA's existing system.

The simulation model confirmed the finding of the cost performance modeling conference, that for present levels of client demand, hiring one more operator would be more cost efficient than automating the permit assistance program. This analysis also showed, however, that hiring an additional operator without expanding the base capacity of the phone and computer systems supporting the operators would lead to low marginal productivity of human operators and wasted resources. The model demonstrated that, at higher volumes of demand, the automated permit assistance program could substitute for one or more human operators. In addition, the model demonstrated that the volume of inquiries being handled by the current ORMA system was probably limited more by internal capacity constraints than by customer demand (i.e., ORMA lacked the capacity to respond to the existing number of incoming calls).

The major steps required to create the ORMA system simulation model are presented briefly here with examples of some of the products derived from it. A complete description of the assumptions, structure, data needs, and results of this simulation exercise can be found in Mohammed T. Mojtahedzadeh and David F. Andersen, A System Simulation of ORMA's Business Permits and Phone-based Public Assistance Program, CTG.ORMA-007, (Center for Technology In Government, 1994).

❑ Create a Common View of the Problem — A Sector Overview Diagram of the Simulation Model

The first step in moving from the process map to a simulation model was to propose the major sectors that must interact to create the problems (and solutions) being studied. This could have been done though a group decision conference, but in this case, the sector overview diagram was constructed from interviews with the management team. Figure 3 is the sector overview diagram of the simulation model that emerged from these interviews. The model consists of three sectors. The Caller Sector reflects citizen demand for ORMA's phone system. ORMA's Phone System sector provides information to the System Performance Sector. The System Performance Sector provides indicators for decisions on capacity expansion strategies, as well as information to the Reputational Dynamics Sector. The higher the system performance, the larger the magnitude of the reputational dynamics, which determines the number of ORMA's customers. The reputational dynamics were not formulated in the model. Instead, different scenarios with changing base call volumes were introduced to capture the effect of system performance on customer satisfaction and on citizen demand.

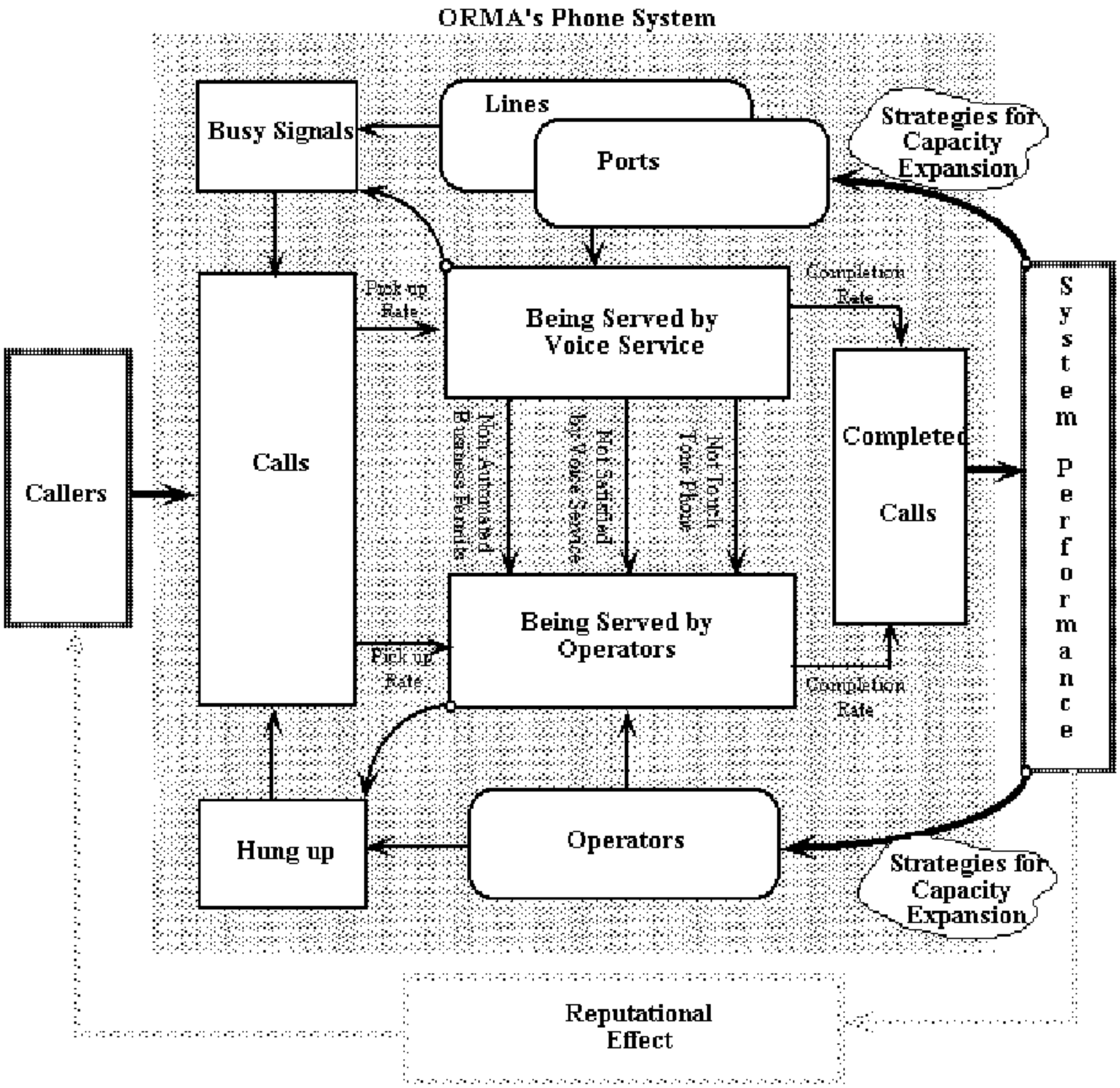


Figure 3: The Sector Overview of ORMA's Business Permits and Phone-Based Public Assistance.
(Note that reputational effect is not formulated in the model. Instead, different scenarios will be introduced to capture the effect of system performance on citizen demand.)

❑ Translate the Process Map and Sector Diagram Into a Simulation Stock and Flow Diagram

The process map and sector diagram provided conceptually complete, common views of the ORMA voice response system, its present problems, and potential solutions. Although understanding how the sectors interact and what the detailed processes at work are is important, by itself it is not sufficient to simulate the effect of capacity constraints on overall system performance. This requires a more comprehensive flowchart that not only provides information about the procedures of call processing, but also gives information on the number of calls at each stage of processing. A stock and flow diagram provides both types of information — the stages of call processing and the number of calls being processed in each stage — that are required in simulation.

Figure 4 is the principal stock and flow diagram of the ORMA simulation model. It shows how a call coming into the system is processed to completion. It also provides the number of calls at each stage. A rectangle (level variable) represents the system condition at any point in time. Level variables accumulate the number of calls in different stages of call processing. Rate variables (circles) describe how level variables change over time; they represent the system activity. When combined into a flow diagram, the level and rate variables, with the associated flow paths between, show how calls flow through the system.

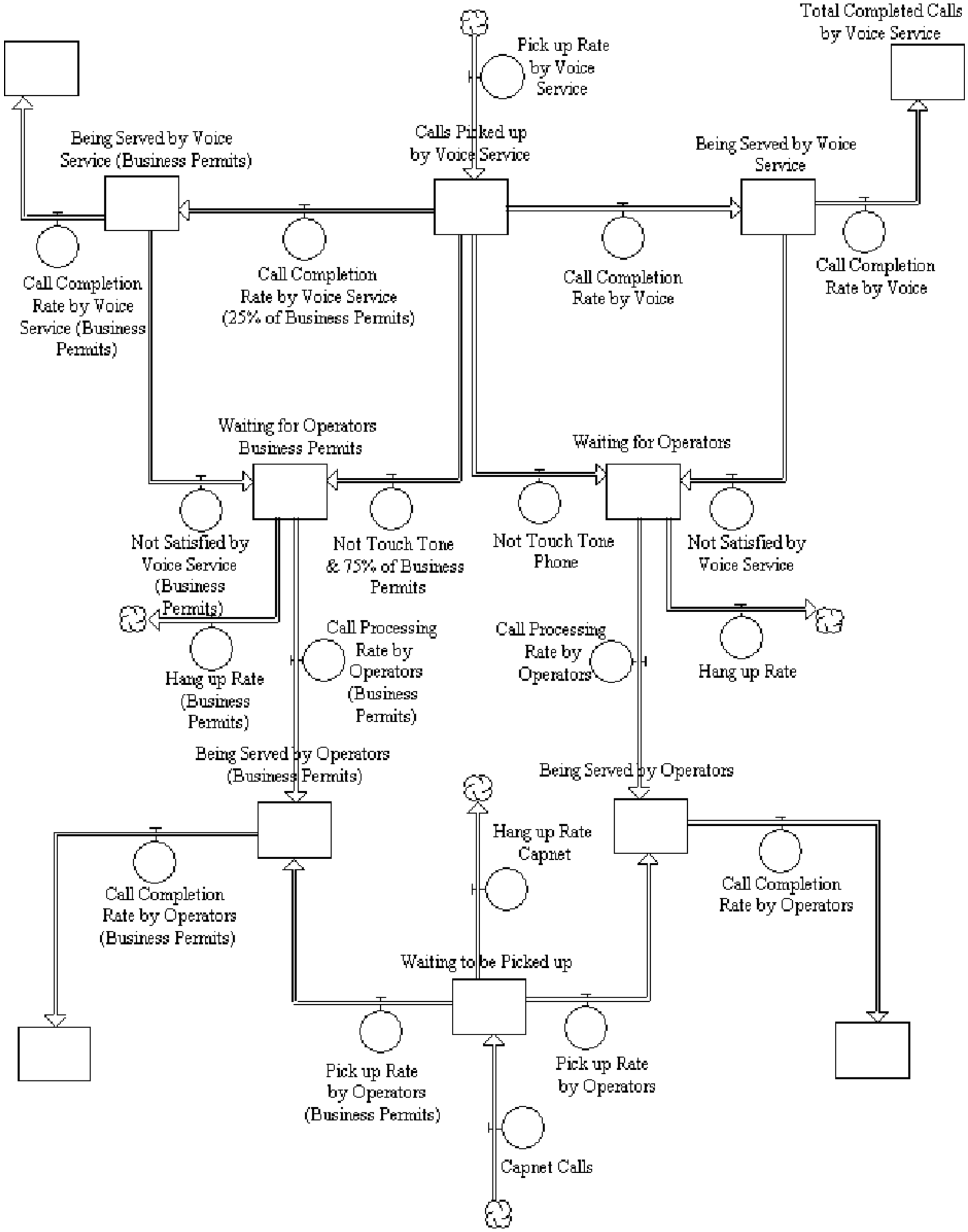


Figure 4: Stock and Flow Diagram of ORMA Model

❑ Get Some Numbers and Specify System Performance Measures

The stock and flow model in Figure 4 is output from a formal simulation language, STELLA. This simulation language allowed the modeler to use the exact parameters that had been estimated in the initial one day decision conference to create a daily simulation of how a full scale voice response system would work at ORMA. For this model, some additional data were needed because the decision conference did not deal with the phone line system, with the dynamic allocation of port capacity to incoming calls, nor with customer call-back dynamics. These numbers were estimated either from agency records or by the project team.

Since the purpose of developing the simulation model was to measure system performance, it had to calculate performance measures that described how well the voice response system would do on a typical simulated day. Hence, the model calculated attempts per completed call, waiting time for an operator, average output-input ratio, and telephone line, port, and operator utilization to evaluate system performance. The behaviors of some of these variables could be dynamically correlated with others.

❑ Use the Model to Simulate System Response

Given the structure of the model and its parameters as gathered from the agency, the behavior of the measures of system performance could be simulated over time. A base run of the model captured the current situation, replicating in simulated form the problems ORMA was experiencing with its permit assistance program. Subsequent model runs could then simulate the impact of adding phone lines, of adding ports to the system, of adding more operators to handle calls, or of adding an automated voice response system.

ORMA management verified that the dynamics generated internally by the simulation model presented a fair description what happened on a typical day within the agency. The stage was now set to use the model to experiment with different policies and investment priorities to solve the problems that were now evident both in reality at ORMA and from the base run simulation within the model.

❑ Use the Simulation Model to Explore Different Solutions to the Agency's Problem

The simulation model enabled the project team to do "what if" analysis. It permitted exploration of the consequences of adding various types of capacity in the face of current customer demand for information, as well as doubling or tripling the base level of demand. Within the simulated environment, three different policies were explored:

1. Hire additional operators
2. Implement new system hardware
3. Automate business permits

Since improved performance leading to better service could in turn lead to more calls, three scenarios were simulated representing dramatically different volumes of activity being handled by the agency:

- Scenario I: current base volume; 150 completed calls a day (approximately 37K calls a year)
- Scenario II: 300 completed calls a day (approximately 74K calls a year)
- Scenario III: 450 completed calls a day (approximately 110K calls a year)

The simulation model provided management with a flexible tool for experimenting with alternative futures for the agency's permit assistance program. It turned out that what was an efficient and effective solution in the short run, when caller volume was low (Scenario I), did not work well in the longer run, when caller volume increased. In relatively low volume scenarios, the best policies favored adding new system hardware and hiring more operators, whereas in higher volume scenarios, automation provided a cost-justifiable alternative to relatively more expensive operator time. The final project report gave a fairly complete view of alternative simulated futures.

Example 2D.
Measuring System Performance with an Experiment

A primary goal of the ORMA project was to test the effectiveness of a proposed new voice response system in delivering complex information to agency customers, because ORMA was interested in a technology solution that would improve or enhance customer service. The prototype addressed issues associated with the technical feasibility of an automated voice response system. Equally important to the agency, however, were customer perceptions of such a system and the relative ease with which individuals would be able to get the information they needed. The project team wanted to compare the relative effectiveness of various approaches to disseminating business permit information. For example, were people just as likely to obtain and retain information provided by a voice response system as by a human operator? How user friendly was the proposed system? Did customers encounter difficulty navigating through its menu choices?

An experiment was designed and carried out to address these questions. The goals were to:

- Assess clients' perceptions of both the prototype and the current system
- Check for differences in accuracy and consistency in information dissemination and retention across mechanisms
- Assess user satisfaction with different phone systems
- Develop an understanding of clients' information search s trategies
- Assess perceptions of the complexity of the New York state regulatory environment

❑ Participants

While it would have been preferable to conduct the experiment using real agency customers, that was not feasible. First, the experiment had to be completed quickly, and second, the prototype was populated only with information about the top six business types, based on frequency of customer inquiry. Therefore, it would have been impossible to get enough useful participant responses from real agency customers in the time available. Instead, the experiment used graduate students in business and public administration.

❑ Methods

Under quasi-controlled circumstances, approximately 60 graduate students were instructed to find and report the permit information that would be required to start one of the six types of businesses in New York state that were included in the prototype. The students were divided evenly into three groups. Twenty were directed to use the prototype, twenty to call ORMA's existing system (eventually connecting to human operators), and twenty were given no information about ORMA, but simply told to use existing information sources such as the public library or the phone book. Participants were asked to limit their searches to two hours. They were to turn in an answer sheet that listed the permits required for their assigned business type, as well as what forms and fees were required for start-up. Additionally, participants turned in a time log and a survey designed to gather their reactions to doing business with New York State. Each participant was paid $20 upon completion of the experiment.

ORMA Experiment
(3 Conditions)

1. ORMA Group
2. Prototype Group
3. Control Group

❑ Results — Accuracy and Reliability of Information

This experiment tested the relative effectiveness of the automated business permit system in providing business permit information. One aspect of effectiveness is the accuracy and reliability of the information disseminated by the automated system. This in turn can be divided into two parts: the accuracy and completeness of the information being given out by the source, and the accuracy and completeness of the information as received and recorded by the client. This analysis assumed that the information encoded in the prototype was accurate and that the information base of ORMA operators was complete and accurate. Hence, any inaccuracies should be attributable to a combination of incomplete information either being sought or given and inaccuracies in how information was perceived and recorded by participants. The best measure of accuracy and completeness was defined as the final scores that participants received on their answer sheets.

As Table 1 shows. the accuracy and completeness of information collected were quite low for all three groups, with a mean score of only 38%. When the search was complete, the average participant, including those who called the prototype or ORMA, had recorded less than half of the information that he or she should have collected. Even the best performer missed roughly one quarter of the information that should have been collected. The large standard deviation in responses indicates that this rather low overall accuracy varied quite a bit from participant to participant. Several participants scored zero, indicating that after 2 hours of information searching, they had not recorded any correct information.

Ironically, in light of the relatively low scores for information collection, 43% of participants were confident they had obtained all of the information that they needed to file for the permits related to their assigned type of business. A statistically significant correlation was found between participants' actual accuracy score and their level of confidence about having obtained all of the needed information.

Table 1.
Accuracy and Variability of Responses by Group and Group Measure of Confidence in Responses

Group	Group Size	Mean Score on Permit Responses	Standard Deviation of Mean Score	Fraction Confident Got All Information
ORMA Group	16	36	23	50%
Prototype Group	18	47	16	50%
Control w/ORMA	5	49	21	40%
Control w/out ORMA	12	21	13	25%
TOTAL	51	38	21	43%

The table includes one additional group. Of the 17 usable responses in the control group (the group that was not given any direction as to where to search for information), 5 respondents identified ORMA and contacted the agency for information. Their responses are separated from the rest of the group.

Additional questions remain as to why those participants who did contact ORMA in one form or another did so poorly in terms of accuracy and completeness and why there was such high variability in scores. An item-by-item analysis of answers missed did not reveal any strong pattern for either group. Missed answers seemed to be spread randomly in the answer sheets. There is some evidence that participants using the prototype had difficulty capturing all of the necessary information as it came to them over the phone (the Fax-back feature of the prototype was not working during the test). On average, a participant spent 39 minutes interacting with the prototype phone system. Of those who interacted with the prototype system, 61% had to have options repeated several times, while 89% had to have options repeated at least once.

With respect to those individuals who contacted ORMA's current system, the data also suggest that participants had some difficulty navigating their way through it. For example, one third of the participants who called the present automated screening system did not report contact with a human operator. It appears they hung up before they got to an operator, believing that no further assistance was available to them. As it is necessary to contact a human operator under the current system in order to obtain the permit information, the inability of these individuals to get through to an operator provides some explanation as to why their scores were so low.

The experiment provided no clear answer as to why the overall participant accuracy and completeness scores were so low. These results point to a clear need to understand, in greater depth, the behaviors of clients who call into the system and how information can be more effectively transferred to them.

❑ Results — Customer Satisfaction

Client satisfaction with the prototype can be decomposed into several component parts. First, we can compare the overall satisfaction level of those who called the prototype with the satisfaction level of those who contacted a human operator at ORMA . Second, we can examine how the levels of satisfaction varied from one part of the telephone protocol to another, such as getting through on a phone line, being pre-screened by the automated voice response system, and finally receiving more complex permit information either from the voice response system or from human operators. Finally, we can consider whether the survey results provide any indication of why clients are more or less satisfied with various components of the service that they get from the prototype. Each of these was addressed in the experiment.

Table 2 presents a summary of level of satisfaction of participants who interacted with the prototype as compared to those who interacted with ORMA. Each value reported in Table 2 indicates the percentage of participants in that group who agreed with the survey item.

Table 2.
Comparison of Participant Satisfaction, by Selected Components of ORMA Service

Survey Item	Prototype	ORMA Human Operators	ORMA Automated Call Screening
Overall Satisfaction with Interaction	81%	100%	NA
Easy to Get Information	53%	100%	NA
Enjoyed Interaction	41%	100%	11%

Table 3 examines the interactions in more detail, and indicates clearly that the poor performance of ORMA's 800 phone line service was detracting from customer satisfaction.

Table 3. Comparison of Client Satisfaction with Various Types of Phone Line Connections			
Survey Item	**Prototype 800 Phone Lines**	**ORMA 474 Phone Lines**	**ORMA 800 Phone Lines**
No Difficulty with Phone Connection	90%	92%	44%
Satisfied with Timeliness of Phone Connection	94%	100%	38%
Got Through on First Call	89%	73%	17%

Table 3 also explains why clients are relatively dissatisfied with phone connections at ORMA, particularly the 800 phone system. While 89% of the clients calling the prototype got through the first time that they called, this dropped to 73% for ORMA's 474 phone system and to only 17% for ORMA's 800 phone system.

Table 4 analyzes in more detail the experience of those who accessed the prototype system. It is noteworthy for project planners that nearly a third found the process to be too complex for an automated system.

This finding is confirmed elsewhere in the participant survey, with 89% of those calling the prototype reporting having to have options repeated at least once in order to get the needed information. These data suggest that obtaining all of the necessary information from an automated system may be difficult. The average client calling the prototype spent a total of 39 minutes getting information, including one or more call backs for most. By contrast, clients who called ORMA reported an average of only 10 minutes getting permit information from human operators. Clients who called the prototype expressed relatively high levels of satisfaction with their interactions, despite not finding it easy to get complete information. Most did not

Table 4. Participant Perceptions of Prototype System			
Statement	**Disagree**	**Neutral**	**Agree or Strongly Agree**
Recorded Information was Useful	12%	18%	70%
Process too Complex for an Automated System	47%	23%	30%
Recorded Information Complete	12%	23%	65%

enjoy the interaction, by contrast with those who called ORMA and spoke with a human operator.

This discussion illustrates the use of an experiment and accompanying participant survey to test the effectiveness and client perceptions of a prototype technology solution. The results of the experiment complimented the findings of other aspects of the overall prototype evaluation. While the prototype tested the technical feasibility of an automated voice response system, and the system dynamics and cost-performance models examined the cost-effectiveness of such a system under various scenarios, the experiment provided insight into customer satisfaction and system effectiveness in providing complex information. Additionally, the survey results gave the agency some feedback about what customers liked and disliked about the prototype system and therefore some ideas about what might be done differently if the IT solution were actually implemented.

Case 3: Internet Services Testbed (1996)

❑ Background

Electronic networks have become an increasingly important means of communicating in today's world. Networks can be used to disseminate information to customers, and to transact business. Internet-based government services can be accessed by customers 24 hours a day through commercial networks such as America On-Line or CompuServe, or through community networks. Networks can be used by agency staff to link remote offices to central agency databases, to link agencies with their suppliers and contractors, and to exchange and share information between agencies and levels of government. For these reasons, most government organizations are eager to use the Internet to deliver services to citizens and to conduct internal business.

❑ Problem Statement

There is very little experience to date in using the Internet as a channel for delivering government services. The technology is new and evolving very rapidly. The traditional methods that agencies use to define, design, and develop information systems do not seem to work very well in this highly public, networked environment. For example, security, both internal to an agency site and on the network itself, has been identified as a major obstacle to making effective use of the Internet. Other barriers include lack of experience in managing networked information resources, resistance to change, and lack of knowledge about how to measure costs and benefits.

Because so many agencies are trying to learn how to use Internet technologies, there is a critical need for standard tools, such as guidelines for designing and implementing Internet-based services, a methodology for identifying customer needs and for estimating the potential of the Internet to meet those needs, recommendations for staffing and management, compilations of sound information management practices, recommendations for security measures, and help in identifying and quantifying costs and performance targets for Internet services.

❑ Potential Solution

A multi-agency testbed project, where government organizations of different kinds and sizes would work together to develop World Wide Web sites to support their individual missions. The testbed would also result in a set of guidelines and practices for Internet-based services that could be shared widely as models for other public organizations.

❑ References

Theresa Pardo, David Connelly, and Sharon S. Dawes, Delivering on the Web: The NYS Internet Services Testbed, CTG Project Report 96-1. Center for Technology in Government, September 1996.

Sharon S. Dawes, Theresa Pardo, Peter Bloniarz, Ann DiCaterino, Donna Berlin, and David Connelly, Developing & Delivering Government Services on the World Wide Web: Recommended Practices for New York State, CTG.ISG-1, Center for Technology in Government, September 1996.

❑ Examples of Evaluation Products and Methods Used in the Internet Services Testbed Project

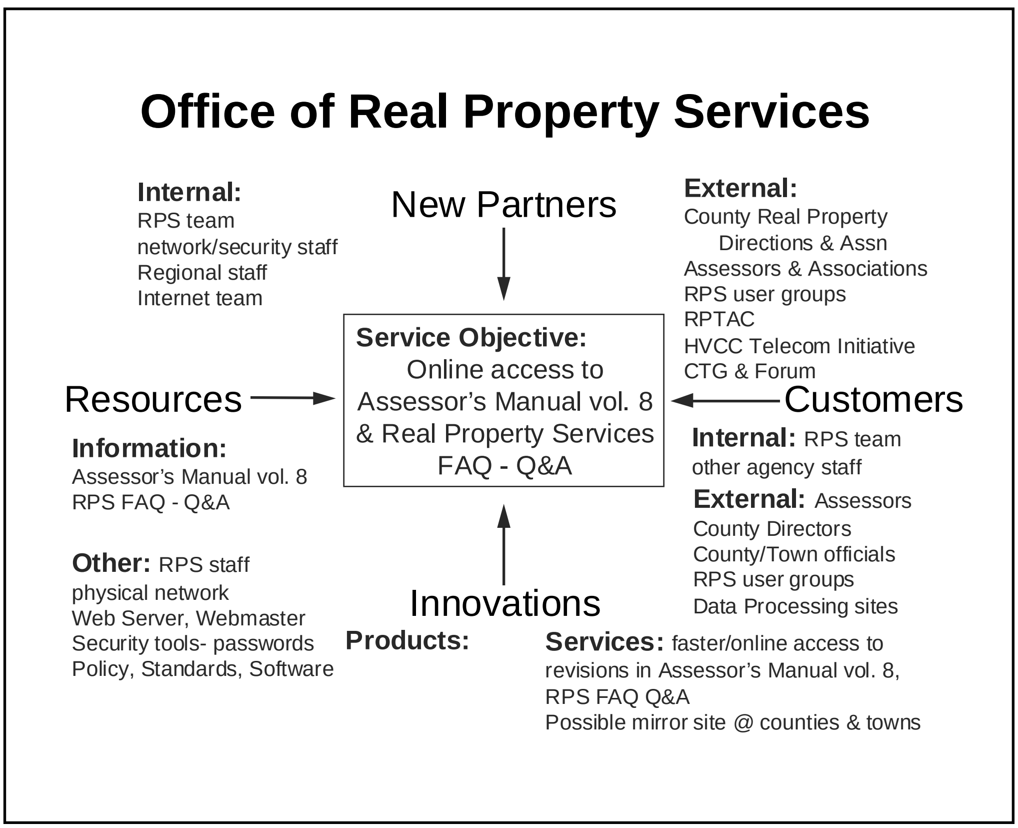
3A. Strategic Framework Using Group Decision Conferences

3B. Finding Best Practices Through Electronic Internet Searches

3C. Assessing Performance Barriers With a Survey

Example 3A.
Strategic Framework Using Group Decision Conferences

One of the Internet services testbed agencies was the New York State Office of Real Property Services (ORPS). Its Internet service goal was to enhance communication and information sharing with local assessors and county real property tax directors. The World Wide Web site that ORPS planned to develop would make its "Assessor's Manual" (which undergoes frequent changes), and related "Frequently Asked Questions" documents available on-line to these local officials to replace cumbersome paper documents that generated high printing costs, were difficult to maintain and use, and were often out of date. A strategic framework for this initiative was created in a facilitated group discussion at one of the testbed workshops. All members of the project team participated in refining the statement of service objective, and in identifying customers, innovations, resources, and potential partners for achieving it. Their finished product looked like this:



In reviewing the results, the ORPS Web development team recognized the critical need to add program staff to their group, since the main information resource (the assessor's manual) was created and maintained by the Real Property Services unit. They also began to identify the characteristics of their expected customers so that they would be better able to choose technologies that will meet their needs.

Example 3B.
Finding Best Practices Through Electronic Internet Searches

The Division of Military and Naval Affairs (DMNA) was also involved in the Internet Services Testbed project. DMNA manages the New York Army and Air National Guards, the New York Naval Militia, and the New York Guard. It handles all kinds of emergencies and manages a variety of armories. DMNA used best practices research to help define the content of its Web site, and to identify key presentation and technical features that would deliver the agency's message in an attractive, user-oriented, and cost-effective way. While best practices research can be conducted in various ways, DMNA chose to rely heavily on the Internet itself as the best source of expertise, experience, and examples of how military organizations around the country were using this fast-growing means of communicating with the public.

The questions DMNA sought to answer with its best practices research included:

- What kind of information about "citizen-soldier" programs is best suited for presentation on the World Wide Web?
- What is the content of the Web sites created by other states and the National Guard Bureau?
- Which styles and methods of information delivery in these sites are most and least effective?

DMNA staff visited the WWW sites of seven states and the federal National Guard Bureau. They evaluated each site, noting both good and bad practices that they wanted to be aware of in developing their own Web site. Sample pages from these Web sites were printed out in color to illustrate and document the staff's assessment of each. The package of information then became a handy reference guide as the DMNA staff further defined and designed the agency's own site.

Some of their findings were:

- Identification of good business uses of the Internet, such as recruiting, announcing full time employment opportunities, and providing information about benefits to guard members, their employers, and their communities. Useful organizational topics and services including mission statements, phone directories, and unit locations (especially sites that used maps). Useful links to other military information sites and to other relevant information within the state.

- Examples of good design principles in action: clear organization, consistent look from page to page, information about how to contact the person responsible for maintaining the Web site, attractive color schemes, effective home pages that give visitors a complete and accurate overview of the entire site.

- Examples of bad design: overuse of graphics that make the site extremely slow to load and add little useful information, no way to contact the organization to ask questions or give feedback, sites that are little more than empty shells with little useful information for visitors, sites that are organized and presented from the agency's rather than from the customer's point of view, sites that have no discernible information structure that users can understand, sites that follow no consistent format from page to page or that offer little navigation aid to visitors.

As a result of this best practices review, DMNA was able to define more clearly the information that could usefully be presented on its Web site. The agency staff devised a consistent format for use on all pages, and an informal set of customer-oriented criteria for evaluating each page or feature they developed. They also identified their counterparts in several other states for on-going discussions about mutual concerns.

Example 3C.
Assessing Performance Barriers With a Survey

One objective of the Internet Services Testbed project was to identify barriers that agencies encountered in their efforts to define, design, and deliver government services over the World Wide Web. The project involved a series of group workshops held over a six month period. Some time was reserved at each workshop for agency staff to discuss their progress, problems, and insights with one another. These discussions were recorded in staff notes throughout the project. At one of the later workshops, the agency staff were asked to identify explicitly the technical, managerial, and policy barriers they had encountered during their projects. Each agency team devised its own list and presented it to the full group. All the agencies, working together, then made a rough priority ranking of the most significant barriers they had encountered overall. This information became the basis for a formal survey of agency participants that was conducted by mail. Each individual member of each agency team was sent a survey and asked to respond. Follow up calls were made to those who had not responded by the due date. The results were summarized for presentation at a public demonstration of the Internet Services Testbed project, and were further refined in agency interviews leading to the final project report. Part of the survey instrument is reproduced here:

Survey of Barriers Encountered and Lessons Learned in the Internet Services Testbed

Instructions:

Barriers Encountered:
The following three pages (pages 2,3, & 4) contain technology, management, and policy barriers encountered by agencies in the Internet Services Testbed. If you attended Workshop 3, these items should be quite familiar. For each item in each list, please circle the number that corresponds to your professional opinion about the severity of that item as a barrier to Internet service development in your agency. If the barrier was severe, circle 7. If the item was not a barrier at all, circle 1. If your opinion falls between these two extremes, circle the number that best represents your opinion. If you have no opinion, circle 9. There is space at the bottom of each list of barriers for you to add barriers that you encountered that are not on the list. If you add a barrier, be sure to circle the number that corresponds to its severity.

Assurances
No information you supply on this survey will be attributed to you personally. You will be able to review anything we write about your agency.

Please answer the following questions about yourself before you begin. These demographic data will help conduct our data analysis.

1. Name of your agency: ____

2. Your own professional specialty (check one)
   [ ] IT or MIS
   [ ] Public Affairs
   [ ] Program Management
   [ ] Research
   [ ] Planning

3. Do you consider yourself an experienced Internet user? (check one)
   [ ] Yes
   [ ] No

Please complete this survey by COB Friday, June 14 and FAX it back to CTG at 442-3886. Thank you!!

Technology Barriers to Internet-based services	A Severe Barrier					Not a Barrier		Don't Know
1. Existing technical infrastructure in our agency (equipment, local & wide area networks, software, support) is inadequate, incomplete, obsolete, or inappropriate	7	6	5	4	3	2	1	9
2. Technical staff do not have the needed expertise and are not given the time to develop it (a learning curve problem for both development and ongoing operations).	7	6	5	4	3	2	1	9
3. Among the technical staff, there are widely varying levels of understanding of the Internet and Internet tools.	7	6	5	4	3	2	1	9
4. There is a need to know so many new technologies.	7	6	5	4	3	2	1	9
5. There is an overabundance of technology choices, making it difficult to settle on an appropriate set of tools.	7	6	5	4	3	2	1	9
6. Internet technology is ever-changing — much more so than the other technologies we use.	7	6	5	4	3	2	1	9
7. Internet technology has a special allure, and therefore has a high risk of becoming a solution in search of a problem.	7	6	5	4	3	2	1	9
8. Our technical security is inadequate for the services we want to provide.	7	6	5	4	3	2	1	9
9. The development team has limited access to the Internet.	7	6	5	4	3	2	1	9
10. There are no NYS-specific Web page design standards.	7	6	5	4	3	2	1	9
11. We are unsure about the "right" technology platform to host our service.	7	6	5	4	3	2	1	9
12.	7	6	5	4	3	2	1	9
13.	7	6	5	4	3	2	1	9

Management Barriers to Internet-based services	A Severe Barrier					Not a Barrier		Don't Know
1. There is a general lack of understanding of the complexity of the task.	7	6	5	4	3	2	1	9
2. There is a need to coordinate and communicate among an unusually large number of organizational units.	7	6	5	4	3	2	1	9
3. Work needs to be done by a diverse team of people who have different kinds of knowledge, and don't usually work together.	7	6	5	4	3	2	1	9
4. Management tends to set the process in motion without having clear goals or a plan for achieving them. The message is "just do it."	7	6	5	4	3	2	1	9
5. Program units are not convinced that they should be active stakeholders.	7	6	5	4	3	2	1	9
6. Some organizational units or individuals feel threatened by this new approach to information dissemination or service delivery.	7	6	5	4	3	2	1	9
7. There is a lack of attention to the need to follow up and respond to customer inquiries.	7	6	5	4	3	2	1	9
8. The customers for our Internet-based service are not well-defined or well-understood.	7	6	5	4	3	2	1	9
9. Our existing organizational culture impedes content development (including design, creation, and ownership of content).	7	6	5	4	3	2	1	9
10.	7	6	5	4	3	2	1	9
11.	7	6	5	4	3	2	1	9

Policy Barriers to Internet-based services	A Severe Barrier					Not a Barrier		Don't Know
1. Policy development follows application development, rather than vice-versa.	7	6	5	4	3	2	1	9
2. Our agency lacks a policy about which staff should have access to the Internet, how they get it, and what they can do with it.	7	6	5	4	3	2	1	9
3. We lack of a policy framework that at least identifies the topics that need policy guidance.	7	6	5	4	3	2	1	9
4. Content questions (e.g. What information will be placed on the web site?) are inadequately addressed.	7	6	5	4	3	2	1	9
5. Policy makers are unprepared to give policy guidance because they are not familiar with the capabilities of this new technology.	7	6	5	4	3	2	1	9
6. We have not addressed new copyright & liability issues.	7	6	5	4	3	2	1	9
7. We lack an appropriate security policy.	7	6	5	4	3	2	1	9
8. Pre-existing information policies are not good models for Internet-related policies; something new has to be created.	7	6	5	4	3	2	1	9
9. The policies we have tend to restrict creativity.	7	6	5	4	3	2	1	9
10. We can't decide whether to charge fees for access to our service.	7	6	5	4	3	2	1	9
11. We have not addressed Internet-related Freedom of Information issues.	7	6	5	4	3	2	1	9
12.	7	6	5	4	3	2	1	9
13.	7	6	5	4	3	2	1	9

The results of this survey enabled the project staff to identify the top technical, managerial, and policy barriers from the overall experience of the seven agencies. The most severe barriers that were specific to each agency formed the basis for in-depth agency team interviews, in which project staff attempted to understand how those specific barriers related to the working environment of that agency. These interviews also allowed staff to assess how much and how well various design and decision-making tools that had been introduced in the workshops had actually helped the agencies address the barriers they encountered.

Chapter 5. Exercises

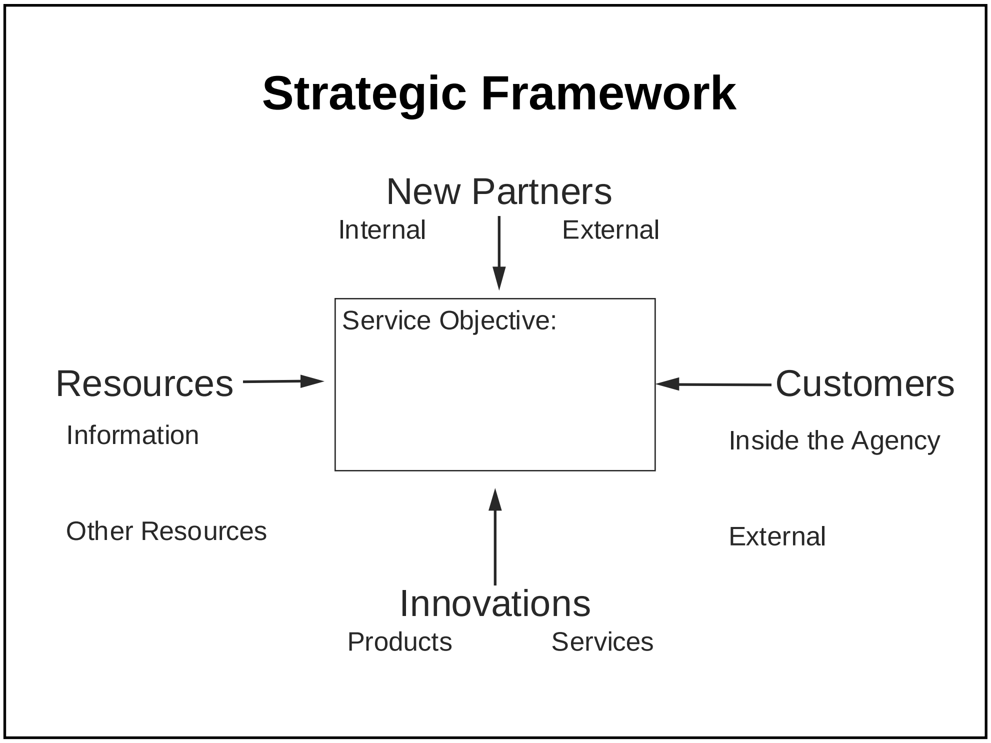
These exercises are designed to help you become more familiar with the products, methods, tools and techniques described in this handbook.

Exercise 1. Using a Strategic Framework to Identify Resources to Help Solve a Problem

1. Your office wants to institute an employee of the month program that employees really care about.

- What is the key objective to be achieved?
- Who are the internal and external customers for the initiative?
- What information and other resources will you need to achieve the key objective?
- Which people or organizations, both inside and outside your own organization, might become partners?
- Which innovative tools, technologies, or management approaches might help you succeed?

2. Now choose any program or management initiative you are familiar with that is being considered by your organization. Complete a strategic framework for that initiative.



Exercise 2. Using a Model to Define a Problem

The Peterson family budget has gone out of balance rather suddenly. The credit card balances are building up, for two of the past four months the mortgage has been paid late, and there hardly seems to be enough cash left to take the family out to the movies on a Saturday night. Here is how they used a model to define their problem and help them move toward a solution. What the Petersons did is similar to what any organization might do when planning to make a smart IT choice.

1. Gather Points of View. In the Peterson's case, they didn't have to do a stakeholder analysis, because the identity of the stakeholders was all too clear. Roger, a self-employed contractor, takes a salary from his business. His wife Angela works as a bookkeeper for a local insurance agency. Son Bill has just turned sixteen and has a 15 hour a week job stocking shelves in a local supermarket. Bill's older sister, Ellen, is a sophomore away at college and has a summer job. Roger has focused on car insurance as a prime cause of their present financial woes. Bill is a young male driver and insurance costs are going through the roof. Angela sees a seasonal slump in Roger's business as the cause of an income shortfall. Bill believes that Ellen's expenses at school are what is driving up costs. Ellen is away from home and not available to be consulted.

2. Create a Common View of the Problem. A monthly budget is a simple model of a financial system that can be used to create a common view that synthesizes everyone's particularistic views of what is happening. At a family meeting called when Ellen was home on a mid-semester break, Angela had the whole family work out a way of looking at the budget. Even before the figures were filled in, this budgeting exercise was tough because decisions had to be made about whether Bill's car insurance bills should be broken out separately, how to handle month to month shifts in Roger's income from the business, and how to account for Ellen's books and legitimate educational expenses as opposed to her entertainment and other discretionary college-related expenses.

3. Use the Common View to Decide What's Important. Just structuring the budget helped the family see more clearly what they wanted to do. Roger was in the process of buying new equipment for his business, so these investments had to be taken into account as detracting from current income, but leading to long-term income growth. The family identified discretionary expenses as those that needed to be targeted in the short term, and expenses unique to a single member of the family (such as Bill's car insurance) that needed to be examined separately.

4. Get Some Numbers. The next step was to go back to the family checkbook for the past six months and see how actual expenses and income stacked up against the categories that the family had decided were important. There were some real surprises in this exercise. When books and other expenses related to her schooling were taken into account, Ellen had actually been spending less on discretionary items in recent months. The tax bill hidden in the escrow portion of the monthly mortgage payment had taken a real jump in recent months, as had the utility bills because of an unusually severe winter. The really big discretionary items that could be controlled in the short run were clothing purchases on the credit card and dining out on those nights when no one felt like cooking.

5. Do "What If" Analyses to Test the Robustness of Your Emerging Model. Roger put these monthly data into a spreadsheet and did some forecasts for the next 12 months. Making assumptions about what would happen to his business income once the new equipment was paid off, and with a reasonable guess about Angela's cost of living salary adjustment, they computed that the family could easily make it through the next year, assuming that Ellen's college expenses grew by less than 10%, and her non-educational expenses stayed even. For any of these forecasts to work, Bill would have to pick up the cost of his own car insurance from his income at the supermarket. Everyone could see the whole picture of the family's finances for the next year clearly from the spreadsheet, and everyone went away with a greater appreciation of what was causing the family's financial problems, and what each of them needed to do about it.

6. Decide Whether You Need to Contact Modeling Experts. Once the Peterson's were able to lay out clearly a model that showed where their problems were coming from, it was not too hard to come up with a solution that they could all work toward. They didn't feel a need to go further and get any help from a professional financial planner.

Exercise 3. Using a Process Model to Identify and Test Solutions

In addition to the problems with the family budget, the Petersons have been running into snags at meal times. It seems they are always running out of something they need, or throwing out spoiled food that they over bought. Almost every day, Angela had to stop at the grocery store on the way home from work to pick up milk or eggs or some other ingredient required for whatever meal they were planning for that evening. Son Bill, working part-time at the local supermarket tries to help by bringing home from work items he thinks they are running out of, but frequently the family ends up with too much of one thing, bread for example, but not enough of something else.

One morning, while throwing out yet another loaf of bread to the birds and pining for some orange juice, it occurred to Bill that the current grocery shopping system was just not working. It seemed that every time he wanted to make his famous Broccoli Bake, they were out of one or more ingredients. He was sick of eating his cereal without milk, and why on earth were there always three packages of tofu and 10 yogurts in the fridge? The only one in the family who ever ate that stuff was Ellen, and she was away at college most of the time. While the birds and the squirrels in the neighborhood were becoming pleasantly plump, it just didn't seem right to be throwing all this food away while other people were going hungry. Bill wondered if the money they were throwing away on food was depleting his college fund.

One weekend, while Ellen was home from college, Bill called a family meeting. He expressed his concern over the inadequacy of the family's grocery shopping process and suggested that they devise a more effective strategy for bringing food into the home. He also added that the supermarket where he worked was starting an on-line (computerized) service for grocery purchases. This interesting idea had been developed by the store owner's precocious ten year old daughter, who stumbled upon a similar service offered by a market in Sweden while surfing the net for information on the mating rituals of marsupials.

The new Internet-based shopping service would allow customers to designate certain items as 'staples' — those they bought routinely. Each time the customer began an on-line order, this list would be available. The customer would be able to click on or off items on this list for the current order, and would also be able to add or delete items, so that the modified version of the staples list would be presented during the next ordering session. The on-line service would also allow customers to select among various brands for each item type. For the 'staple' items, the brand usually purchased would be the default, but the customer would have the option of choosing a different brand. The system would highlight in-store specials. The customer could view all of the specials, just those on items that they were already buying, or specials on brands that they bought frequently.

Bill thought that this system might be the solution to their problems. Shopping for groceries over the Internet would force the family to think more systematically about their food purchases for an upcoming week. For example, they should consider family members' schedules. If Ellen were coming home for a visit, they would need to buy some of the natural food items she loved, that tasted like cardboard to the rest of the family. How many nights that week would the folks be dining out, having company, etc.? Which nights would Bill be dining with the family? They also needed to iron out brand loyalty issues. Roger, Bill's dad, had practically gone through the roof when Angela bought a bargain brand toothpaste. There had also been much ado about the whites not being white enough because of the purchase of an inferior laundry detergent. Additionally, they would have to take menu planning into account to ensure that the required ingredients were available. This would entail making decisions about which meals they would have at home or pack for their respective lunches, what ingredients these meals required, and, of course, what was currently in stock in the Peterson's kitchen.

Bill, still concerned about the family's budget problems and how they might interfere with his plans for college, also wanted to take advantage of whatever in-store specials or bargains might be available. He thought that perhaps they could stock up on non-perishable items when they were on sale and buy on-sale brands for those items for which the family didn't exhibit adamant brand loyalty. Bill knew that he would be able to get one hour per week of the family's time to deal with these issues, and wanted to develop a process that would enable him to compile a weekly food order that could then be input into the on-line system.

Develop a process model that allows Bill to take all of these issues into account in preparing the family's weekly grocery order.

Exercise 4. Using a Prototype To Identify and Test Solutions

Once the Petersons realized how much their spreadsheet model helped them understand their budget problems and craft a solution (cf. Exercise 2), Roger and Angela decided that it would be a good idea to keep track of their family budget on an ongoing basis. By recording their income and expenses as they occurred, they could monitor how well they adhered to their budget plan and be in a better position to know where they stood so they could address unforeseen events as they happened. Because they have a computer at home that Roger and Angela use for word processing and Internet surfing, the Petersons thought that it would be most effective to keep this information on their home computer. Angela had just received training at her job on writing scripts for their home spreadsheet system, so they decided to experiment with a spreadsheet-based system for doing this job. Because neither Bill nor Ellen were especially proficient with the spreadsheet program, the Petersons wanted the system to be as easy as possible to use and to be able to correct the inevitable mistakes that they might make in typing. They also wanted a system that would allow all family members to record their income and expenses, including Ellen from college. Ellen has electronic mail at college that allows her to send and receive any type of files from the family at home.

The Petersons sat down and decided what kind of information they wanted to record in their system. Based on their experience with the budgeting exercise, they wanted to be able to record not only actual expenses, but also upcoming mandatory expenses that they knew about so that they could anticipate and make sure they had sufficient money to pay their bills.

In this exercise, we ask you to put yourself into the Petersons shoes, and design a first version of a system that they could use for managing their finances. In particular, think about some of the following issues:

Design the systems functionality. What should the system do for the Petersons? What kinds of information should it store, and what kinds of analysis should it be capable of performing? What kinds of reports should the Petersons be able to retrieve from the system? Do all the Petersons need the same set of capabilities? Should the system anticipate problem situations and alert the Petersons to upcoming difficulties?

Design a user interface. How should each family member interact with this system? Should the system use a raw spreadsheet model for entering and display of information, or should specialized screens be developed that would be easier to use and more error-free? If you decide to build separate screens, what should the screens look like?

One particular complexity in this situation is how to provide Ellen with access to this system. Does she have the same set of needs as other family members? How should she be able to interact with the system? (Some possibilities are through email requests to another family member who uses the system on her behalf, getting her copies of the program and database and letting her work at her colleges computer facilities with a copy, or developing a special email interface that communicates directly with the spreadsheet program with no human interaction.)

Consider alternative models. Perhaps Ellen should email her mom with her expenses, and Bill should record his income and expenses on a sheet of paper taped to the refrigerator. Explore the possibilities.

Design a security and audit system. How will errors be detected and corrected? What kinds of automated support will there be to help detect and correct errors?

Non-functional requirements. One issue affecting the success of this effort will be the fact that all the Petersons need to work together to achieve their objective of keeping track of their finances on an ongoing basis. Because all the Petersons are busy, and because Ellen is away, it may be necessary to develop incentives to ensure that the entire family has the information they need to effectively manage their budgets. It would be unrealistic to assume, for example, that every expense needs to be recorded on the day it occurred, even when Bill buys himself a pack of gum. Decide a plan for incorporating this prototype system effectively into the familys decision-making process.

Assess the alternatives. It may be that a computer-based program might not be the best way to accomplish this goal. Maybe using a paper ledger and hand calculator would be more effective at meeting the familys goals. Develop a list of the pros and cons of using this system and other alternatives.

Implement the prototype. Try one or more of your alternatives on the family for a month. Discuss their experience using the different systems, and then develop a workable solution for the family.

Exercise 5. Using Interviews to Evaluate Results and Make Smart Choices

1. Choose two colleagues who are experienced word processor users and who are willing to help you with a training exercise. Keep a record of how much time you and your colleagues actually spend on this exercise. Conduct separate, 15 minute, one-on-one interviews (unstructured) with each. The initial question is: "If you could change to some other word processing software, would you? Why or why not?" Discuss their answers with each and take notes. Look for patterns and consistencies as well as divergence in the answers. Estimate how much the total exercise costs (yours and their time, analysis, etc.). If you were assessing software, would the results have been worth the cost? Could you have anticipated their answers? How could the results be improved or obtained an easier, cheaper way?

2. Write up a brief analysis and interpretation of each interview. Identify the reasons given, the meaning of key terms, and an interpretation of each respondent's logic and frame of reference for evaluating software. Give the summary to each interviewee and ask each of them to critique your interpretation. Discuss any errors or omissions and why they occurred.

3. Watch a "Larry King Live" interview. Take notes on his questions. It may be useful to record the interview on a VCR to playback and review. What kinds of questions does he use: open/closed ended? structured/unstructured? How many of each? Is there a pattern in his questioning? What kinds of questions get the best responses? Why? What non-verbal techniques (gestures, facial expressions, posture, movements, laughter, etc.) does he use to establish rapport, encourage responses?

Exercise 6. Using a Survey to Evaluate Results and Make Smart Choices

1. Write questions for a self-administered questionnaire to collect the following information from a small sample of respondents:
   - age
   - level of education
   - field of study, if college educated
   - occupation, if employed
   - ethnic identification

   Write brief directions for completing the questionnaire, including the fact that it is only a training exercise. Then have 3-5 people answer the questionnaire without any assistance or communication with you as the question writer. When the survey is complete, meet with the respondents together and discuss any problems or questions they had answering the questions. Discuss with them how the questions could have been improved.

2. Review the following items, taken from the 1990 U.S. Census questionnaire, as an example of a carefully designed, thoroughly tested survey instrument. Consider why the items are constructed as they are. What issues of clarity, completeness, accuracy, validity are apparent in each item's design? Can you see any flaws or ways to improve the items? (Instructions for the questions call for filling in circles with a pencil to record answers for many items.)

   8. In what U.S. State or foreign country was this person born?

   (Name of State or foreign country: or Puerto Rico, Guam, etc.)

   9. Is this person a CITIZEN of the United States?
      Yes, born in the United States - Skip to 11
      Yes, born in Puerto Rico, Guam, the U.S. Virgin Islands, or Northern Marianas
      Yes, born abroad of American parent or parents
      Yes, a U.S. citizen by naturalization
      No, not a citizen of the United States

10. When did this person come to the United States to stay?

1987 to 1990	O 1970 to 1974
1985 or 1986	O 1965 to 1969
1982 to 1984	O 1960 to 1964
1980 or 1981	O 1950 to 1959
1975 to 1979	O before 1950

11. At any time since February 1, 1990, has this person attended regular school or college? Include only nursery school, kindergarten, elementary school, and schooling which leads to a high school diploma or a college degree.

No, has not attended since February 1
Yes, public school, public college
Yes, private school, private college

15a. Does this person speak a language other than English at home?

Yes
No - Skip to 16

15b. What is this language?

<u>(For example: Chinese, Italian, Spanish, Vietnamese)</u>

15c. How well does this person speak English?
Very well
Well
Not well
Not at all

(Source: Official 1990 U.S. Census Form. Washington, D.C.: U.S. Department of Commerce, Bureau of the Census)

3. Suppose you wanted to survey the residents of your neighborhood to find out how satisfied they are with local government services (police, fire protection, snow plowing, etc.). How would you define the population, i.e., how big is the neighborhood? How would you estimate the size of the total population in your neighborhood? How many people would you need to survey to have an adequate sample? Consult the books by Rea & Parker, or Weisberg & Krosnick, that are listed at the end of the section on "Surveys" in Chapter 3, or any other survey research text on

how to determine sample size. Would you treat the neighborhood as one homogeneous unit, or are there groups or sections that should be sampled separately (i.e., is stratified sampling necessary)? If there are distinct subpopulations, how can a sample be selected that assures they are adequately represented?

Exercise 7. Using an Experiment to Evaluate Results and Make Smart Choices

1. A colleague proposes the following experiment to test a prototype for a new point-of-service computer system to record service transactions in an agency's field offices throughout the state.

    a) Install the prototype system in the largest field office in each of the state's five regions.
    b) Operate the prototype for 2 months and record its performance and cost factors in detail.
    c) Compare the prototype's performance to the previous 2 months' performance data from the old system in the same field offices.

    What flaws do you see in this design? What changes in the design would you recommend to improve it? Make a list of any influences on performance not taken into account in this design and how they might be handled in an improved experimental design.

2. For the example given above, is an experiment the best way to evaluate the new prototype? Describe alternative evaluation methods that might be used and how they would compare to an experiment as an assessment tool.

Center for Technology in Government

Handbook Evaluation

We would like to have your feedback on our handbook.
Please take 5 minutes to fill out this short and return it to us by fax or mail. Thank you.

Handbook Title: ______________________________ **Date:** ______________

1. Where did you hear about the handbook?

☐ Corporate partner ☐ Newsletter
☐ CTG Program ☐ Press Release
☐ Web site ☐ Word of mouth, if so who?______________________________

☐ Other: ______________________________

2. Did you buy/download any other CTG handbooks? ☐ Yes ☐ No

If yes, which one(s):
☐ Making Smart IT Choices
☐ Tying a Sensible Knot: A Practical Guide to State-Local Information Systems
☐ Developing and Delivering Government Services on the WWW
☐ A Cost/Performance Model for Assessing WWW Service Investments

3. If you downloaded a handbook, did you experience any problems? ☐ Yes ☐ No

If yes, please explain______________________________

4. Do you think you will buy/download another one if it suits your interest? ☐ Yes ☐ No

If no, why?______________________________

5. Who in your organization read/used the handbook?

☐ Technical Staff ☐ Program Managers ☐ Other: ______________
☐ Senior Managers ☐ Project Management Specialists

6. Please rate the following statements about the handbook:

The handbook was easy to read and understand:	1 Strongly Agree	2	3	4	5	6	7 Strongly Disagree
The handbook was useful for my current work:	1 Strongly Agree	2	3	4	5	6	7 Strongly Disagree
The handbook should be more technical:	1 Strongly Agree	2	3	4	5	6	7 Strongly Disagree
The examples in the handbook were useful for my organization:	1 Strongly Agree	2	3	4	5	6	7 Strongly Disagree

7. How did you or how are you planning to use the handbook?

☐ Personal development ☐ Staff training
☐ Reference ☐ Other: ______________________________

8. **Did you implement any of the practices/methods described in the handbook?** ☐ Yes ☐ No

If yes, which ones: ______________________________

If no, why: ______________________________

9. **Are you planning to implement any of the practices/methods described in the handbook?**

☐ Yes ☐ No

If yes, which ones: ______________________________

If no, why: ______________________________

10. **Please describe how the handbook affected or will affect your department:**

____

____

11. **Would you be interested in attending a one-two day professional development workshop based on the handbook?**

☐ Yes ☐ No

Any other comments?

____

Name: ______________________________

Title: ______________________________

Organization: ______________________________

Type of organization: ☐ Corporate ☐ Local Gov't ☐ State Gov't ☐ Other

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University at Albany, SUNY
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Albany, NY 12203
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Fax: (518)-442-3886