
**A Cost/Performance Model
for Assessing
WWW Service Investments**

CTG.ISG-4



**Center for Technology in Government
University at Albany / SUNY**

Acknowledgments

The core of this guide was drawn from the experiences of the participants in the Internet Services Testbed Project conducted by the Center for Technology in Government during 1996. This project helped the agencies identify and address the policy, management, and technology issues associated with developing and delivering Web-based services.

Seven agencies participated in the project. They are:

- Governor's Traffic Safety Committee
- Hamilton County and the NYS Performance Measurement, Reporting, and Improvement System Project
- NYS Division of Housing and Community Renewal
- NYS Division of Military and Naval Affairs
- NYS Motion Picture and Television Development Office
- NYS Office of Real Property Services
- NYS Office of Alcoholism and Substance Abuse Services

The case examples in this guide are hypothetical situations. Much of the material contained in this guide is derived from a one-day group decision conference organized at the University at Albany on June 6, 1996: "Cost and Performance Factors for Developing and Operating Internet-based Services." John Rohrbaugh of the Department of Public Administration and Policy led this decision conference and developed many of the tools in this guide. We are also indebted to the other CTG staff who carried out the Internet Services Testbed Project: Sharon Dawes, Theresa Pardo, Ann DiCaterino, Donna Berlin, and David Connelly.

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Executive Summary

No organization should embark on the creation of a World Wide Web site or a Web service without understanding the costs and performance issues of such efforts. Because they lack experience with building such a service, many organizations have decided to build Web sites without really understanding these issues. As a consequence, many organizations construct Web sites that are incomplete, don't meet the organization's goals, or are more expensive than expected to develop and maintain.

This guide was created to help organizations create Web sites that meet their needs, at a cost that they can estimate in advance. Through a structured process, the reader is guided toward a better understanding of the cost and performance factors involved in creating a Web service, and in maintaining an effective presence on the World Wide Web.

This guide is a product of CTG's Internet Services Testbed, and builds on the experience of seven organizations who developed Web services as part of that project. The guide addresses many of the factors relevant to conducting an effective effort, including defining service goals, evaluating infrastructure needs, and estimating the human resources required to sustain the effort. By applying the tools to a planned project, the reader should have a new and valuable perspective on the process of developing a useful Web service.

The authors would appreciate your feedback on and experiences using the guide. Please send comments to the authors at research@ctg.albany.edu.

1. Introduction

For whom this guide is written

We have written this guide with a particular audience in mind: the agency team responsible for designing, developing, and managing a Web service. Our approach is based on the experiences of similar teams in NYS who participated in the Internet Services Testbed project at the Center for Technology in Government during 1996. This guide reflects their experiences and includes the practical tools and techniques that were used, tested, and refined during the project.

How the guide is organized

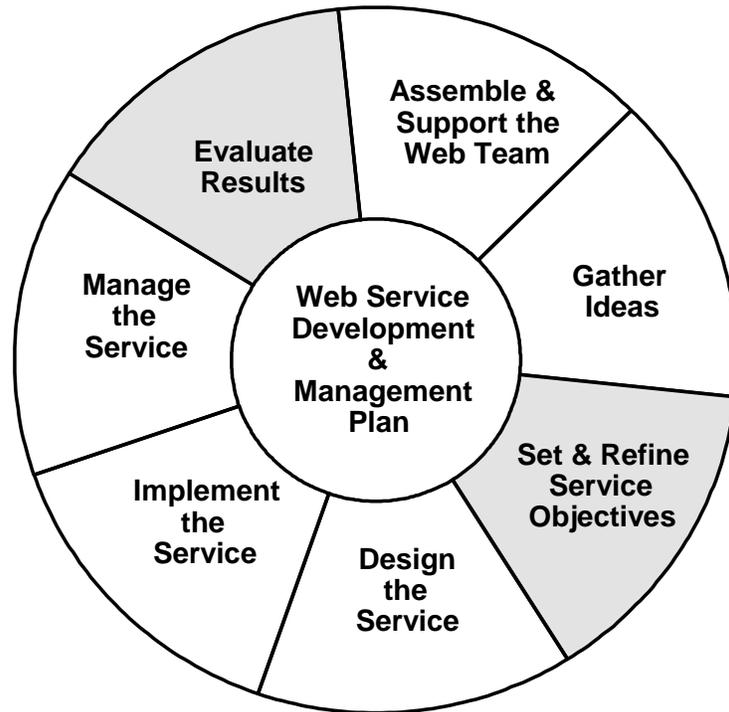
We begin with an introduction. In Chapter 2, we present the key concepts relevant to a cost-performance analysis of a proposed Web-based service. Chapter 3 describes a method for approaching the decision, and the two following chapters describe specific analytic tools that we recommend to support decision making. Chapter 6 discusses options for performing the analysis, and the following chapter presents three hypothetical case examples in which these tools are applied. The final chapter identifies some of the patterns that we have observed from agencies with which we have worked over the years.

Current versions of supportive tools

Several tools are presented in this document, including worksheets for helping estimate costs and benefits of proposed Web-based services. We plan to improve these tools based on future experience. The most recent version of these tools may be obtained from the CTG Web site at <http://www.ctg.albany.edu>.

Framework

A comprehensive suite of guidelines for developing World Wide Web services is presented in *Developing & Delivering Government Services on the World Wide Web: Recommended Practices for New York State* published by the Center for Technology in Government. In that document, seven areas that are keys to developing a successful WWW system are presented.



This working paper contains expanded and revised tools and a method for two of the quantitative phases of this process: “Setting and Refining Service Objectives,” and “Evaluating the Results.” This working paper provides a more comprehensive suite of tools and decision models to help government agencies assess cost and performance factors for developing and delivering Web-based services. The *Recommended Practices*, containing the comprehensive suite of guidelines, should be considered an indispensable companion to this guide. It is available from the Center for Technology in Government as Internet Services Testbed Report ISG-1, September, 1996. These two documents together supply government managers with a set of planning tools and good practice guidelines for approaching the Web as a mode of service delivery.

2. Setting and refining service objectives: A framework

Identifying performance and cost measures

Creating an effective Web service requires a significant investment of resources. It's easy to underestimate the costs and overstate the benefits because the technology is so attractive. Once you've investigated the capabilities that the Web provides, and decided that the technology can provide significant benefits to important stakeholders, the next question is "Is it worth it?" In this section, we present a framework for estimating these benefits and expected costs that will help you determine whether you should make the investment.

This exercise serves two purposes. First, it identifies expected costs and benefits that are ingredients in the investment decision. Second, it quantifies these predictions in the form of explicit expectations that will enable an assessment of whether the project has achieved its goals once implemented. Explicit qualitative and quantitative forecasts of costs and performance improvements will help ensure informed decisions about this technology as a form of service delivery.

Performance measures

The benefits of a WWW initiative typically fall into three performance categories: services that are better, cheaper, or faster. WWW technologies can enable all three types of improvements, depending on the specific goals and objectives of the proposed service. The following list of sample performance improvements has been drawn from a number of sources, including the experience of the seven NYS agencies that participated in CTG's Internet Services Testbed.

Cheaper

- ◆ Time savings
- ◆ Cost savings

Faster

- ◆ Response time
- ◆ Information distribution time

Better

- ◆ Consolidation of services
- ◆ Convenience
- ◆ Improved accuracy
- ◆ Enhanced information (service) quality
- ◆ Innovation
- ◆ More frequent communication
- ◆ Wider communication
- ◆ Larger number of inquiries

- ◆ Increased use of services
- ◆ Revenue generation
- ◆ More accountability
- ◆ Human resource development
- ◆ Greater participation in administrative processes
- ◆ Additional visibility

We encourage you to think, as much as possible, in terms of outcomes and results rather than outputs. For example, think in terms of how the agency staff member, business partner, or constituent will have their lives changed, rather than how many hits your WWW pages will receive. While this will often be difficult to quantify, especially in the complex world in which your service will reside, a focus on the end results can help to clarify your objectives and sharpen your efforts.

Some measures will be relatively easy to describe in quantitative terms, especially those in the cheaper and faster categories. Others will need to be described in more qualitative terms that, nonetheless, can be translated into empirical measures that can be quantified. For example, “increased client satisfaction” can be operationalized by “an increase of at least 25 percentage points in the number of clients who answer ‘Satisfied’ or ‘Highly satisfied’ on the customer feedback questionnaire.” While collecting this information can often require time-consuming methods such as interviewing and surveying, it can contribute significantly to your ability to assess real impact.

It is important to make your expectations explicit so you can assess whether your expectations were met. Concrete statements of how you will serve citizens can help build realism into your plans. As much as anything else, grappling with the issue of what impact your project will have will help build ownership in the project in the agency, and subject your ideas to additional scrutiny and discussion that will help fine-tune your efforts and clarify your expectations.

Cost categories

Because it is easy to use, people often tend to underestimate the cost of developing an effective WWW service. Many agencies are surprised when they add up the amounts that they have spent in developing their service. The implementing technology is relatively easy to use and inexpensive. The expensive part is coordinating its development and creating or reconstituting all the information that will be provided in the WWW site. In addition, advanced features such as forms access to agency databases require customer support and technical support that may drastically affect the cost of hosting the WWW site and operating the service.

In our experience, personnel and technical infrastructure costs comprise the bulk of expenses. The cost of such items as WWW development tools and WWW servers is usually small compared with the human effort to define and develop the content of the service and the base level of computing and networking that needs to be available in the agency. In addition, such services as database access may require hosting the WWW server in-house raise the cost substantially over applications that can be outsourced.

In general, costs for developing an Internet-based service fall into five categories: resources to get the organization ready to develop the service, Internet access for end-users of the system, training and help desk support for the end-users, resources to develop the content of the service, and computer facilities to host the system. In each of these categories, there may be one-time costs that are necessary to get the project started, as well as annual maintenance and development costs to operate the service and keep it current.

Organizational readiness. Public agencies can vary tremendously in their preparedness to take advantage of this technology. Some have experience with networking and the Internet, either through work assignments or by personal experiences. Others have little experience with Web-based services, and lack the computing infrastructure needed to develop content. Public information officers and other agency staff who are responsible for public outreach in the agency often have not experimented with the variety of services available on the Web. Agency managers in general may not be well-versed in the technology, and need to become educated about the potential costs and benefits of developing these services. Developing an awareness of the technology among all levels of the agency staff may be necessary in order to enable meaningful discussion of the merits of a proposed service.

Access for agency staff and other users. In considering this category of costs, the needs of both information providers and information users need to be addressed. Some staff will provide the technical support for the service, others will participate in the development of content. Access will need to be provided for both. Depending on the goals of the project, it may be necessary for agency staff to be able to browse the WWW, receive and respond to electronic mail, communicate with other staff, and have access to specially developed internal Intranet applications. Agencies may have this infrastructure in place, or it might need to be developed further. While this equipment might also serve other purposes (such as general office automation and communication), if it is necessary for the success of the Web service, its cost must be considered in the cost of the entire project. How much of the cost is charged to the Web project varies depending on circumstances.

In all cases, the agency will need to purchase the services of an "Internet Service Provider" or "ISP" who can provide access to the Internet in a number of ways. Individual accounts with dial-in access to an ISP provides an inexpensive starting approach that grows as the number of users increases. This approach requires modem access, either directly or through a LAN, for each user of the services. Alternatively, the agency's LAN or mainframe computers may be connected to the ISP, either through a dial-up or leased connection, at a higher cost but with increased flexibility. This method involves security considerations because, depending on the configuration, the agency resources may be available to other Internet users.

End user support. Staff and other users of the system will need training and help-desk support to make effective use of the resources. Studies have indicated that formal training is less costly than self-learning. This training and day-to-day support may be provided in-house, or outsourced to a separate organization. In the latter case, the cost of establishing and monitoring the contract must be included.

Content development and maintenance. Developing a suite of information and services that will be provided on the Web entails, at a minimum, converting existing information into a form that can be delivered by WWW servers. At present, this often requires “mark-up” activities that require special skill and can be time-consuming. This is an area in which the support tools are rapidly changing, and should be assessed based on current technology.

If the intended application involves two-way communication, (via electronic mail, by fill-in forms that users can access via the WWW, or by specialized applications that link agency databases and other applications to the WWW front end,) then the cost of developing the service may be substantial. Customer service staff will need to handle these contacts and specialized programming skills and on-site hosting of the WWW site may be required.

Development of the content, because it is so tightly integrated with agency operations, is usually done completely in-house. However, some specialized applications can be outsourced (Texas, for example, outsources the tourism feature of its statewide Web service). Basic design templates and perhaps the home page might also be contracted out to get a jump-start on developing the service.

Host of site. Once the content is ready to be installed on the Internet, a system containing a WWW server and space to store the information must be available, usually on a 24 hour a day, seven days a week basis. This may be accomplished through outsourcing or connection of the agency’s WWW server. While outsourced hosting can support simple informational Web pages and electronic mail, more advanced two-way applications typically require development of a custom WWW server application that may require in-house hosting.

You will find a simple worksheet that encompasses all these on the next page. In this sheet, we assume that the one-time costs for the project will be incurred during the first year, and hence we distinguish the first year cost which may be different than subsequent years. We return to this worksheet again in chapter 4 after suggesting an approach for using it in the next chapter. An interactive version of the worksheet may be found at <http://www.ctg.albany.edu/projects/inettb/SpreadSheets.html>.

		First Year Cost	Subseq. Annual
Organizational Readiness			
Training for Technology Awareness	1		
Planning for Internet Presence	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 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 Contracts	19		
Development and Delivery of Staff Training	20		
Staff Time in Training	21		
Webmaster	22		
Editorial Review	23		
Content Creation and Coordination	24		
Web Site Design and Development	25		
Staff Support for Service	26		
Programming Support	27		
Database Administration	28		
Other Management Support	29		
Other Clerical Support	30		
Host of Site-Infrastructure			
Hardware	31		
Software	32		
Network and Internet Access	33		
Other Vendor Services	34		
Human Resources			
Front-end Research and Technical Evaluation	35		
Start-up Process for Equipment Procurement	36		
Establish and Manage Vendor and ISP Contracts	37		
Development and Delivery of Staff Training	38		
Staff Time in Training	39		
Network and Systems Administration	40		
Web Server Management	41		
Operations Support	42		
Clerical Support	43		
INFRASTRUCTURE AND OTHER SUBTOTAL			
HUMAN RESOURCES SUBTOTAL			
TOTAL COSTS			

Figure 1: Blank Cost Worksheet
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3. Identification of system features and functionality

In this and the following two chapters, we present a specific framework for making WWW investment decisions. Although this framework consists of several tools and should be considered a holistic suite. However, each may be used individually for specific purposes, or may be modified to suit unique circumstances.

The first step in making the decision is to be as explicit as possible about the features and functionality of the Web-based services that you plan to deliver. There are many ways to identify service objectives. Although you probably will not need to have every last detail worked out, there are some important questions about system features and functionality for which you should have clear and ready answers:

- ◆ Who are your customers?
- ◆ What information-based services will you provide?
- ◆ How will customers get access to these services?
- ◆ What will customers be able to do?
- ◆ What system features will be included?
- ◆ What internal and external information sources must be coordinated?
- ◆ What security and confidentiality measures must be implemented?
- ◆ What activities will be outsourced?

The methods described in *Developing & Delivering Government Services on the World Wide Web: Recommended Practices for New York State* can be used to help find answers to these questions.

Three levels of aspiration

Plans can be developed with different levels of aspiration. (An optimist typically will have grander schemes than a pessimist.) In resource-poor situations, agencies may want to invest slowly and carefully in Web-based services. In other circumstances, the WWW may be exactly the big investment opportunity the agency seeks for significant change. The cost and performance assessments described in Chapters 4 and 5 will be especially useful when they are calculated for at least three different levels of aspiration. At what level of aspiration does the performance of Web-based services best justify the associated costs: modest, moderate, or elaborate?

- **Modest**

System features and functionality at a modest level are the minimum investments that might define an initial exploration of WWW potential for the agency. The development of a modest set of Web-based services would include relatively inexpensive features and limited information sources. Modest objectives would be consistent with a somewhat skeptical management team that is willing to “test the water” but not “take the plunge.”

- **Moderate**

At the moderate level, a plan for Web-based services might include additional advantageous features and a wider range of internal and external information sources. Delivery might be targeted distinctly at several different types of customers. Overall, this would offer mid-range functionality with some economy-of-scale advantages built in by expanding beyond the modest level. The moderate level of aspiration, however, should not be viewed as an excessive commitment of agency resources to the WWW initiative.

- **Elaborate**

Realistically, what is the most you could hope for? The highest level of aspiration could be a set of objectives that offers a wide range of Web-based services, and/or technically sophisticated design goals, consistent with the resources potentially available to the project. Of course, one agency's modest level of aspiration might be the elaborate version of service objectives for another agency. In detailing the elaborate level, be imaginative enough to be called "optimistic" but not "dreamer."

A blank worksheet for defining your project is provided for your use on the next page. Completed examples are found in the case studies on pages 24 and 29, these illustrate the process of identifying system features and functionality at modest, moderate, and elaborate levels of aspiration.

System Features and Functionality

	Modest	Moderate	Elaborate
Who are your customers?			
What information-based services will you provide?			
How will customers get access to these services?			
What will customers be able to do?			
What system features will be included?			
What information sources (internal and external) must be coordinated?			
What security and confidentiality measures must be implemented?			
What activities will be outsourced?			

Figure 2. Blank Worksheet for System Features and Functionality

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4. Cost assessment for developing and delivering services

People often tend to underestimate the cost of developing and delivering effective Web-based services. This may be due to the fact that there are so many different kinds of investments that need to be made that it is easy to forget a few key expenses. We find that it is very useful to make an effort to identify explicitly as many of the costs as possible, even when you cannot be absolutely exact or certain about every amount. To make these estimations as straightforward as possible for the three levels of service you have described, we have constructed a model cost worksheet; a blank copy is provided for your use on page 12.

There are five cost categories listed in the worksheet: organizational readiness, access for agency staff and other users, end user support, content development and maintenance, and host of site infrastructure. In each category, the worksheet allows for two levels of costs: “one-time” and “annual.” One-time costs are incurred during development and implementation only, while annual costs recur for as long as the service continues to be delivered.

Most categories also partition costs in a second way: costs for human resources and costs for other purposes. You are likely to find that the human resources costs dwarf the cost of the electronic infrastructure. In making your estimates, you should account for all the staff time necessary to launch and operate the Web-based services. For example, we identify two costs you should consider in estimating training expenditures: the cost to buy or develop and deliver the training program, as well as the cost of staff time needed to attend the training classes.

Some of these activities may be done by agency staff, others may be outsourced. When outsourcing, you need to anticipate costs for identifying potential vendors, selecting vendors, and managing the contract. On the other hand, if you plan to do activities in-house, but don't have appropriate staff, you should include costs for recruiting and hiring staff or for retraining existing staff in your estimates.

The cost worksheet can be a useful tool for planning the evolution of your Web site. A worksheet should be completed to represent the costs for various levels of aspiration: modest, moderate, and elaborate. In this way, you can assess rather explicitly what the start-up costs might be for these three different versions. Sometimes it makes a great deal of sense to undertake substantial one-time investments in aiming for an elaborate level of service objectives from the very beginning. In other situations, enormous first-year costs can be daunting, so that more modest investments may be more feasible. In any case, the point here is to be able to compare the costs of at least three alternative plans as thoroughly and explicitly as possible.

		MODEST		MODERATE		ELABORATE	
		First Year Cost	Subseq. Annual	First Year Cost	Subseq. Annual	First Year Cost	Subseq. Annual
Organizational Readiness							
Training for Technology Awareness	1						
Planning for Internet Presence	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							
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Development and Delivery of User Training	11						
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Help Desk for Users	13						
Content Development and Maintenance							
Hardware for Content Developers	14						
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Other Clerical Support	30						
Host of Site-Infrastructure							
Hardware	31						
Software	32						
Network and Internet Access	33						
Other Vendor Services	34						
Human Resources							
Front-end Research and Technical Evaluation	35						
Start-up Process for Equipment Procurement	36						
Establish and Manage Vendor and ISP Contracts	37						
Development and Delivery of Staff Training	38						
Staff Time in Training	39						
Network and Systems Administration	40						
Web Server Management	41						
Operations Support	42						
Clerical Support	43						
INFRASTRUCTURE AND OTHER SUBTOTAL							
HUMAN RESOURCES SUBTOTAL							
TOTAL COSTS							

Figure 3. Blank Cost Worksheet, 3 column

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It's never too early to begin this analysis, even though you will not have comprehensive estimates until more design work has been done. You should start as early as possible to identify and estimate these costs, and then refine the numbers as you go along. Complete instructions for this activity are included in *Appendix A*.

5. Performance assessment

Web-based services might improve the agency's performance in several ways and any good performance assessment will depend on how using the Web will affect key work process and outcome variables.

Selecting the best set of process and outcome variables will not be easy. In fact, this may be the most difficult aspect of the entire cost and performance assessment procedure. While many of us have experience with costing out projects, fewer people have substantial experience quantifying performance measures. If you intend to make the strongest case for developing and delivering Web-based services in your agency, you should select performance variables that are viewed widely as important. Avoid variables about which there is considerable disagreement, not only concerning their importance but also about how they will be affected by your service objectives.

Measures also should be preferred if it is possible to think about their measurement in easy, direct, and explicit ways. At this point in the planning process, it is not necessary to have actual data available, so you are not necessarily limited to only those variables about which the agency already collects data. Nevertheless, it would be a good idea to identify measures for which information might be readily generated. You should anticipate that at a later time someone might decide to evaluate the agency's implementation of Web-based services using the work process and outcome variables that you select.

As discussed in Chapter 2, it may be helpful to think about the benefits of a WWW initiative in three performance categories: cheaper, faster, and better. *Cheaper* refers to all the ways that Web-based services may save resources such as time or money. An initiative may not produce savings immediately but only over the long term, sometimes by avoiding increased or perhaps new agency costs in the future. *Faster* refers to shortening response times and waiting times, as well as the time required to distribute information that has not been directly requested. Providing information and services more quickly also can be considered as an increase in efficiency, even though no cost savings may accrue to the agency. *Better* refers to all the other ways in which performance may be improved beyond increasing the efficiencies of cost and speed. These improvements may be viewed as more "qualitative," though they can be measured, too.

You should not limit your thinking about performance improvements to your agency alone. Web-based services may make processes and outcomes cheaper, faster, or better for customers, for the general public, or for other agencies, as well. Keep all important stakeholders and constituencies in mind. We have collected a short list of variables to illustrate cheaper, faster, and better, although it is far from an exhaustive set. Don't let this list constrain your own creativity.

Cheaper

- ◆ Time savings: current personnel (plus reducing/avoiding other, longer-term

investments of time)

- ◆ Cost savings: current telephone, mailing, printing, travel (plus reducing/avoiding other, longer-term expenditures)

Faster

- ◆ Response time/waiting time: inquiries, requests, processing, transactions (24-hour availability; on demand)
- ◆ Information distribution time, including training (agency initiated, not customer initiated)

Better

- ◆ Consolidation of services: one-stop shopping, fewer steps in a process
- ◆ Convenience: central location, more accessible locations
- ◆ Improved accuracy, fewer errors, greater consistency, more standardization, always up-to-date
- ◆ Enhanced information (service) quality, more useful/relevant/practical information (service)
- ◆ Innovation: new services, new ways of using information
- ◆ More frequent communication (with same people): information distribution
- ◆ Wider communication (to more people): information distribution
- ◆ Larger number of inquiries, requests, processing, transactions (from more people)
- ◆ Increased use of services (more people use services; same people use more services)
- ◆ Revenue generation (from customers, general public, other agencies)
- ◆ More accountability, improved record keeping, better tracking systems
- ◆ Human resource development, enhanced professional abilities, improved work skills
- ◆ Greater participation/input/involvement from others in administrative processes
- ◆ Additional visibility, positive media coverage, public relations advantages

How well will it work?

Performance assessment, as we are using the term here, does not require collecting data. We are attempting to make forecasts or predictions: how well do we expect Web-based services to perform? Neither optimism nor pessimism is advantageous here--only realism. For each level of aspiration (i.e., modest, moderate, and elaborate), targeted measures of performance are required. These targets will most likely be "judgment calls," since no perfect prediction will be available. As part of the Internet Services Testbed, we asked agency teams to discuss and agree on these targeted measures of performance for their own service objectives. No one felt entirely comfortable with their forecasts but everyone agreed that they were using their most informed judgment at the time. For estimates such as these, informed, consensual judgment from a group of knowledgeable managers is probably the best forecasting approach that we can use in this context.

A thorough treatment of performance measurement is beyond the scope of this guide. A good

discussion of how to develop meaningful measures can be found in *Information Management Performance Measures: Developing Performance Measures and Management Controls for Migration Systems, Data Standards, and Process Improvement*, available from the National Academy of Public Administration, 1120 G Street, NW, Suite 850, Washington, DC 20005.

A sample worksheet for identifying performance variables, measures, and targets is shown below. For examples of its use, see p. 27 and p. 32. Often, only a few performance variables are identified, and this is sufficient to drive the analysis. On the other hand, you may decide that more performance variables are required to measure fully the improvements that you anticipate from WWW use. In principle, there is no limit to the number of performance variables that could be incorporated into this assessment.

Performance Variables, Measures, and Targets

Variable: (Cheaper)

Measure:

Modest Target

Moderate Target

Elaborate Target

Variable: (Faster)

Measure:

Modest Target

Moderate Target

Elaborate Target

Variable: (Better)

Measure:

Modest Target

Moderate Target

Elaborate Target

Figure 4. Blank Performance Targets

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6. Combining cost and performance assessments for decision support

Given the cost and performance assessments that you make, the key question is what level of agency investment in Web-based services to recommend. Is the elaborate version the best level of investment or is it too expensive? What about a moderate or only a modest investment at first? It may be that the cost and performance assessments support taking no initiative on the WWW at all. But how would you know? It is sometimes very difficult to draw an obvious conclusion from all of this information.

There are many ways that cost and performance information can be combined and integrated to support decisions about WWW investments. Three approaches are reviewed in this chapter: benefit-cost analysis, resource allocation methods, and multi-attribute utility models. Describing these three approaches in detail is beyond the scope of this guide. However, a general overview may help you get started, and references for additional reading are provided in case you are interested in learning more. Examples are presented in Chapter 7.

Why would the agency choose one over the others? The answer to this question depends on several factors. There is no one right way to say which method or methods should be used by a specific agency, but certain indicators can be found. If your agency is only concerned with cost, you should probably perform a traditional benefit-cost analysis. If the agency has a short list of performance criteria (as described on p. 17), the multi-attribute utility model should be chosen. If the agency has a long list of performance criteria, they should probably use the resource allocation method.

Indicator:	Recommended tool:
Cost important	Benefit-cost analysis
Short list of performance criteria	Multi-attribute utility model
Long list of performance criteria	Resource allocation method

Figure 5. Indicator/Tool

Benefit-Cost Analysis

If the only performance measure of importance is “cheaper,” then you should do a benefit-cost analysis, because it is relatively easy to convert “cheaper” into dollars, and costs are already in dollars. The “cheaper” criteria chosen by the agency can be such items as saved time, avoided cost, and cost savings. Anything that in terms of equipment, space, time and other attributes is in the “cheaper” category.

Benefit-cost analysis provides information on the full cost of meeting specific service objectives through the Web and weighs those against the dollar value of the benefits received. The net benefits of the proposed project, examine the ratio of benefits to costs, determine the rate of

return on the original investment, and compare the benefits and costs for each level of aspiration (i.e., modest, moderate, and elaborate) with the others. Benefit-cost analysis requires three steps:

1. determine every cost associated with the Web-based services, adding them together as a total dollar amount;
2. determine the total performance benefits of the Web-based services, placing a dollar value on each benefit; and
3. compare the benefits (measured in total dollars) to the costs (measured in total dollars).

This description of benefit-cost analysis gives the impression that the three steps will be easy to complete, but, in fact, benefit-cost analysis can be very difficult. The cost worksheets contained in chapter 4 of this guide will help with the first step, but placing a dollar value on each benefit (second step) can sometimes be problematic, especially if these performance variables are of the “faster” or “better” type. How might one calculate the dollar value of reducing customer waiting time by 10% or of providing client information with 20% fewer errors? Increasing the number of in-coming inquiries or the number of services provided may be more costly, not less so. In general, benefit-cost analysis may be most useful where the performance variables are of the “cheaper” type and, therefore, more amenable to quantification in dollar terms.

For a more in-depth discussion of what to do, please see James Edwin Kee, “Benefit-Cost Analysis in Program Evaluation,” in Joseph S. Wholey, Harry P. Hatry, and Kathryn E. Newcomer (eds.), *Handbook of Practical Program Evaluation*. San Francisco: Jossey-Bass, 1994.

Resource Allocation Methods

Resource allocation methods may be helpful in situations where there are problems attaching dollar values to every benefit, as in benefit-cost analysis. Although resource allocation methods, similar to benefit-cost analysis, compare total benefits to total costs, the measure of benefit is much more generic, judgmental, and subjective. A benefit is assessed on a simple, 100-point rating scale. The increasingly costly versions of Web-based services (from modest to elaborate) are measured, as an index of overall performance, across this scale of holistic benefit. The “no investment--no Web service” alternative anchors the lower end of the 100-point scale (i.e., 0: least overall benefit), while the elaborate version of Web-based services anchors the upper end (i.e., 100: most overall benefit). Modest and moderate versions are scored somewhere in between (see Figure 6).

To assess the incremental advantage of investing more agency resources in Web-based services, the additional benefit of each alternative (Δ benefit) is divided by its additional cost (Δ cost), relative to the benefit and cost of the “no investment--no Web service” alternative. The version with the largest incremental advantage of benefit relative to cost would seem to be preferable. The difficulty with resource allocation methods, however, is the problem of reducing multiple performance measures to a single, aggregate benefit scale. This approach may be more practical than benefit-cost analysis when many of the performance measures are of the “faster” or “better” type, but it may be criticized as not sufficiently analytical.

Again you should try to decide between modest, moderate, and elaborate versions of the system. In this model, you may have a number of criteria, maybe six or seven, that would indicate advantages of the service. In the resource-allocation model we give the lowest level a 0 benefit, and the top level a 100 benefit. Then position the intermediate levels (modest and moderate) somewhere between 0 and 100. Given all of these benefits, instead of putting them on a dollar scale, put them on a utility scale from 0 to 100. For example, if the moderate level is fairly close to the elaborate level, that could mean that moderate might get an 80 utility. If modest seems to be fairly close to the middle between no investment and moderate you might give this a 40.

Costs are used more objectively. For the “no investment-no Web service” option, the cost would be 0 dollars. The cost worksheet would give us the costs for the other levels of investment (modest, moderate and elaborate). We then use this information to create a ratio of incremental benefit to incremental cost. You can treat these as pseudo-benefit-cost ratios.

By dividing the benefits by the costs, a ratio of benefits to costs is created. Within the frames of available resources, the agency should pick the level of investment that precedes the level where the ratio starts to decline.

No Investment	Modest	Moderate	Elaborate
	Benefits:	Benefits:	Benefits:
Benefit: 0 Cost : 0	Benefit: _____ Cost : _____ Ratio : _____	Benefit: _____ Cost : _____ Ratio : _____	Benefit: _____ Cost : _____ Ratio : _____

Figure 6. Blank Resource Allocation Method

The above figure can be used as a guide. Fill out the benefits associated with the different levels of investment inside of the boxes (or on a separate sheet of paper), and use those to assess the benefit (between 0 and 100 for the different levels of investment).

This method is somewhat more subjective than the first. Judgment is required in determining how to aggregate the benefit across these multiple dimensions. For an example with numbers, please refer to Figure 15 on page 34.

For additional information, please see Sandor P. Schuman and John Rohrbaugh, “Decision Conferencing for Systems Planning,” *Information & Management*, 1991, 21, 147-159.

Multi-attribute Utility (MAU) Models

This model should be used when there are relatively few performance measures. Although, in principle, complex situations can be analyzed using a MAU model, for best results a complex MAU analysis should be done in consultation with an expert. A sample MAU model is described below (for an example with numbers, please refer to Figure 16, page 35 and Figure 17, page 35).

Rank	Weight	Criteria	Alternatives			
			No Investment	Modest	Moderate	Elaborate
_____	_____					
_____	_____					
_____	_____					
_____	_____					
		Total Utility:				

Figure 7. Sample Multi-attribute Utility Model

Typically, each performance criterion is evaluated separately. The “utility” associated with each of the multiple criterion is scored on a simple, 100-point rating scale. The same 100 point scale is used to assess the alternatives on every performance measure.

Multi-attribute utility models differ from benefit-cost analysis and resource allocation methods in that project cost is treated as just one more performance measure. In particular, a ratio of benefit to cost is not formed. Web-based services that cost the agency more of its resources (moderate and elaborate versions) are rated as having less “utility.” Here, the elaborate version of Web-based services anchors the lower end of the scale (i.e., 0: most cost), while the “no investment--no Web service” alternative anchors the upper end (i.e., 100: least cost).

Typically, some of these performance criterion is more important to the agency than others and are given more weight. Each performance criterion is given a weight. A final overall rating for each of the (now four) options is obtained by computing a weighted sum of the ratings on each individual utility. Utility associated with less cost is merely added to utility associated with more benefit on other performance measures.

7. Sample analyses

To help you use these models, we present two sample analyses using the tools described above. Although these cases are based on our experiences in the Internet Services Testbed Project and other agencies, they are entirely fictional. In our experience, there is no such thing as a “typical” situation -- each agency has its own set of unique characteristics such as opportunities for cost-sharing or shortages of personnel that make general conclusions difficult. The cost figures used in these examples are based on assumptions that may not be stated in the analysis; for example, all staff at the first agency have network-ready PC’s on their desks, so little additional equipment is necessary. Depending on your situation, you may be able to share the costs of the Web service with other projects and agencies, so that your costs may vary tremendously from those described here. The analysis has been simplified; for example only first-year costs are considered. The examples are provided solely to show how the analysis might proceed using these tools. Your situation will likely be different.

Example 1. Using Benefit-Cost Analysis at the Office of Cost Reduction (OCR)

The Scenario

The IT director of the Office of Cost Reduction thought it was going to be a bad day when was running late for work. Her pessimism was muted when she got to work for her weekly meeting with the Commissioner of OCR. The Commissioner wanted to know whether OCR could accomplish its mission in a cheaper way. A friend of his at the Office of Mental Hygiene had told the Commissioner about their Web site, and now the Commissioner wanted to find out whether a Web site could be useful for OCR.

The IT director and her team had been eager for months to conduct an Internet development project. She left his office full of energy; however the Commissioner’s words “Only if it saves us money” were still ringing in her ears when she left his office.

Thinking about the agency’s collection of information from the general public, local government, and certain private sources such as insurance companies and appraisers, she come up with the first areas that should be addressed. The agency had a number of paper based forms and information packets that it distributes to these constituents. “If we could distribute and collect these forms electronically, we might be able to save money,” she thought to herself. She decided to explore the option of allowing key business partners the option of submitting forms electronically by building an Web site, and giving these partners access.

She walked back to her office and opened a draft of this guide that she had received a month ago. She found the chapter on Benefit-Cost analysis, Resource Allocation methods, and Multi-attribute Utility models. After reading through them she decided that the appropriate analysis tool would be the Benefit-Cost analysis, not only because it was the best one for dealing with

“cheaper” type situations, but the Director had earlier shown a certain fondness for this method.

There were four things she had to do to complete a benefit-cost analysis:

1. Determine the features and functionality of potential Web-based services.
2. Determine the performance benefits of the Web-based services, placing a dollar value on each benefit.
3. Determine every cost associated with the Web-based services, adding them together as a total dollar amount.
4. Compare the benefits (measured in total dollars) to the costs (measured in total dollars).

Filling out the System Features and Functionality Worksheet

Understanding the potential value of the tools available, she got together a small team of people to plan the service. Staff from the program areas, from human resources, from the IT division, and from OCR’s public information office did the planning. Using the “system features and functionality” worksheet, the group was able to specify three potential systems, ranging from giving the public electronic access to their most popular forms, to on-line submission of the forms from key business partners (see Figure 8).

System Features and Functionality

	Modest	Moderate	Elaborate
Who are your customers?	citizens, taxpayers, government officials at all levels	same as modest, plus local tax officials, libraries	same as moderate, plus key business partners: realtors, appraisors, and insurance companies
What information-based services will you provide?	e-mail, limited number of existing documents published on the WWW	same as modest, plus many more documents and forms	same as moderate, plus on-line forms for the key business partners and access to agency databases
How will customers get access to these services?	e-mail and WWW as available in the customer base	same as modest	same as moderate
What will customers be able to do?	send e-mail to agency, receive e-mail replies, access our Web page	same as modest	same as moderate, plus fill in forms. web front end to agency databases
What system features will be included?	e-mail and Web page	same as modest	same as moderate, plus on line forms. Support for partners to help them fill out on line forms.
What information sources (internal and external) must be coordinated?	all departments creating forms	same as modest	same as moderate, plus departments that manage agency databases
What security and confidentiality measures must be implemented?	none	same as modest	heightened--policies plus restricted access, encryption and authenticity
What activities will be outsourced?	none	same as modest	training and support for key business partners that want to fill out on line forms

Figure 8. System Features and Functionality, OCR

The final “system features and functionality” worksheet showed that the modest and the moderate alternatives would be fairly similar. The elaborate alternative included a Web site with access for agency key partners to register forms themselves.

Filling out the Cost Worksheet

Enthusiastic after filling out the last worksheet the team started the job of quantifying the costs of offering the specified services on the Web. The team soon realized that because their agency was already well-equipped technically, not all cells had costs in them.

		First Year Cost	Subseq Annual	First Year Cost	Subseq Annual	First Year Cost	Subseq Annual
Organizational Readiness							
Training for Technology Awareness	1						
Planning for Internet Presence	2	10,000		10,000		10,000	
Access for Agency Staff and Other Users							
Hardware for End Users	3					12,000	4,000
Software for End Users	4					5,000	2,000
Network and Internet Access for End Users	5					10,000	3,000
Other Vendor Services	6						
Human Resources							
Start-up Process for Equipment Procurement	7					2,000	
Establish and Manage Vendor and ISP Contracts	8	1,000		1,000		5,000	1,000
End User Support							
Vendor Services	9					10,000	15,000
Human Resources							
Establish and Manage Vendor Contracts	10					2,000	1,000
Development and Delivery of User Training	11	2,000	2,000	2,000	2,000	35,000	15,000
User Time in Training	12	2,000	2,000	2,000	2,000	2,000	2,000
Help Desk for Users	13					20,000	20,000
Content Development and Maintenance							
Hardware for Content Developers	14	3,000	3,000	3,000	3,000	3,000	3,000
Software for Content Developers	15	1,000	1,000	1,000	1,000	1,000	1,000
Network and Internet Access for Content Developers	16	3,000	1,000	3,000	1,000	30,000	15,000
Other Vendor Services	17						
Human Resources							
Start-up Process for Equipment Procurement	18					3,000	3,000
Establish and Manage Vendor Contracts	19	1,000	1,000	1,000	1,000	1,000	1,000
Development and Delivery of Staff Training	20	15,000	15,000	15,000	15,000	30,000	30,000
Staff Time in Training	21	20,000	10,000	20,000	10,000	40,000	20,000
Webmaster	22	45,000	45,000	45,000	45,000	45,000	45,000
Editorial Review	23						
Content Creation and Coordination	24	3,000	3,000	3,000	3,000	10,000	5,000
Web Site Design and Development	25	10,000	10,000	10,000	10,000	100,000	50,000
Staff Support for Service	26	15,000	15,000	20,000	20,000	30,000	30,000
Programming Support	27					40,000	20,000
Database Administration	28					20,000	20,000
Other Management Support	29						
Other Clerical Support	30	3,000	3,000	3,000	3,000	3,000	3,000
Host of Site-Infrastructure							
Hardware	31	8,000	4,000	8,000	4,000	8,000	4,000
Software	32	3,000	1,000	3,000	1,000	6,000	2,000
Network and Internet Access	33	1,500	1,500	1,500	1,500	1,500	1,500
Other Vendor Services	34						
Human Resources							
Front-end Research and Technical Evaluation	35	500	500	500	500	1,000	1,000
Start-up Process for Equipment Procurement	36	500		500		500	
Establish and Manage Vendor and ISP Contracts	37						
Development and Delivery of Staff Training	38	1,000	1,000	1,000	1,000	2,000	2,000
Staff Time in Training	39	500	500	500	500	2,000	2,000
Network and Systems Administration	40	3,000	3,000	3,000	3,000	6,000	6,000
Web Server Management	41	1,000	1,000	1,000	1,000	5,000	3,000
Operations Support	42	1,000	1,000	1,000	1,000	3,000	3,000
Clerical Support	43	0					
INFRASTRUCTURE AND OTHER SUBTOTAL		29,500	11,500	29,500	11,500	96,500	50,500
HUMAN RESOURCES SUBTOTAL		124,500	113,000	129,500	118,000	407,500	283,000
TOTAL COSTS		154,000	124,500	159,000	129,500	504,000	333,500

Figure 9. Cost Worksheet, OCR

With the cost worksheet filled out, the group had its total costs over the three dimensions (modest, moderate, and elaborate). It was now time to go to the next step in the benefit-cost process, assessing the benefits of the new system.

Performance Variables, Measures, and Targets

Because their primary objective was reduced costs, the group decided to develop only the “cheaper” dimensions of the “Performance Variables, Measures, and Targets” worksheet. This resulted in two different “cheaper” variables, as depicted in Figure 10):

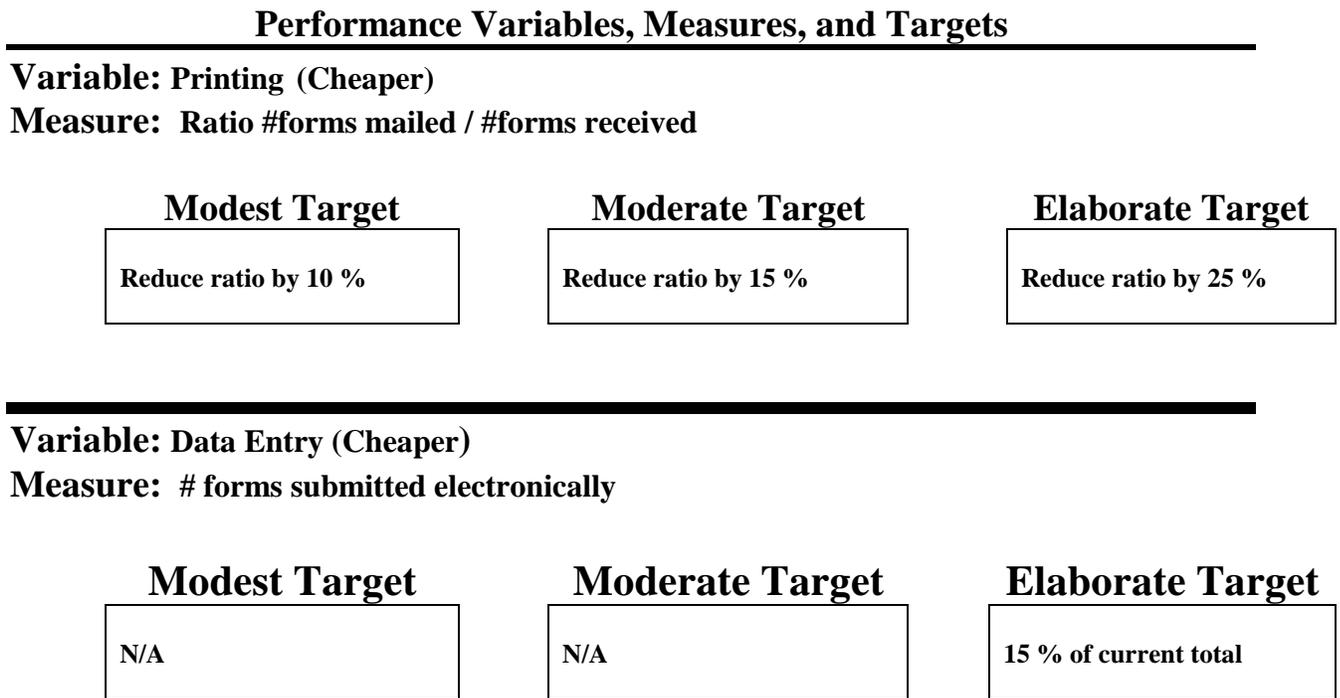


Figure 10. Performance Variables, Measures, and Targets, OCR

The Benefit-Cost Analysis

The group felt ready to finally get to the benefit-cost analysis. Having the costs ready, it was now time to specify the benefits in quantitative terms. Each benefit had to be turned into a dollar amount. Additional information about the agency's annual printing, and data entry costs were collected. With the performance variables, measures, and targets to draw on, the group managed to quantify the benefits reasonably quickly.

	Modest	Moderate	Elaborate
Benefits:			
Printing Costs	\$100,000	150,000	250,000
Data Entry			400,000
Sum Benefits:	100,000	150,000	650,000
Sum Costs (from cost worksheet):	124,500	129,500	407,500
Benefit-Cost Ratio	0.80	1.16	1.59

Figure 11. Benefit-Cost Table, OCR

Aftermath

The benefit-cost table above indicates that investment at the modest level will not pay off. For each dollar invested, only 80 cents are saved. However, at the moderate level the agency would see a payoff. For each dollar invested, \$1.16 is saved. Finally, at the elaborate level, the investment will pay off with \$1.59 saved per dollar invested. It would seem that the elaborate level would be the right investment for OCR.

After doing the calculations in the benefit-cost table, the group decided to do sensitivity analysis on the numbers. They questioned their own beliefs about the numbers, and tested how different assumptions about both benefits and costs related to different benefit cost ratios. They found that the ratios were fairly sensitive to changes in the underlying assumptions, but as they felt reasonably confident in their assumptions, the group decided to recommend that the agency invest in an *elaborate Web site*. However, knowing that a lot of uncertainties needed to be resolved, the group also recommended a project development strategy of first developing a moderate Web site, with a prototype of the elaborate functions. The elaborate functions would then be worked on after the moderate Web site had been implemented and the agency had more experience developing services for the Internet.

*The benefit-cost model developed in this example is very simple. An agency deciding to do a benefit-cost analysis should have, or get, expertise on benefit-cost modeling. Issues that were not addressed in this example such as opportunity cost, interest rates, and multi-year investments, can in many cases change the results completely. For an introduction to benefit-cost analysis, see James Edwin Kee, "Benefit-Cost Analysis in Program Evaluation," in Joseph S. Wholey, Harry P. Hatry, and Kathryn E. Newcomer (eds.), *Handbook of Practical Program Evaluation*. San Francisco: Jossey-Bass, 1994.*

Using different models at the Office of Business and Tourism (OBT)

The Office of Business and Tourism wishes to attract businesses and tourists to the state. It works with a variety of state agencies, local governments, business officials, the tourist industry, and citizens groups to help promote the idea of people working and vacationing in the state.

Recognizing that many business leaders and affluent tourists have access to the Internet, and that other states are using this technology for economic development, the agency wishes to augment its current efforts with a new Web service.

A group of OBT leaders got together, and used the "system features and functionality" worksheet to specify what was wanted from the new service. The results indicated that the Web-service would be different levels of information dissemination, from a fairly modest system, to an elaborate system (below).

System Features and Functionality

	Modest	Moderate	Elaborate
Who are your customers?	general public business, and entrepreneurs	same as modest, plus potential tourists	same as moderate
What information-based services will you provide?	access to directory of agency and regional services	same as modest, plus business and tourism promotion	same as moderate, plus one-stop shopping for business start-up
How will customers get access to these services?	WWW with possible follow-up telephone call	WWW, email, follow-up mailing of tourism documents. agency provides some Internet access for businesses through libraries	same as moderate
What will customers be able to do?	browse agency general information and follow pointers to related sites	browse official promotional information for businesses and tourists. request additional info. be sent to them.	same as moderate, plus get all government information related to business start-up or relocation to a partic. area of the state
What system features will be included?	hypertext and email	same as modest, plus WWW, email, some multi-media	same as moderate, but a expanded set of information
What information sources (internal and external) must be coordinated?	agency directory of services, and key external information sources	same as modest, plus tourism brochures; business start-up information	same as moderate, plus all forms and brochures related to businesses from federal, state and local offices
What security and confidentiality measures must be implemented?	Make sure no one can change information	same as modest	same as moderate
What activities will be outsourced?	host of WWW site	same as modest	same as moderate

Figure 12. System Features and Functionality, OBT

Knowing that they would have to quantify the costs of providing these features and functionality, the group decided to use the cost worksheet to find out how the different investment levels would result in different cost scenarios.

		MODEST		MODERATE		ELABORATE	
		First Year Cost	Subseq Annual	First Year Cost	Subseq Annual	First Year Cost	Subseq Annual
Organizational Readiness							
Training for Technology Awareness	1	1000		10000		10000	
Planning for Internet Presence	2	1000		10000		100000	
Access for Agency Staff and Other Users							
Hardware for End Users	3			100000	30000	100000	30000
Software for End Users	4			10000	10000	10000	10000
Network and Internet Access for End Users	5				10000		10000
Other Vendor Services	6						
Human Resources							
Start-up Process for Equipment Procurement	7			10000		10000	
Establish and Manage Vendor and ISP Contracts	8			5000	1000	5000	1000
End User Support							
Vendor Services	9						
Human Resources							
Establish and Manage Vendor Contracts	10						
Development and Delivery of User Training	11			2000	1000	2000	1000
User Time in Training	12						
Help Desk for Users	13			10000	10000	10000	10000
Content Development and Maintenance							
Hardware for Content Developers	14	10000		20000		40000	20000
Software for Content Developers	15	2000	1000	4000	2000	10000	10000
Network and Internet Access for Content Developers	16		1000		2000		10000
Other Vendor Services	17					20000	
Human Resources							
Start-up Process for Equipment Procurement	18	1000		1000	1000	1000	1000
Establish and Manage Vendor Contracts	19					5000	5000
Development and Delivery of Staff Training	20			1000	1000	5000	5000
Staff Time in Training	21			10000	1000	20000	10000
Webmaster	22				40000		40000
Editorial Review	23	1000	1000	1000	1000	10000	10000
Content Creation and Coordination	24	10000	10000	10000	10000	100000	100000
Web Site Design and Development	25	10000	10000	10000	10000	20000	20000
Staff Support for Service	26					50000	50000
Programming Support	27					50000	20000
Database Administration	28					20000	10000
Other Management Support	29	1000	1000	10000	10000	10000	10000
Other Clerical Support	30			1000	1000	10000	10000
Host of Site-Infrastructure							
Hardware	31					50000	10000
Software	32					20000	10000
Network and Internet Access	33					10000	10000
Other Vendor Services	34		1000		10000	20000	20000
Human Resources							
Front-end Research and Technical Evaluation	35					20000	
Start-up Process for Equipment Procurement	36					10000	
Establish and Manage Vendor and ISP Contracts	37		1000		1000	10000	10000
Development and Delivery of Staff Training	38					10000	5000
Staff Time in Training	39					30000	20000
Network and Systems Administration	40					20000	20000
Web Server Management	41					20000	20000
Operations Support	42					5000	5000
Clerical Support	43					5000	5000
INFRASTRUCTURE AND OTHER SUBTOTAL		12000	3000	134000	64000	280000	140000
HUMAN RESOURCES SUBTOTAL		25000	23000	91000	88000	568000	388000
TOTAL COSTS		37000	26000	225000	152000	848000	528000

Figure 13. Cost Worksheet, OBT

Knowing the specific costs associated with the possible levels of investment, the group decided that it was important to specify measurable targets for the new system. Knowing that this could easily be accomplished by using the “performance variables, measures, and targets” worksheet. The worksheet was filled out as described below:

Performance Variables, Measures, and Targets

Variable: Reduced mailing costs (Cheaper)

Measure: # requests for information go down¹

Modest Target

Reduce by 5 %

Moderate Target

Reduce by 10 %

Elaborate Target

Reduce by 15 %

Variable: Customer response time (Faster)

Measure: time customer must wait for information

Modest Target

WWW-service: < 1 minute
Regular service: 50 % reduct.

Moderate Target

WWW-service: < 1 minute
Regular service: 50 % reduct.

Elaborate Target

WWW-service: < 1 minute
Regular service: 50 % reduct.

Variable: One stop shopping (Better)

Measure: Time of customer stay on WWW-service

Modest Target

Mean of 5 minutes

Moderate Target

Mean of 10 minutes

Elaborate Target

Mean of 20 minutes

Variable: Enhanced service quality (Better)

Measure: Customer surveys

Modest Target

Increase customer satisfaction
by 10 %

Moderate Target

Increase customer satisfaction
by 20 %

Elaborate Target

Increase customer
satisfaction by 30 %

¹ The reason for the relatively low targets is that the WWW-service increases visibility and might produce additional requests for information.

Variable: Expanded communication² (Better)

Measure: Increase in # national/international customers.

Modest Target

National : 10 % increase
International : 5 % increase

Moderate Target

National : 15 % increase
International : 10 % increase

Elaborate Target

National : 20 % incr.
International : 15 % incr.

Variable: Increased revenue generation for the state (Better)

Measure: Traceable to new customers³

Modest Target

3 x agency spending

Moderate Target

4 x agency spending

Elaborate Target

5 x agency spending

Variable: + Competition (Better)

Measure: % of businesses relocated to our state compared to other states

Modest Target

Increase 5 %

Moderate Target

Increase 10 %

Elaborate Target

Increase 15 %

Figure 14. Performance Variables, Measures, and Targets, OBT

Having all this data available, the group decided that it was now time to try out the decision tools that they had. First they decided to use the resource allocation method.

Using the Resource Allocation Method

All this available information can now be used to select the appropriate level of investment. To do this we use a simplified resource allocation method. All the information in the model is transferred from the cost worksheet and the “performance variables, measures, and targets” worksheet.

² Able to communicate both nationally and internationally

³ Only measure revenue from customers that are traceable to OBT’s effort

The final model (all costs in thousands of dollars, transferred from cost worksheet):

No investment	Modest	Moderate	Elaborate
Benefits:	Benefits: 1? mailing costs reduced 5% 2? response time WWW: < 1 min regular 50% red. 3? customer stay 5 minutes 4? satisfaction + 10% 5? Communication National +10%, International + 5% 6? state rev. gen. 3x our budget 7? competition other states +5%	Benefits: 1? mailing costs reduced 10% 2? response time WWW: < 1 min regular 50% red. 3? customer stay 10 minutes 4? satisfaction + 20% 5? Communication National +15%, International + 10% 6? state rev. gen. 4x our budget 7? competition other states +10%	Benefits: 1? mailing costs reduced 15% 2? response time WWW: < 1 min regular 50% red. 3? customer stay 20 minutes 4? satisfaction + 30% 5? Communication National +15%, International + 15% 6? state rev. gen. 5x our budget 7? competition other states +15%
	Benefit: 40 Cost : 37 Ratio : 1.08	Benefit: 80 Cost : 134 Ratio : 0.59	Benefit: 100 Cost : 848 Ratio : 0.12

Figure 15. Resource Allocation Method, OBT

The different levels of benefit were ranked from 0 to 100 as described on page 20, and the costs from the cost worksheet on page 31 were retrieved (in \$1000's for simplicity). The group of leaders were somewhat surprised to find that the ratio for the first investment level was the highest, then the ratio declined as the agency invested in more elaborate Web sites. The result indicated quite clearly that the modest Web site investment would be the best management decision for the agency.

Note to the reader: There is no "cutoff" single ratio to be used in the decision. The decision is made by comparing the different ratios to one another.

Using the Multi-attribute Utility (MAU) Model

For projects where the agency decides to use the MAU model, the number of decision criteria will generally be fewer than for the resource allocation model. Even though the number of criteria developed for OBT is higher than what would normally be used for a MAU model, the OBT example is used to make it easier for the reader to follow the problem. However, for simplicity and realism in using the MAU model, a few criteria have been removed.

Since the OBT had some previous experience with using a MAU model, they might have decided to use a MAU model rather than the Resource Allocation method to analyze their plans. Following the same rules as for the resource allocation method, for most performance measures the agency gave the "no investment" a 0 utility value and "elaborate" investments a 100 utility value. The cost category was given the reverse, with "elaborate" getting a 0 utility. This resulting table is shown in Figure 16.

Rank	Weight	Criteria	Alternatives			
			No Investment	Modest	Moderate	Elaborate
—	—	Cost of developing WWW-service	100	90	70	0
—	—	Expanded comm. Capabilities	0	33	67	100
—	—	Increased revenue generation	0	30	95	100
—	—	Better comp. w/ other states	0	33	67	100
Total Utility:						

Figure 16. Partial MAU model, OBT

Next, for each criterion, they rated the remaining alternatives between 0 and 100. Remember that a utility is an assessment of how much a certain alternative on one criterion is “worth” to the agency. It is very important to understand that this ranking is often not linear, this can be true even if the underlying measurements are linear. E.g. the criteria “increased revenue generation” is measured by “3 x agency spending” at the modest investment, “4 x agency spending” at the moderate level of investment, and “5 x agency spending” at the elaborate level. This might be interpreted as a linear variable, however, the funding sources for the agency might have set a minimum goal of 4 times agency spending. This means that achieving the modest goal of “3 x agency spending” is of little or no value. Whereas the difference between four times and five times is negligible. This might lead the weighting of the “increased revenue generation” criteria to be: 0, 30, 95, and 100. The procedure for finding the weights is explained on page 21.

Rank	Weight	Criteria	Alternatives			
			No Investment	Modest	Moderate	Elaborate
2	.27	Cost of developing WWW-service	100 27	90 24	70 19	0 0
4	.06	Expanded comm. Capabilities	0 0	33 2	67 4	100 6
1	.52	Increased revenue generation	0 0	30 16	95 49	100 52
3	.15	Better comp. w/ other states	0 0	33 5	67 10	100 15
Total Utility:			27	47	82	73

Figure 17. Complete MAU model, OBT (numbers rounded)

Notice that the second criterion in the “Performance variables, measures, and targets” worksheet was dropped from this analysis. This is because it did not change over the three investment alternatives, and thus would not have changed the model.

With the MAU model almost complete, the group from OBT had to compare the importance of the different criteria. This was done by comparing every criterion to the others to find the most important ones. Increased revenue generation, was given a 1 in the “rank” column, and then compared to every other remaining criteria. This led to the “cost of developing WWW-service” getting the second highest ranking. This criterion was then compared with the two remaining criteria, resulting in the “better competition with other states” ending up as rank number three, and the last criterion getting the last rank.

With the ranking done, weights needed to be assigned to the criteria. Knowing the rank made it a little easier for the OBT group, because they knew that the criterion ranked as number one had to have a higher weight than the criterion ranked as number two, and the criterion ranked as number two had to have a higher weight than the third ranked criterion, etc. When there are relatively few performance criteria (i.e., 3 - 5), weights may be determined relatively easily by an expert. When the number of performance criterion is larger, it may be very difficult indeed to determine how to weight the cost attribute relative to all the other performance criteria so that the trade-off between cost and benefits is appropriate. An expert in MAU modeling can assist in this process.

Rather than assigning weights, it may be simpler and more efficient to just rank the criteria in order of importance. This approach has been developed in F. Hutton Barron and Bruce E. Barrett, “Decision Quality Using Ranked Attribute Weights,” *Management Science*, 1996, 42(11), 1515-1523. In their process, each of the performance criteria are ranked from most important to least important. Once that ranking has been established, weights are assigned according to the following table:

Rank	2 criteria	3 criteria	4 criteria	5 criteria	6 criteria	7 criteria	8 criteria
1	.75	.61	.52	.46	.41	.37	.34
2	.25	.28	.27	.26	.24	.23	.21
3		.11	.15	.15	.16	.16	.16
4			.06	.09	.10	.11	.11
5				.04	.06	.07	.08
6					.03	.04	.05
7						.02	.03
8							.02

Figure 18. MAU-Model Weighting

For more information, please see Ward Edwards and J. Robert Newman, “Multi-attribute Evaluation,” in Hal R. Arkes and Kenneth R. Hammond (eds.), *Judgment and Decision Making: An Interdisciplinary Reader*. New York: Cambridge University Press, 1986.

After applying the weights, the group multiplied the weights with the utility scores in each cell, and put the product in the middle of the cell. These numbers were summarized into the total utility row.

Looking at the final result, the group decided to do a sensitivity analysis. They tried to “tamper” with some of the numbers to get the answers to some “what if” questions. e.g. “what if something in the

funding situation change, and the first and second ranked criteria change order?.” This, and a number of other “what if” questions were discussed, and the agency group finally decided that the resulting recommendation was not very sensitive to changes in the environment.

The group decided that the agency Web site *should* be designed and built and that they should go for the moderate level of investment.

Note to the reader: It is important to understand that using the resource allocation model and the MAU-model on the same problem might lead to different recommendations. This is because the assumptions underlying the two models are quite different. While the resource allocation model uses real costs, the MAU model uses weights that might in some situations be more appropriate, and in other situations not appropriate. The MAU model also differs by weighting the different criteria. You must understand these assumptions, and choose a model according to what best fits your situation.

8. Conclusions

Even though each situation is different, based on our experience with the agencies in the Internet Services Testbed Project, we can make the following general observations:

- Developing a WWW service is a multi-year proposition. You should plan for resources to maintain and enhance the service once it is developed. Often, the ongoing investment needed to keep the Web service current is substantial.
- The human resource costs to develop and operate a typical Web site are usually significantly larger than the cost of the technical components.
- In situations where the technical infrastructure is not already present, one-time infrastructure costs may also be large.
- The addition of advanced capabilities such as access to agency databases, search engines, or flexible Web sites usually requires operating the Web site in-house, rather than outsourcing.
- The shift from outsourced to in-house hosting of the site usually means a large increase in costs, especially if technology and skilled personnel are not already available in the agency.
- While defining and estimating the cost measures is typically easier than defining and quantifying performance measures, most groups can do it.
- With some “outcome” measures (e.g. increasing tourism and business relocation), it may be difficult to sort out the effect of the Web service from other factors in the environment.

In summary, even though the World Wide Web and the Internet are relatively new technologies, developing plans to deliver a service should proceed along the same lines as any technology-based project. One method is described in *Developing & Delivering Government Services on the World Wide Web: Recommended Practices for New York State* also of interest is *Making Smart IT Choices: A Handbook*, both published by the Center for Technology in Government. Because the technology can span the whole organization, it is critical to get a development team that includes all the involved parties. Using the method described in this guide and its companion provides a useful framework for making sound investments. We wish you all the best.

Appendix A. Detailed Directions for Worksheet

Organizational Readiness

Often, the development of the first Internet-based project in the agency requires a great deal of planning and support to get off the ground. The Internet is relatively new, the technology is rapidly changing, the user base is quickly developing, and few government agencies have first-hand experience with developing and operating Internet services.

This category includes the resources necessary to get the agency to the point where implementation of the Internet-based service is feasible. It includes training, demonstration projects, and other educational activities designed to help agency management and staff become more familiar with Internet-based services and technologies so that they may make sound decisions about the proposed project and its technology.

A variety of activities can support this decision. Specific activities appropriate for WWW services can be found in the CTG publication *Delivering Government Services on the World Wide Web: Recommended Practices for New York State*. More general suggestions may be found in CTG's *Making Smart IT Choices: A Handbook*.

Line	Human Resources Costs	Description
1	<i>Training for Technology Awareness</i>	This category includes the training and demonstration activities necessary to acquaint the agency management and staff with the potential of Internet-based services. It includes exploratory investigations and trials of the Internet, best practices research and demonstrations, development and demonstration of preliminary prototypes, and training and self-study of staff involved in the decision making.

2	<i>Planning for Internet Presence</i>	<p>This category includes the management, technical, program, and policy staff resources to plan for the service. This includes project development, review, and fiscal analysis on the project. The plan should include an assessment of outsourcing options for developing and operating portions of the service.</p> <p>Specific tasks might include:</p> <ul style="list-style-type: none"> • strategic planning for services • conducting a successful pilot • gaining executive level support • cost-performance analysis • internal and external marketing • promoting intraorganizational cooperation • identification and structuring of information • defining roles and responsibilities • team formation • identifying liaisons for program areas • developing staff expertise • advance public relations • providing for post-implementation Web site support.
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Access for Agency Staff and Other Users

Each Internet service will involve users communicating over the Internet. Depending on the particulars of the project, it may be necessary for users to be able to browse the WWW, receive and respond to electronic mail, communicate with one another, and have access to specially developed internal Intranet applications. The users might be the public at large, agency staff, staff in other agencies and affiliated provider agencies, business partners, or clients.

In order to be successful, it may be necessary to provide hardware, software, Internet access, and training on both general software and on your particular service. For services aimed at the general public, user access is typically not subsidized by the project and general WWW competency is all that is required. For users within the agency or perhaps for non-profit affiliates, the cost of necessary components should be included when planning the project. You may have this infrastructure in place, or it might need to be developed further for a successful project. While this equipment might serve other purposes in addition to the specific activities of the Internet-based project (such as general office automation and communication), if it is necessary for the success of the project its cost must be considered in the cost of the entire project. How much of the cost is charged to the Internet project varies depending on circumstances.

Line	Infrastructure Costs	Description
3	<i>Hardware for End Users</i>	This should include PC's capable of supporting Internet access, either dial-up via modem or network-ready for LAN access to the Internet. The annual cost should include hardware upgrades on a periodic basis.
4	<i>Software for End Users</i>	This includes network software, WWW browsers, electronic mail systems and gateways, other Internet software, and security software. The annual cost should include software upgrades.
5	<i>Network and Internet Access for End Users</i>	This category includes all capabilities needed to provide access to the Internet services from the end users' PCs. In almost all cases, a unit external to the agency that provides access to the Internet will be involved. This "Internet Service Provider" or "ISP" can provide access to the Internet in a number of ways. Individual accounts with dial-in access to an ISP provides an inexpensive starting approach that grows as the number of users increases. This approach requires modem access, either directly or through a LAN, for each user of the services. Alternatively, an agency's LAN or mainframe computers may be connected to the Internet through the ISP, through either a dial-up or leased connection. The latter comes at a higher cost but with increased flexibility and level of service. Connecting through a LAN or mainframe involves security considerations because, depending on the configuration, other Internet users may gain unauthorized access to agency resources. What exactly is included depends on whether you intend to use dial-in from individual PC's or connect through a LAN. For dial-in access, this typically includes modems, phone line charges, and Internet access accounts. For LAN access, this may include network interface cards, hubs, routers, switches, firewalls, data line charges, and ISP accounts.
6	<i>Other Vendor Services</i>	This may include network design and installation, PC configuration, and maintenance.

Line	Human Resources Costs	Description
7	<i>Start-up Process for Equipment Procurement</i>	This should include costs of the purchasing department as well as the installation and testing of the network if that is to be done in-house.
8	<i>Establish and Manage Vendor and ISP Contracts</i>	This includes all costs related to managing the outsourced activities. One-time costs include the initial time to research options, select a vendor, and establish the contract. Ongoing costs include technical liaison with the vendor and contract administration and coordination.

End User Support

Staff and other users of the system will need training and help-desk support to make effective use of the resources. Again, depending on the user, the cost to support the users may be borne by the agency or by other parties.

Studies have indicated that, in general, formal training is less costly and more effective than self-learning. The training and day-to-day support may be provided in-house, or outsourced to a separate organization.

Line	Infrastructure Costs	Description
9	<i>Vendor Services</i>	If training or help desk support are outsourced, include the cost paid to the vendor here.
10	<i>Establish and Manage Vendor Contracts</i>	This should be included if line 9 is not-zero. It includes all costs related to managing the outsourced activities. One-time costs include the initial time to research options, select a vendor, and establish the contract. Ongoing costs include liaison with the vendor and contract administration and coordination.

Line	Human Resources Costs	Description
11	<i>Development and Delivery of User Training</i>	This should include only the cost of developing the training program, not staff time in receiving the training. Even if outside trainers are engaged, staff may be involved in planning and designing the specific training activities.

12	<i>User Time in Training</i>	This should include staff time spent in both self-help and formal training.
13	<i>Help Desk for Users</i>	This should include all costs of day-to-day support for both agency staff and other users of the system.

Content Development and Maintenance

Developing a suite of information and services that will be provided on the Internet entails, at a minimum, converting the information into a form that can be delivered to recipients by WWW servers. At present, this often requires specialized “mark-up” activities that require trained personnel and can be time-consuming. This is an area in which the support tools are rapidly changing, and project plans need to be reassessed frequently to keep up with the current technology.

If the intended application involves two-way communication, using such technologies as electronic mail, fax-back services, fill-in forms that users can access via the WWW, specialized applications that link agency databases and other applications to the WWW front end, or adaptive Web pages, then the cost of developing and operating the service may be substantial. Agency staff may be needed on an ongoing basis to reply to email and handle the additional work generated through the Web service. Developing the technical infrastructure may involve security planning, technical evaluation of alternatives, specialized programming, linking of search engines and databases to Web pages, and on-site hosting of the WWW site.

Once again, development of the content may be done completely in-house, outsourced, or some combination of the two. The initial development is often outsourced to get a jump-start on developing the services.

In the categories below, a number of different functions related to developing and maintaining the Internet service are detailed. In a large organization, these functions may be done by separate staff members; in a smaller agency one person may perform several of these functions.

Line	Infrastructure Costs	Description
14	<i>Hardware for Content Developers</i>	If the service or Web pages are developed in-house, the content providers will need suitable systems.

15	<i>Software for Content Developers</i>	This may include page creation tools (graphics tools and HTML tools), application development tools (CGI scripting tools, Java development environments), search engines, database interfaces, document creation and conversion software, a variety of Web browsers for testing, design manuals, and reference materials. The annual cost should include software upgrades and acquisition of new tools. Although many shareware tools are available, a cost may be incurred just to keep up with this rapidly changing field.
16	<i>Network and Internet Access for Content Developers</i>	If a LAN connection has been provided for general users, this may suffice for the content providers as well. However, if the plan is to use individual dial-in accounts, there may be an additional cost to provide access for the content developers.
17	<i>Other Vendor Services</i>	All other outsourced costs related to content development go here. This may include development of the system information architecture, graphics design, layout, HTML conversions, technical design, and testing.

Line	Human Resources Costs	Description
18	<i>Start-up Process for Equipment Procurement</i>	If hardware and software need to be provided, the administrative and technical costs should be included. This should include costs of the purchasing department as well as the installation and testing of equipment.
19	<i>Establish and Manage Vendor Contracts</i>	This should be included if line 17 is not-zero. It includes all costs related to managing the outsourced activities. One-time costs include the initial time to research options, select a vendor, and establish the contract. Ongoing costs include liaison with the vendor and contract administration and coordination.

20	<i>Development and Delivery of Staff Training</i>	This includes the training of content developers, and may be done internally or contracted out. This should include the cost of the training only; staff time to attend the training should be included in the staff costs below. Depending on the service and how much of it is to be developed in-house, this may include training in technical topics such as HTML editing, search engines, database integration, Java programming, CGI scripting.
21	<i>Staff Time in Training</i>	This should include staff time spent in both self-help and formal training. It may include technical training on the tools used in developing content for WWW-based services, as well as general training on new operating systems or network technologies.
22	<i>Webmaster</i>	This person is responsible for overall coordination of the WWW-based service. It is typically a single person or unit that manages the creation and evolution of the service. Depending on the agency organization, this may be done in the office of the PIO or in the program offices.
23	<i>Editorial Review</i>	It is usually important that all aspects of the developed system have a consistent look and feel. This staff effort ensures the consistency and quality of information that goes on the WWW site.
24	<i>Content Creation and Coordination</i>	This effort provides information to be made available on the WWW service. Typically staff that perform this function are from the program offices or the public information office. It also includes the managers that are involved in the selection and maintenance of content.
25	<i>Web Site Design and Development</i>	This should include the effort to design the service, create an information architecture, page design and testing, graphic design, and HTML conversion.
26	<i>Staff Support for Service</i>	Staff that provide components of the WWW-based service. This may include responding to email, providing new or expanded agency services that are accessed through the WWW service, or additional interaction with other agencies or organizations.

27	<i>Programming Support</i>	Many custom services such as database access, customized WWW pages, search engines, and automatic form handling require programming activities.
28	<i>Database Administration</i>	Management of the content of information provided in agency databases linked to the WWW. This may be increased if new databases are added or more complexity is added to existing databases.
29	<i>Other Management Support</i>	For coordination, approvals, auditing.
30	<i>Other Clerical Support</i>	For necessary typing and other routine tasks.

Host of Site

To support a WWW-based service, a system containing a WWW server and space to store the information must be available, usually on a 24 hour a day, seven days a week basis to support a Web site. Advanced applications may require additional equipment to support email access, process forms, link to databases, perform searches, or generate customized HTML pages for individual users. These WWW hosting activities may be outsourced to a vendor, or may be implemented by connecting the agency's WWW server to the Internet. While simple informational Web pages, forms, and electronic mail can typically be outsourced, more advanced two-way applications often require development of a custom WWW server application and a dedicated host to provide that service.

Again, several roles and responsibilities are defined below. Unlike the previous category, these are typically done by different individuals. A very small organization may combine some of these roles or outsource most of them for cost effectiveness.

Line	Infrastructure Costs	Description
31	<i>Hardware</i>	If done in-house, additional hardware may be necessary to host the WWW service. If not accounted for elsewhere, this may include not only processors but also networking equipment such as hubs and routers. Often, to protect the agency LAN from outside intruders, this may include security hardware such as a dedicated Web server system, firewalls, and proxy servers.
32	<i>Software</i>	This may include database servers, WWW servers, search engines, monitoring tools, and security software. Again, this may only be necessary if the WWW service is hosted in-house.
33	<i>Network and Internet Access</i>	This may have already been included earlier if Internet access for the Web server is to be shared with agency users or content developers.
34	<i>Other Vendor Services</i>	The entire Web site may be outsourced. Even if hosted by the agency, such activities as network design, security planning, and technical support may be outsourced for cost considerations.

Line	Human Resources Costs	Description
35	<i>Front-end Research and Technical Evaluation</i>	There are a number of technical considerations related to providing a WWW service, particularly whether to host the site in-house or outsource it. Often the cost of performing this evaluation is significant, especially if the planned service is technically complex.
36	<i>Start-up Process for Equipment Procurement</i>	This should include costs of the purchasing department as well as the installation and testing of equipment if that is to be done in-house.
37	<i>Establish and Manage Vendor Contracts</i>	This should be included if line 33 is not-zero. It includes all costs related to managing the outsourced activities. One-time costs include the initial time to research options, select a vendor, and establish the contract. Ongoing costs include liaison with the vendor and contract administration and coordination.

38	<i>Development and Delivery of Staff Training</i>	This includes the training of the technical support staff, and may be done internally or contracted out. This should include the cost of the training only; staff time to attend the training should be included in the staff costs below. There may be a cost even if the site is outsourced both in order to make informed decisions and in order to support a connection to the Internet to manage the information at the off-site service.
39	<i>Staff Time in Training</i>	This should include staff time spent in both self-help and formal training.
40	<i>Network and Systems Administration</i>	The workload of IT support staff will be increased if the service is hosted on the agency computer. Software will need to be installed, linkage to data connections will need to be established, security measures will have to be added, and additional backups will need to be managed.
41	<i>Web Server Management</i>	Someone will be required to install and maintain the operation of the WWW server, search engines, database linkages, and other Internet services
42	<i>Operations Support</i>	There may be an increase in workload due to such needs as backup and installation services.
43	<i>Clerical Support</i>	There may be increased workload if such services as printing, mail-back, and other information services are included.

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