

Introduction and Purpose

"Measure a thousand times, and cut once" — Ancient Turkish Proverb

The Office of Information Systems Management (OISM) of the Administration for Children and Families (ACF) has a continuing interest in helping States to improve the quality and usefulness of the plans and studies that support their development of public benefit information systems. To this end, OISM has published the *Feasibility, Alternatives, and Cost/Benefit Analysis Guide* (the Guide), has sponsored State systems planning working groups, has developed a set of model spreadsheet templates for cost/benefit analysis, and has prepared cost/benefit training materials.

To augment these efforts, *and especially to respond to suggestions and comments by State working group participants and reviewers of draft versions of the Guide*, OISM has developed this *Companion Guide: Cost/Benefit Analysis Illustrated*. This optional guidance is intended to respond to the State working group's request for:

- Examples of sound cost/benefit studies,
- Clarification of what is required by law and regulation to be submitted to ACF,
- Differentiation between what may be developed and held in State files and what is submitted,
- Additional guidance in the area of developing benefits, and
- Further information on reporting actuals against a baseline.

This *Companion Guide* is, in a sense, four documents in one.

Chapter 1: Introduction and Purpose. This introductory chapter provides general information to supplement the information presented in the Cost/Benefit Guide. It also provides a section on developing benefits.

Chapter 2: Sample State Documentation. This chapter provides an example of a cost/benefit study prepared by a State and maintained in State files. It simply serves to

illustrate, when compared to Chapter 3, that the information submitted to ACF can be a summary of or extracts from the State's study.

This section in no way implies a standard, approach, or format that States must use.

Chapter 3: Sample State APD Documentation. This chapter provides an example of the part of the Implementation APD which addresses cost/benefit analysis. This example illustrates the summary or key information that ACF considers important. Among the most important factors are:

- Detailed descriptions of benefits, and
- Clear establishment of a baseline for later cost/benefit measurement and reporting.

This guide does not mandate a format. It does illustrate a sufficient level of detail for ACF's purposes since this section (and the other chapters) underwent review in ACF's program offices.

Chapter 4: Sample State APDU Documentation. This chapter is an example of a cost/benefit measurement report. It is written as though reporting in the second year of the project described in Chapters 2 and 3. This clarifies the relationship between the planning stage studies and the post-implementation measurement and reporting phase.

This *Companion Guide* stresses the importance of *completeness, reasonableness, and internal consistency* in a cost/benefit analysis. It is intended as a companion to the Guide, and not as a replacement. The Guide remains the definitive ACF reference on the subject of cost/benefit analysis to support State public benefit information systems advanced planning.

Definitions and Clarification of Terms . . . Not Policy

Cost/benefit analysis for public benefit information system planning purposes overlaps two distinct philosophic disciplines: economics and finance¹. Each of these disciplines has been (and continues to be) the subject of tremendous volumes of research by academics and corporate and government scientists. As a result, and especially when discussions of cost/benefit analysis refer to these academic roots,

¹ Of course, to a lesser extent it also involves the disciplines of politics, sociology, computer and communications sciences, psychology, probability, statistics, etc.

endless nuances and subtleties, complex formulas, and difficult jargon can become involved.

Practical cost/benefit analysis is, at its heart, based on a simple, fair, common sense approach to comparing alternatives. However, because cost/benefit analysis usually involves evaluating monetary costs and benefits *over time*, some basic rules for handling such "time distributed" monetary values must be applied. Beyond these basic rules (which are discussed further below), practical cost/benefit analysis involves no more than basic arithmetic: adding, subtracting, multiplying and dividing.

The *Feasibility, Alternatives, and Cost/Benefit Analysis Guide* is based on methodologies and formats in current and common use within the Federal government. Most of the terminology in the Guide derives from the usage within Office of Management and Budget Circulars². OMB Circulars are the primary vehicle by which the Executive branch establishes and disseminates Federal agency management policies that derive from Public Laws.

OMB identifies cost/benefit analysis as the recommended technique to use in formal, economic analysis of Government programs or projects. In this context, it is *social net benefits*, and not the benefits and costs to the government, that should be used as the basis for evaluating alternative approaches. This means that system benefits are evaluated not just from a State or Federal perspective, but also from a public perspective as well. What benefits accrue to citizens?

OMB also defines a less comprehensive approach, called cost-effectiveness analysis. An alternative is *cost-effective* if it costs the least of the alternatives, for a given amount of benefits. Cost-effectiveness analysis is appropriate when the benefits from competing alternatives are identical, or where a given level of benefits must be provided as the result of a specific new legislative or policy decision. Cost-effectiveness analysis is a one-sided cost/benefit analysis: only costs are analyzed.³

For ACF and most organizations, the standard metric for cost/benefit analysis of alternatives is

² In particular, OMB Circular No. A-94: *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, 57 Federal Register No. 218, November 10, 1992.

³ Note that this paragraph discusses OMB's policy on cost-effectiveness analyses conducted by Federal agencies — not ACF's for the States. Federal cost-effectiveness analysis is most typically used in weapons acquisitions.

***Cost/Benefit Analysis Illustrated
Guide
Introduction
Chapter 1***

Companion

net present value (NPV). NPV is simply the difference between total projected benefits and total projected costs, and may be referred to as net benefit (or net

cost). Note that NPV may be negative (a net cost) for one alternative, and positive (a net benefit) for another alternative.

Another term sometimes used is return-on-investment (ROI). (The Guide uses the term benefit-cost ratio.) ROI is expressed as a percentage or a ratio — total projected benefits divided by total projected costs. If the NPV is positive, ROI will be greater than one and a net benefit results. A negative NPV means an ROI of less than one (and a net cost). Because the NPV incorporates a discount factor (to account for the time value of money, as noted above), sometimes a third metric, internal rate of return (IRR) is applied. The IRR is the value of the discount factor that results in an NPV of zero (that is, when projected total benefits *equal* projected total costs).

Although a positive net present value cannot always be demonstrated for all alternatives, efforts to measure it can produce useful insights, even when the monetary values of some benefits cannot be determined. Enumerating such benefits (e.g., in terms of clients served) can be helpful in identifying the full range of program effects, even if they cannot be assigned a dollar value, or monetized.

On the Importance of Being Consistent

Perhaps more important than the form and content of a cost/benefit analysis is its internal consistency.

If a cost/benefit analysis does not demonstrate internal consistency, nothing else matters; its results are meaningless. Internal consistency depends entirely on two things: that costs and benefits are assigned properly, and that the time value of money is considered.

Costs and benefits are assigned properly if nothing significant is left out, nothing that doesn't belong is included, and nothing gets counted twice. The Guide provides an outline of typical cost and benefit factors that *may* appear in a cost/benefit analysis; of course, any and all other significant factors should be included and explained as well. The things that don't belong in a cost/benefit analysis are the things that have already been paid for, and the gains that have already been achieved⁴. Counting

⁴ Generally referred to as "sunk costs" and "realized benefits", respectively.

things twice often results when a cost or a benefit is included in two or more

categories, or when a cost or benefit that is included within a larger factor is included again, as a separate factor.

Future costs and benefits can be presented in terms of today's prices or in terms of future (inflated) prices. Using today's prices (called constant or real dollars) rather than future prices (called current or nominal dollars) is the generally preferred approach for planning purposes, since inflation is so difficult to predict. Whichever approach is selected *must* be applied **consistently** throughout the analysis.

The time value of money must be accounted for **consistently** throughout a cost/benefit analysis. Regardless of whether constant or current dollar values are used, a *discount factor* should be applied to future costs and benefits. The discount factor reflects a basic principle of economic analysis — that money today is worth more than money in the future. Because the most obvious effect of this economic principle is on interest rates, the discount factor is sometimes described as reflecting the impact of interest rates on future costs and benefits.⁵ The 7% discount rate recommended for use in the Guide is based on the assumption that States will use constant dollars and that the systems will generate public benefits.⁶

Much of what comprises a cost/benefit analysis is presented in the form of spreadsheets or tables. The information is derived by calculation, applying formulas or rules to a given set of input values. It should be possible for an analyst to recreate the basic results of any internally consistent cost/benefit analysis by starting from only the initial values, assumptions and formulas that were used in that initial analysis. OMB puts this point more succinctly in Circular A-94: "Measures should be consistent with basic economic principles and should be replicable."

About the More Sophisticated Techniques

As noted above, new, advanced methods and techniques for cost/benefit analysis are constantly

⁵ Note, as a point of interest only, that the discount factor used in a nominal (current) dollar analysis will be different from that used in a real (constant) dollar analysis.

⁶ The foundation for the 7% policy is OMB Circular A-94.

being introduced, discussed and refined. Sometimes these techniques have a practical application to cost/benefit analysis for systems planning; often they add little in the way of new information or insights, and sometimes they serve only to confuse matters.

These techniques may involve:

- Using functions to estimate uncertain risks;
- Weighting benefits according to their relative importance;
- Evaluating external economies and diseconomies, spillovers or externalities;
- Measuring excess burdens or deadweight losses;
- Estimating prices absent market distortions such as excess burdens and externalities (shadow prices);
- Estimating willingness to pay; or
- Other methods or algorithms for financial or economic analysis.

Traditionally (and as is true in most areas of human endeavor), the new techniques that have real value find their way into the mainstream of practical cost/benefit analysis, while the questionable or overly complex techniques get left aside.

The bottom line: If you understand, and can explain, and can defend the use of these techniques in your cost/benefit analysis, and if they provide useful additional information, then use them. Otherwise, don't.

How much effort is all this worth?

One of the most frequently asked questions by analysts responsible for cost/benefit analyses is "how detailed does this thing need to be?" Put another way, how does one determine the "appropriate" scope or level-of-effort for any given cost/benefit analysis?

There are three traditional answers to the question of scope:

- Conduct a cost/benefit analysis with detail commensurate with the size and

scope of the acquisition.

- Make it as complete and detailed as it needs to be to support the decision it is intended to support.
- Spend up to 3% of the total projected system cost on planning (including needs, feasibility, alternatives, cost/benefit, risk, and requirements analyses).

Applying the "3%" rule: If the system is estimated to cost in the \$6,000,000 to \$8,000,000 range, the supporting analyses "should" cost from about \$180,000 to \$240,000. Cost/benefit analysis may comprise as much as 15% of the total initial planning effort, or from about \$27,000 to \$36,000 in this example. If a planning analyst receives \$40,000 per year in salary and \$20,000 per year in benefits, the total level of effort (in time) for the cost/benefit analysis should be from about 23 work weeks up to about 31 work weeks.

From another perspective, before any manager signs off on a plan to spend five or ten million or more taxpayers' dollars, he or she is going to want to see ample evidence that alternatives, costs, and benefits were analyzed, weighed, *and documented* carefully and completely.

Further, ACF emphasizes the importance of tracking and reporting "actuals" — the real costs and benefits that result from implementing a new public benefit information system. In order for the actuals to have any value or meaning, there must be a reasonably detailed "forecast", or pre-implementation cost/benefit analysis.

Assembling Data

A cost/benefit analysis can be no better than the basic numbers that are used to build it. In fact, a cost/benefit analysis can be *internally consistent* (see above), and yet be *practically useless* if unreasonable starting numbers were used.

After ensuring that a cost/benefit analysis is internally consistent, reviewers evaluate the *completeness* and *reasonableness* of the costs and benefits that are presented. Costs and benefits are complete when all significant factors have been identified and evaluated. Costs and benefits are reasonable if their sources and bases are clearly identified, explained and justified. As a rule of thumb, costs are simpler to identify and quantify than benefits, and require less in the way of explanation and justification. For example, new system hardware and software costs

Cost/Benefit Analysis Illustrated
Guide
Introduction
Chapter 1

Companion

usually are readily available, in adequate detail, from interested vendors. On the other hand, benefits are often speculative or uncertain and must be developed and documented carefully for inclusion in a cost/benefit analysis.

A good way to start is to assemble the team (sometimes a team of one!) that is to be responsible for developing source information. Make sure that the right people inside the organization are aware that a study is underway, and that they know who will be contacting them for information, and when. Much useful information can be developed through interviews or other survey techniques. Often, important cost or benefit factors will be identified by program managers or proposed system users that would not otherwise have been considered. As one member of such a cost/benefit analysis study team noted:

We had trouble with intangibles. Everybody had a gut feeling that we needed to do something, but they all wanted numbers before reaching consensus. So we went to the experts — the managers and users in areas affected by the project. We developed the benefits with their help. The final numbers stood up because of their source.⁷

Cost information sources include internal budget, finance, operations, and human resources cost records and reports; reports to the public and outside organizations; management and staff directly, by interview or survey; commercial research organizations, such as DataPro or Gartner Group; and external information sources, such as other government organizations or vendors.

Benefit information sources include internal budget, finance, operations and human resources forecasts, projections, record systems and reports; management and staff directly, by interview or survey; and external sources, such as other government organizations.

A particularly useful way to project quantified benefits (and to determine costs for the status quo) is to find out exactly how much time is currently being spent, by activity, by (for example) child support enforcement specialists. Another method is to use survey techniques to determine (for example) the average number of new

⁷ ROI? *There is a better way.*, Marc Dodge, *Corporate Computing*, May 1993, p. 109.

cases per month, time to process new cases (by type of case), number of referrals per month, time to complete referral forms, number of "locate" cases per month, time to complete various phases of locate activity, number of paternity cases per month, time to complete, etc. These "baseline" numbers can be used to estimate the value of system improvements that reduce the time necessary to perform specific functions, and thus increase the caseload that can be handled by an average caseworker. The

increased caseload can be translated into dollars as cost savings or avoidances from reduction in overtime expenditure, reduction in staff, and / or reduction in staff growth.

Remember also that benefit information does not have to be expressed in monetary terms to be useful or have value. Competing alternatives may have comparable *quantifiable* (monetary) costs and benefits, and yet differ widely in terms of non-monetary or intangible benefits.

As with most worksheet-oriented problems, an electronic spreadsheet is the ideal tool to use in developing and producing tabular reports. A spreadsheet can automate routine tasks, such as the distribution of costs over time or the generation of summary or "roll-up" views of information. To illustrate these and other capabilities, OISM has developed a prototype set of spreadsheet templates and macros (with brief instruction sheet) to automate the development and production of cost/benefit analysis tabular reports. These templates are available in Lotus 1-2-3™, Microsoft Excel™, and Borland Quattro-Pro™ formats. They are recommended only for experienced users since ACF can provide only limited phone support.

Developing Benefits

Cost/benefit analysis in the private sector is normally concerned with determining whether expenditures will result in increased income. The effect on the bottom line is the primary concern. What net profit will result?

Only a handful of federal programs can conduct cost/benefit analyses as "profit" decisions — notably, the IRS and the Child Support Enforcement Program. These organizations generate collections (income) that offset (in a sense) the costs of the government's programs to collect or provide welfare support. In these systems, improved and integrated information systems can increase collections, resulting in a net gain for the government.

Cost/Benefit Analysis Illustrated
Guide
Introduction
Chapter 1

Companion

However, most public sector cost/benefit analysis is concerned with net program effect. The government does not charge for its services: public services or benefits are required by statute to be provided. So the government's obligation is not to maximize profit, but to make cost-effective expenditures and to deliver maximum benefits within the budget.

Therefore, most public sector cost/benefit analysis does not seek to increase program funds — but *to change the distribution of costs enough to support system development*

within the overall budgetary limitations of the organization. By this means, public agencies prove projects to be cost-effective.

ACF views cost/benefit analysis as serving four fundamental and equally important needs — to:

- Evaluate alternative mixes of financial, human, and information resources,
- Support wise economic decisions on proposed information system investments,
- Establish a performance baseline against which to measure the success of the systems project, and
- Provide fundamental management tools to maximize benefits and minimize costs.

Therefore, cost/benefit analysis is a process of developing "economic indicators" that serve as important tools in management decision-making. These economic indicators reflect how the distribution of costs change — so that the net effect on the program can be evaluated. The questions are:

- Can enough be "saved" in other categories to "pay for" the costs of developing the new system,⁸ and
- Will the system project result in measurable improvements over current

⁸ This process is sometimes referred to as work process re-engineering. Examples in this document include elimination of courier services and staff reassignment (Benefits 5 and 1, respectively, in Chapters 2 and 3).

operations?

Public sector cost/benefit analysis is not an accounting process. When benefits equal costs, the analysis has not proven the system will cost nothing. It has proven that the organization will remain within the overall, projected program budget — and that the projected benefits are sufficient to warrant the expenditure for the system project.

Given these precepts, ACF permits States to develop benefits in several ways, listed below in approximate order of preferability:

- Increased collections,
- Program cost savings,
- System cost savings,
- Program cost avoidances, and
- System cost avoidances.

In this context, *cost savings* apply when benefits are developed from firm, fixed costs approved in the State's law or budget (such as cost-of-living increases) or set in a contract to which the State is a party. *Cost avoidances* are more speculative and are based on reasoned projections of costs expected to develop and affect future budgets and expenditures. *The inherent nature of a cost avoidance calculation requires more rigorous analysis and justification*, because it is based on assumptions (estimated future staff needs) rather than facts (budgeted staff costs).

[Compare, for example, the detail in Benefits 2 (cost savings) and 3 (cost avoidances) in Chapters 2 and 3.]

System costs are those costs that directly relate to the systems project and are included in the "cost side" of the cost/benefit analysis. *Program costs* are those *affected by the project but not obligated for the systems project itself*. Program costs are not on the "cost side" of the cost/benefit analysis, but may be the basis for claiming benefits. The table below shows the characteristics of each type of benefit.

Type of Benefit / Characteristic	Collections	Program Cost Savings	System Cost Savings	Program Cost Avoidances	System Cost Avoidances
Cost in Budget, Law, or Contract?		√	√		

Cost for System Development or Operation?			√		√
Cost for Program Operations?		√		√	
Could Affect Cost Side of Cost/Benefit Analysis?			√		√
Increased Revenues?	√				

Benefits Based on Increased Collections

For child support systems, States can base benefits on the expected effect of the new system on caseworker productivity, measured in terms of increased collections or other indicators. Claiming these benefits requires several steps, which begin during the feasibility and alternatives analysis. These steps include:

- Determining current problems and setting system objectives,
- Setting performance goals for collections or other indicators,
- Determining how the system will support the desired improvement,
- Calculating the probable effect on collections, and
- Determining how the improvement will be measured.

During the feasibility study, States identify system problems and set objectives. For example, the State could express system problems in terms of inadequate access to statewide or nationwide databases required to find absent parents, procedural or operational inefficiencies, unacceptable quality and timeliness of services to the public, or administrative overhead cutting caseworkers' available productive time. To fix those problems, the State develops objectives for the new system, such as online access to statewide and national databases, specific procedural and operational improvements, and the reduction of manual or administrative tasks that the caseworker must perform.

In order to determine how these improvements will affect performance, States must first have good information on what the current performance indicators are. These might include:

- Total successful "locates,"
- Average number of "locates" by caseworker,
- Rate of "locates" (in percentage) by total caseload,
- Average rate of "locates" (in percentage) by caseworker,
- Total collections (in dollars),
- Average collections (in dollars) by caseworker,
- Rate of collections (in percentage) by total caseload, and
- Average rate of collections (in percentage) by caseworker.

In addition, the State should collect or develop timeliness records on elapsed time until absent parents are located and until collection begins, stated in terms of time ranges. For example, the current system's "successful locate rate" is 10% within 30 days, 25% by 60 days, 40% by 90 days, and so forth.

Once the State has this information, the effect of system improvements can be evaluated and new performance objectives set which are both specific and measurable. At the same time the performance objectives are set, a plan to measure performance under the new system should be developed.

Since the cost/benefit analysis developed for this *Companion Guide* is "generic," it does not include a sample benefit for increased collections. However, States may want to consider that this benefit can be evaluated in two ways: the social net benefits⁹ resulting directly from the collections and indirectly from reductions in welfare payments.

Benefits Based on Program Cost Savings

⁹ OMB Circular A-94 provides: "Social net benefits, and not the benefits and costs to the Federal Government, should be the basis for evaluating Government programs or policies that have effects on private citizens or other levels of Government." ACF permits the calculation of social net benefits.

**Cost/Benefit Analysis Illustrated
Guide
Introduction
Chapter 1**

Companion

Benefits based on program cost savings evaluate the effect of the project, such as improved efficiency or elimination of costs, on currently budgeted or obligated funds.

The difference between costs budgeted for program operations under the *current* system and costs projected for program operations under the *new* system is claimed as a benefit for the alternative. This benefit helps offset the project costs.

Note that the budgeted and projected program costs are *not* included as costs in the analysis — only the difference as a benefit.

Program Cost Savings Benefits	Yes	No
Cost in Budget, Law, or Contract?	√	
Cost for System Development or Operation?		√
Cost for Program Operations?	√	
Could Affect Cost Side of Cost/Benefit Analysis?		√

An example of this type of benefit is shown in Benefit 2, set forth in both Chapters 2 and 3. In this benefit, improved caseworker efficiency supported by system improvements is expected to reduce caseworker overtime pay. The program cost

savings of \$150,000 are listed as a benefit. Caseworker costs are not included on the cost side of the cost/benefit analysis. See the table below.

Benefit 2 — Program Cost Savings		
Year	Cost Side	Benefit Side
1		\$ 150,000
2		150,000
3		150,000
4		150,000

5		150,000
Total		\$ 600,000

Benefits Based on System Cost Savings

Benefits based on system cost savings evaluate the projected effect of the project on currently budgeted or obligated funds supporting systems operations.

Examples of this type of benefit include elimination of staff positions for systems operators and programmers, lower utility costs resulting from lower power consumption, and reduced costs for space when moving from centralized to distributed processing.

There are three ways to evaluate this "benefit" in a cost/benefit analysis. None is perfect: all are acceptable.

System Cost Savings Benefits	Yes	No
Cost in Budget, Law, or Contract?	√	
Cost for System Development or Operation?	√	
Cost for Program Operations?		√
Could Affect Cost Side of Cost/Benefit Analysis?	√	

Conventional wisdom suggests that the effect of the benefit be applied to either the cost *or* the benefit side of the cost/benefit analysis, not both. Those two alternatives are addressed first.

Benefits on the Cost Side Only. If the savings were shown only on the cost side, then reduced costs for the alternative would be revealed in a side-by-side comparison of current and proposed system costs, not by reviewing the benefits identified for the system.

There are three problems with this approach.

The first is that a benefit counted in the cost side can get "lost" when combined with other cost

Cost/Benefit Analysis Illustrated
Guide
Introduction
Chapter 1

Companion

elements in the same category and may not be measured during systems implementation and operation. While this may not be important for low dollar cost reductions such as utility costs, it may be quite significant when professional salary reductions are involved. For example, costs for systems programmers (expected to be reduced with the new system) would be combined in the cost analysis with other personnel costs, such as system operators, data entry staff, and security officers. When costs are combined with others on the cost side and no specific benefit is claimed, they are not identified as specific measurement goals.

Benefits are not "lost" when identified on the benefits side. They become discrete, performance management goals against which improvements achieved by the new system are measured.

The second problem is that measuring a benefit on the cost side reflects only the projected cost, not the improvement achieved over the status quo by the new system. For example, if the old system required \$100,000 of systems programmers and the new system is projected to require \$50,000, then actual costs of \$75,000 are evaluated only from the perspective of a \$25,000 cost overrun above projected cost — not of the \$25,000 improvement over prior system operations. This is because actuals are compared to projected costs for the alternative — not the status quo. See the table on the next page.

Third, not only is the cost reduction from the status quo not available for performance measurement, it also is not available for offsetting the system development costs. If the intent is to evaluate *overall program effect*, this method does not assess the cost savings from the old system to the new system.

While this may not matter for low dollar cost savings between cost elements, it may be quite significant in areas where major reductions are projected.

Benefits on the Cost Side Only		
For:	Cost Side	Benefit Side
Status Quo	\$100,000	
Alternative*	50,000	
Actual*	75,000	

*Figures in these rows are compared during cost measurement. Note that cost side figures would typically be combined with other staff costs in the cost analysis and lose their effectiveness as discrete, measurable goals.

Benefits on the Benefits Side Only. Some of the problems cited above are eliminated when a system cost savings benefit appears only on the benefits side: benefits are not lost, are measurable goals, and offset system development costs. In addition, the improvement over the status quo would be evident because the narrative benefit description would establish the basis for the \$50,000 benefit — that is, \$100,000 *status quo* costs less \$50,000 projected costs for the alternative.

However, one major new problem is introduced. A cost element central to the systems project is not counted on the cost side — with the result that the total systems cost is not truly a total systems cost.

Status Quo		0
Alternative*		\$ 50,000
Actual*		\$25,000

*Figures in these rows are compared during cost measurement.

Benefits on the Cost and Benefit Side. The third method shows the respective costs for the current and proposed system and claims the difference as a cost savings on the benefits side of the analysis.

Viewed from an accounting perspective, some claim this is double counting. Using the systems programmer example, this argument suggests that if you project \$50,000 in costs for systems programmers on the new system, then claim a cost savings benefit of \$50,000 over the status quo,¹⁰ you get a net cost of \$0 for systems programmers, which is clearly incorrect.

However, the effect can be interpreted differently.

Accounting Perspective	
Assets (Benefits)	\$ 50,000
Less Liabilities (Costs)	- 50,000
Net	0

¹⁰ If the old system required \$100,000 of systems programmers and the new system is projected to require \$50,000, then the projected cost *savings* are \$50,000 and the projected *costs* are \$50,000.

Taking a net program effect approach, the data would mean that under the new system \$50,000 is projected for systems programmers. Further, a \$50,000 cost savings from the status quo helps offset new system costs and provides a measurable goal for new system operations. The perspective is — what can you buy with available funds? This helps the State evaluate the overall program effect of redistributing expenditures.

Net Program Effect Perspective	
\$ 100,000 Buys You	
*	*
*	*
*	*
System Programmers	System Programmers and System
(Old System)	(New System)

This method is sometimes used by federal agencies and contractors. Given the importance of evaluating overall program effect and of establishing a measurable baseline, States may also use this method.

An example of a system cost saving calculated for net program effect is shown in Benefit 4 in Chapters 2 and 3. In this benefit, the current system is not able to meet peak processing loads, requiring the State to shift some of the processing load to outside service bureaus. The new system would handle all peak loads, so that budgeted costs for the service bureau would not have to be spent. These funds could offset system development costs.

The table below illustrates how the system programmer example would be calculated using both the cost and benefit side of the analysis.

Benefits on the Cost and Benefit Sides		
For:	Cost Side	Benefit Side

**Cost/Benefit Analysis Illustrated
Guide
Introduction
Chapter 1**

Companion

Status Quo	\$ 100,000	0
Alternative*	50,000	\$ 50,000
Actual*	75,000	25,000

*Figures in these rows are compared during cost measurement. Note that cost side figures would typically be combined with other staff costs in the cost analysis and would not serve as discrete performance management goals. On the benefits side, benefits have been achieved, although not as much as anticipated.

Benefits Based on Program Cost Avoidances

Benefits based on program cost avoidances calculate the effect of the project, such as improved caseworker efficiency or staffing for future caseloads, in increasing or decreasing budgetary spending levels. In other words, cost avoidances do not deal with fixed budgetary dollars, but on projected increases (or decreases) likely to be required in the budget.

As indicated previously, cost avoidances are more speculative than cost savings. They are based on reasoned projections of costs expected to develop and affect future budgets and expenditures. *The inherent nature of a cost avoidance calculation requires*

more rigorous analysis and justification.

The difference between costs projected for program operations under the *current* system and costs projected for program operations under the *new* system is claimed as a benefit for the alternative. This benefit helps offset the project costs. Note that the projected program costs are *not* included as costs in the analysis — only the difference as a benefit.

Program Cost Avoidance Benefits	Yes	No
Cost in Budget, Law, or Contract?		√
Cost for System Development or Operation?		√
Cost for Program Operations?	√	
Could Affect Cost Side of Cost/Benefit Analysis?		√

An example of this type of benefit is shown in Benefit 3 in Chapters 2 and 3 and summarized in the table below. In this benefit, staffing increases in the number of

caseworkers are projected to be higher and start earlier for the current system than for the chosen alternative. In this case, the difference between the projected total annual salaries for caseworkers under the status quo and alternatives is claimed as a program cost avoidance benefit. Note that the explanation of the derivation and calculation of this benefit is far more thorough than that of Benefit 2, which claims a program cost savings.

Benefit 3 — Program Cost Avoidances		
Year	Cost Side	Benefit Side
1		0
2		\$ 481,920
3		1,034,120
4		1,257,510
5		1,420,660
Total		\$ 4,194,210

Benefits Based on System Cost Avoidances

***Cost/Benefit Analysis Illustrated
Guide
Introduction
Chapter 1***

Companion

Benefits based on system cost avoidances calculate the effect of the project, such as eliminating courier service fees by enhanced telecommunication capability, in increasing or decreasing budgetary spending levels. In other words, cost avoidances do not deal with fixed budgetary dollars, but with increases (or decreases) likely to be required in the budget.

To repeat, cost avoidances are more speculative than cost savings and require more rigorous analysis and justification.

System Cost Avoidance Benefits	Yes	No
Cost in Budget, Law, or Contract?		√
Cost for System Development or Operation?	√	
Cost for Program Operations?		√
Could Affect Cost Side of Cost/Benefit Analysis?	√	

As discussed in detail under the system cost savings section, there are three ways to evaluate this "benefit" in a cost/benefit analysis:

- Benefits on the cost side only,
- Benefits on the benefits side only, or
- Benefits on the cost and benefits sides.

None is perfect: all are acceptable.

A system cost avoidance calculated for net program effect (both cost and benefit sides) is shown in Benefit 5 in Chapters 2 and 3 and summarized in the table below. In this benefit, the State has begun to incur new expenses resulting from using courier services to deliver information to meet new program and timeliness mandates. The new system would meet this requirement through a new telecommunications network, so that funds would not have to be redirected and budgeted to cover these costs. This cost avoidance allows those funds to be spent *differently*, supporting system development costs.

Benefit 5: System Cost Avoidances		
For:	Cost Side	Benefit Side
Status Quo	\$ 650,000	0
Alternative*	65,000	\$ 585,000
Actual*	65,000	585,000

*Figures in these rows are compared during cost measurement. Note that cost side figures would typically combined with other costs in the cost analysis and would not serve as discrete performance management goals. On the benefits side, benefits have been achieved as anticipated.

Sensitivity Analysis: Dealing with Uncertainty and Risk

Because cost/benefit analysis deals primarily with future events, many costs and most benefits are based on predictions. The degree of certainty of these predictions can vary: from "near certain", such as in estimating future costs for hardware maintenance on a new system, to highly speculative, such as in estimating the dollar value of an electronic mail system that *should* displace a substantial amount of memo and letter writing.

Most cost/benefit analyses are based on a single set of numbers, which usually represent the "best guess" by analysts as to the value of uncertain outcomes. In fact, the degree of risk that is inherent in a cost/benefit analysis depends entirely on the degree of confidence in such "best guesses". Sometimes, varying a single estimated value by a significant amount can alter the basic outcome of a cost/benefit analysis, by shifting the optimum net present value from one alternative to another. How should a cost/benefit analysis deal with such situations, when so much is at stake over what are essentially informed guesses? What is the effect on a cost/benefit analysis of altering the basic estimates or assumptions that went into its development?

The basic technique for resolving such issues is to perform a *sensitivity analysis*. A sensitivity analysis is a methodical approach to varying the basic or underlying assumptions contained within a cost/benefit analysis. Sensitivity analysis is the game of — *what if?* — and serves two important purposes. It validates the conclusions of a cost/benefit analysis by examining the effects of changes to the basic, underlying assumptions that formed the analysis, and it provides

a framework for subsequent recording and analysis of actual incurred costs and realized benefits.

A common approach to sensitivity analysis involves two steps. First, identify the range of possible values for each key variable¹¹. A typical approach is to identify "high", "low", and "expected" values. Second, examine the effect on the outcome of the cost/benefit analysis (e.g., the net present value) as the high, low and expected values are plugged in, *while each of the other variables is held constant at its "expected" value*¹².

The sensitivity analysis may identify a *critical variable*: one that has the effect of shifting the optimum NPV from one alternative to another when its initial value is changed. When this occurs, it is usually an indication that additional research and analysis is needed, either to refine the estimate (i.e., narrow the expected range of values) for that critical variable, or to quantify other costs or benefits that may help differentiate between the alternatives.

The results of the sensitivity analysis should be a part of any cost/benefit analysis. As a system is implemented and becomes operational, the actual costs incurred and benefits realized will provide a confirmation (or refutation) of the "best guess" estimates that were used in the original planning.

When actual outcomes vary substantially from those projected, the sensitivity analysis can be revisited to determine whether the outcomes are within the range of possibilities that were identified by the sensitivity analysis. It's better to be wrong than to be surprised!

Actuals and Updates

Systems designers refer to a system's "life cycle," which underscores the fact that modern information systems are expected to serve a particular purpose for a *limited* period of time, after which (presumably) new technologies will have evolved such that the following generation system will cost less, run faster, be easier to use, and so forth.

¹¹ There should be no more than five or six "key" variables; more than this number adds complexity to the analysis without providing any additional meaningful information. If a cost-benefit analysis contains more than five or six highly uncertain variables, more research and data analysis is needed.

¹² To examine every possible combination of variables (e.g., a high, low and expected value for each of six variables) would result in 720 (6 factorial) separate outcomes! Such an exercise would likely be counter-productive.

Regardless of the stage in the life cycle of a public benefit information system, at some point it will be necessary to begin the planning process anew. For cost/benefit analysis, the best place to start is with the "status quo" — the existing system. The costs and benefits of the status quo provide a baseline from which alternative costs and benefits are estimated, and against which the alternatives will be compared.

During systems design, development, implementation, and operation, costs and benefits should be tracked and recorded in as much detail as possible (commensurate with the level of detail of the original cost/benefit analysis). These "actuals" should be recorded and updated over time, to provide a year-by-year (or quarter-by-quarter, month-by-month, etc.) view of how costs and benefits actually accrue.

Tracking and updating actuals provides a vital feedback-loop for management's use in controlling and maximizing the cost effectiveness of the project. In addition, the process will support the development of better cost/benefit analyses over time. Initial assumptions and formulas can be evaluated and adjusted as suggested by comparison with the results. This should be an iterative process; one of constant refinement. The methods and outcomes of cost/benefit analysis will be improved and management control will be enhanced by access to information systems planning projections and forecast-versus-actual reporting.

The Reviewer's Perspective

As the Introduction to the *Feasibility, Alternatives, and Cost/Benefit Analysis Guide* points out, it was developed for use by Federal personnel in evaluating State submissions, as well as for use by States in developing their submissions. In general, Federal reviewers of State cost/benefit analysis submissions look for three things: *completeness*, *reasonableness*, and *internal consistency*:

- **Completeness** in that all of the important cost and benefit factors have been identified, and that adequate discussion is provided to explain their sources and derivation.
- **Reasonableness** in that the assumptions, rationale, sources, derivations,

justifications, explanations, and projections are sound and defensible.

- **Internal consistency** in the assignment of costs and benefits, in the treatment of real or nominal dollars, and in the application of present value discounting.

Finally, and to sum up, the review process is certainly simplified when submitters have followed the guidance and used the worksheet formats presented in the Guide!