Making the Business Case for Software Performance Engineering

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Shrinking budgets and increased fiscal accountability mean that management needs a sound financial justification before committing funds to software process improvements such as Software Performance Engineering (SPE). Preparing a business case for SPE can demonstrate that the commitment is financially worthwhile and win support for an SPE initiative. This paper presents an introduction to the use of business case analysis to justify investing in SPE to reduce costs due to performance failures. A case study illustrates how to perform a financial analysis and calculate a projected return on investment.

INTRODUCTION

Performance—responsiveness and scalability—is a make-or-break quality for software. Yet, despite widespread recognition of the importance of performance to the success of a project, many software products cannot be used as they are initially implemented due to performance problems. They fail to respond rapidly enough to user actions or to handle the number of transactions that occur under peak load conditions.

These performance failures cost the software industry millions of dollars every year. The costs of performance failures include:

- *Increased Operational Costs*—Poor performance means that your staff needs more time to complete key tasks, or that you need more staff to complete these tasks in the same amount of time. In extreme cases, users may bypass the automated system altogether in favor of faster manual processes.
- *Increased Development Costs*—One company discovered, during integration testing, that an online transaction that should have taken 10 seconds could not be completed in less that 60 seconds. Some transactions took as long as 200 seconds. When problems like these arise, you need to allocate additional resources to the project to "tune" or even redesign the software to try to meet performance objectives.
- *Increased Hardware Costs*—If tuning or redesign isn't sufficient to solve the problem, you may need to increase your hardware capacity (for example, by adding more processors or upgrading to faster disks) to achieve your performance objectives.
- *Canceled Projects*—In some cases it will be impossible to meet performance objectives by tuning, and too expensive to redesign the system late in the process or add more hardware capacity. These projects will be canceled and their costs will be largely unrecoverable.
- *Damaged Customer Relations*—Poorly performing software can cause your organization's image to suffer. The effects of poorly performing Web sites are well documented; customers will simply go elsewhere rather than endure long waits. This problem is not limited to Web sites, however. Long waits on the telephone while customer-service representatives access customer data will ultimately have the same effect. Even if the problem is fixed later, negative perceptions will continue.
- *Lost Income*—"Tuning" or redesign results in late deployment or delivery of software. In some cases, you may find yourself paying penalties for late delivery or failure to meet contractual performance requirements.
- *Reduced Competitiveness*—Late delivery due to "tuning" or redesign can also mean that you miss a critical market window, allowing your competition to increase their market share at your expense.

Software performance engineering (SPE) [Smith and Williams, 2002], [Smith, 1990] provides a systematic, quantitative approach to constructing software systems that meet performance objectives. With SPE, you detect problems early in development, and use quantitative methods to support cost-benefit analysis of hardware solutions versus software requirements or design solutions, or a combination of software and hardware solutions.

SPE is a software-oriented approach: it focuses on architecture, design, and implementation choices. It uses model predictions to evaluate trade-offs in software functions, hardware size, quality of results, and resource requirements. The models assist developers in controlling resource requirements by enabling them to select architecture and design alternatives with acceptable performance characteristics. The models aid in tracking performance throughout the development process and prevent problems from surfacing late in the life cycle (typically during final testing).

SPE also prescribes principles and performance patterns for creating responsive software, performance antipatterns for recognizing and correcting common problems, the data required for evaluation, procedures for obtaining performance specifications, and guidelines for the types of evaluation to be conducted at each development stage. It incorporates models for representing and predicting performance as well as a set of analysis methods.

To many of us, the above paragraphs sound like a solid argument for adopting SPE. Yet, when we present our case to management, they frequently remain unconvinced. Why?

The problem is often a disconnect between what we, as software developers or performance engineers, consider a justification for adopting a technology and what management expects. To management, the above argument is a technical justification preceded by some general, qualitative economic information. It doesn't provide the hard financial information that they need to make a decision.

In today's world, management is being asked to do more with fewer resources. As a result, they need specific, quantitative data to evaluate the economic advantages and disadvantages of adopting a new technology such as SPE. That means making a *business case* for SPE.

What Is A Business Case?

A business case is a document presented to win management commitment for investment in a proposed project or course of action. It establishes that the project will meet an identified business need and is feasible, affordable and a sound investment. If there are competing alternatives, it provides a quantitative basis for choosing among them. The business case also provides a basis for managing the proposed project and measuring its effectiveness.

The concept of preparing a business case to justify a proposed investment is not new. However, in today's economy shrinking budgets, competing proposals for limited funds, and higher fiscal accountability for management have combined to revive the popularity of this tool. Business and government entities from IT departments to human service organizations are now requiring that employees justify new initiatives with a business case.

A business case describes the cash flows (both costs and benefits) that occur as a result of pursuing the proposed course of action and their timing as well as the methods and assumptions that were used in calculating them. It also includes a discussion of critical success factors (e.g., training or the use of consultants), the impact of the project on the organization (will it change the organization chart?), and an identification of any significant risks that could change the outcome along with recommendations for mitigating them.

For example, a business case for SPE would identify the problem to be solved, indicate how SPE can solve the problem, and quantify the costs and benefits of adopting SPE for a given project or the organization as a whole. It would also discuss the impact of SPE on the software development process and identify any risks that might prevent the projected benefits from being realized along with strategies for mitigating them

The following section describes the contents of a business case in more detail.

Business Case Contents

The following sections describe the essential components of a business case. The title and format of each section will vary by organization.

Executive Summary

The Executive Summary should be a short summary of your business case; one page is usually best. The rest of the document will provide details to support the summary. This may be the only part of your business case that some people read, however, so you need to make your case here clearly and succinctly. Include a high-level summary of the results and focus on the financial analysis. Leave the details and explanations for the body of the document.

Problem Statement

There is a reason you are proposing this project. For SPE that reason could be a history of performance failures on previous projects or a high risk of failure on a new project. This section should summarize the issues, how they affect the organization and your assessment of what the source of the problem is.

Proposed Solution

This section describes how the problem will be addressed and the expected outcomes. Begin with an overview of the project. Then provide enough detail to demonstrate that what you propose is in line with your organization's business goals and can, in fact, be achieved.

Financial Analysis

The financial analysis details the costs and benefits of the proposed solution and summarizes them using one or more of the financial analysis tools described below. It is based on a *cost model*—a spreadsheet model that includes all of the costs and benefits related to the proposed project.

The model serves as a guide for performing a cost/benefit analysis (see below). The model results are then used to compute financial metrics such as: Return on Investment, Internal Rate of Return, or Total Cost of Ownership. These metrics are discussed below.

Timeline

Each major step in implementing your proposed solution should be shown on a timeline such as a Gantt Chart. These include major milestones (e.g., completion of training) as well as major cash flows (e.g., expenditures such as equipment).

Sensitivity Analysis and Risks

This section discusses potential problems that might prevent achievement of the objectives and overall benefits of the proposal. For example, what if one or more of the assumptions used in the financial analysis is wrong? Or, what if a step in the process cannot be completed on time?

Sensitivity analysis looks for items in the cost model for which a small change in value can make a difference in the outcome of the analysis. If assumptions were used in deriving these numbers, they should be examined and best- and worst-case estimates used to predict what happens if the assumptions become invalid.

This section should also include any potential risks to the project or organization. For example, if you can't hire a performance analyst by the required date, how will this affect your projected benefits? If these risks can be quantified and used to assign probabilities to model results, this analysis should be included [Schmidt 2003c]. For example, do you have a 50% probability of realizing 100% of your projected benefits and a 90% chance of realizing at least 40% of the projected benefits? For information on risk analysis methods, see [Boehm 1991] and [Boehm 1989]. Also discuss ways of minimizing or mitigating each risk.

Conclusions and Recommendations

This section should summarize the problem, the proposed solution, and the costs and benefits of the solution. Be sure and include information on return on investment or other positive financial outcomes.

It's important to make your conclusions and recommendations explicit. Don't assume that because you have presented all of the evidence your audience will reach the conclusions on their own.

Cost/Benefit Analysis

Cost/benefit analysis weighs the anticipated benefits of a course of action against its expected costs. In performing a cost/benefit analysis, you attempt to quantify every cost and benefit, including seemingly intangible costs or benefits such as reduced employee turnover. If a cost or benefit cannot be quantified, it does not contribute to the financial analysis. That is, it is assigned a value of 0.

Costs

Costs are anything for which you spend money. Examples of costs in an SPE initiative include salaries for performance specialists, tools, and support equipment such as workstations for performance analysts or a dedicated performance testing facility.

Benefits

Benefits are anything that generates revenue or avoids a cost. For SPE, benefits are usually costs due to poor performance that you reduce or avoid as a result of applying SPE. These include: costs of refactoring or tuning, hardware upgrades, contractual penalties, user support costs and others described in the introduction.

Incremental Analysis

Business cases are typically based on incremental cost/benefit analysis. An incremental analysis includes only those costs and benefits that are due specifically to the proposed investment or course of action. Each line item in the financial model includes only changes from "business as usual" [Schmidt 2003b]. For an SPE business case, you would include only costs that are due to adopting SPE (such as software modeling tools) and not costs that would occur whether or not you used SPE. Similarly, you would include only benefits that can

SPE Cost/Benefit Worksheet			
One-Time Costs	$	**Cost Avoidance**	$
Tools		Refactoring	
Performance Modeling Tool		Lost Revenue	
Load Driver		Customer Support	
Measurement Toolset		Liability	
Workstation(s)		Hardware/Licensing	
Training			
In-House Training (Developers)			
Performance Engineer(s)			
Consulting/Mentoring			
Total One-Time Costs		**Total Cost Avoidance**	
Recurring Costs (Annual)	$	**Intangible Benefits**	
Software Maintenance (Tools)		Improved Corporate Image	
Salaries (Including Benefits)		Enhanced Customer Relations	
Performance Manager		Improved Employee Morale	
Performance Analyst			
Continuing Education			
Total Recurring Costs			

Figure 1: SPE Cost/Benefit Worksheet

be directly attributed to SPE (such as avoided refactoring costs).

Figure 1 shows a sample worksheet (adapted from [Reifer, 2002]) for an incremental SPE cost/benefit analysis.The worksheet includes both one-time and recurring costs. One-time costs occur once. They typically include outlays for tools or capital equipment or for project startup costs such as training. Recurring costs are ongoing. They include such things as maintenance on hardware or software licenses or salaries.

"Sunk" Costs

Funds that have already been spent or committed are irrelevant to the analysis and should not be included. These are known as sunk costs. For example, the fact that you held an in-house SPE class three years ago is irrelevant if the development team has turned over completely and everyone needs the training now.

Intangible Benefits

It is important to quantify all benefits. In some cases, this may be difficult. For example, it is difficult to quantify the benefits of reduced employee turnover. However, you can value the *effects* of reduced employee turnover in terms of recruiting expense, training costs, and productivity [Schmidt 2003b].

It may be impossible to quantify some benefits. For example, it is difficult to assign a dollar value to "employee morale" and it is likely that your proposed project is only one of many influences that impact employee morale. Benefits such as this are *intangible benefits*.

If you can't reasonably quantify a cost or benefit, it's best to leave it out of the financial analysis. These items are likely to be controversial and leave you open to charges of "padding" the analysis. That does not mean that you can't discuss them elsewhere in the business case. Companies are often willing to invest in "improved customer satisfaction" or "enhanced employee morale" and these important intangibles can tip the scales when the financial analyses for competing alternatives are close.

Financial Analysis Tools

The heart of a business case is the financial analysis. There are several financial analysis tools that may be used in preparing a business case. The particular tools that you use will depend on the types of cash flows that you expect and their timing as well as the specific accounting practices used by your organization. The sections below describe some of the most common ones.

Discounted Cash Flow

If someone offered you a choice between receiving $400 today or $400 at the end of four years you would probably choose the first even though the amount of money is the same. This is because 1) dollars tend to lose value over time due to inflation, and 2) you can invest the money you receive today so that, at the end of the four years, you would have more than $400.

When an amount P_0 is invested at an annual interest rate i, its future value at the end of one year would be:

$$FV = P_0 + iP_0 = P_0(1+i)$$

If the interest is compounded annually, its future value at the end of *n* years would be:

$$FV = P_0(1+i)^n \quad (1)$$

Similarly, if we know the interest rate and the future value of an amount invested for *n* years, we can compute its net present value:

$$NPV = \frac{FV}{(1+i)^n} \quad (2)$$

This is the amount that we would need to invest today at interest rate *i* to have *FV* at the end of *n* years. Thus, given a present amount and an interest rate, we can calculate its future value or, given a future value and an interest rate, we can calculate its present value.

Suppose that you could invest your $400 at 3.5% annual interest (interest rates aren't what they used to be, are they). Now, if someone offers you $400 today or $459 at the end of four years, which would you choose? If you calculate the net present value of $459 invested at 3.5% for four years using equation 2, it is $400. So it doesn't matter which you choose. Here, the interest rate of 3.5% is known as the discount rate. It is the rate at which you would be indifferent between two cash amounts received at different times.

Discounted cash flows, calculated using equation 2, are useful for comparing amounts paid or received at different times by converting them to a common basis, usually today's dollars.

Total Cost of Ownership (TCO)

When you buy a capital item, such as a workstation, the purchase price is only a portion of what it costs to own it over its lifetime. There are also installation, maintenance, repair, and other costs. When the item is no longer useful, you may be able to sell it and recover some costs or you may have to pay someone to take it away. Since these costs occur at different times, they must be discounted to a present value.

The formula for TCO (also known as Life Cycle Cost—LCC) is:

$$TCO = \sum_{i=0}^{N} \frac{C_i}{(1+d)^i} \quad (3)$$

where:

TCO = Total Cost of Ownership
C_i = total of all costs occurring in year *i*
N = number of years the item will be owned
d = discount rate used to adjust cash flows to a present value

For example, suppose you purchase a workstation for $3,000 and pay $100 per year for maintenance over 4 years. At the end of the 4 years, you pay a $25 recycling fee to dispose of the no-longer-needed workstation. If the discount rate is 3%, the Total Cost of Ownership for this workstation is:

$$TCO = \$3{,}100 + \frac{\$100}{(1.03)^1} + \frac{\$100}{(1.03)^2} + \frac{\$100}{(1.03)^3} + \frac{\$25}{(1.03)^4}$$

$$TCO = \$3{,}405$$

The initial purchase and first year's maintenance occur now (year zero); the second maintenance payment occurs at the end of year one, and so on. Note that, due to discounting, the actual total cost is less than the nominal total of $3,425.

Total Cost of Ownership focuses only on costs associated with owning an asset. It does not consider benefits such as increased revenue that might be produced by the asset. Thus, TCO is most appropriate when comparing alternative purchases for a given purpose.

Return on Investment (ROI)

Return on investment is calculated as the net benefits of some course of action divided by the amount of the investment:

$$ROI = \frac{net\ benefits}{investment} \quad (4)$$

An investment of $1,000 that yields benefits totaling $1,500 has a 50% ROI. Costs and benefits are determined by a cost/benefit analysis as described above. However, it is important to beware of this simple formula if the costs and benefits occur at widely different times. For example, if the costs occur at the beginning of the project while the benefits are not realized until much later, it may be necessary to use discounted cash flows to compute ROI in current dollars.

Payback Period

The payback period is the length of time (usually years) required to recover the cost of an investment. In general, if you are considering two alternatives, the one with the shorter payback period is the better investment.

$$Payback\ period = \frac{investment}{periodic\ savings} \quad (5)$$

For example, if the investment is $500 and the periodic savings is $100 per year, the payback period is 5 years.

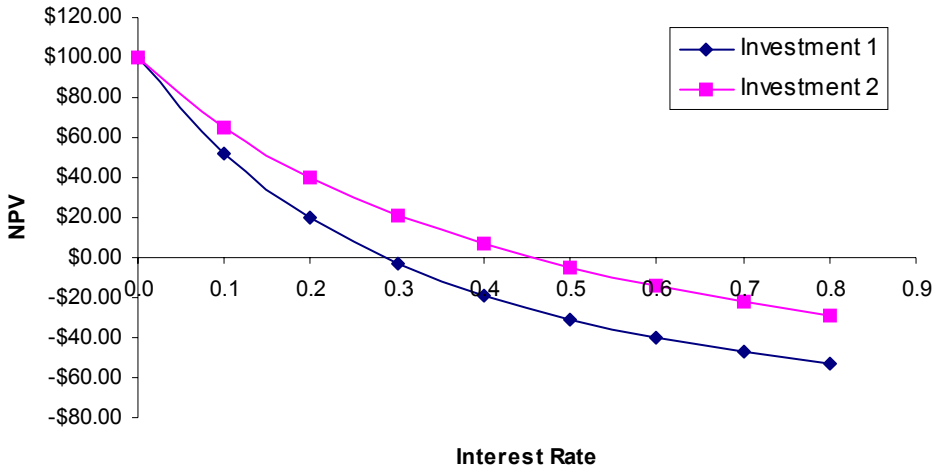

Figure 2: Internal Rate of Return

While payback period is simple to calculate and its interpretation is intuitive, it does have limitations. Payback analysis typically does not consider the time value of money (discounted cash flows). Thus, if the investment is made early in the project but the expected benefits do not occur until several years later, the analysis may overestimate the value of the benefits. In addition, payback analysis does not consider benefits that occur after the payback period.

Internal Rate of Return (IRR)

Internal Rate of Return is less intuitive than Payback Period but it overcomes the limitations of payback analysis by taking an investment view of the proposed project or action and explicitly considering the time value of money. It is most useful for comparing investment alternatives where the costs and benefits differ and/or occur at different times.

The IRR for an investment is the effective interest rate (discount rate) that makes the net present value (NPV) of all cash flows related to the investment—both costs and benefits—equal to zero.

$$NPV = \sum_{i=0}^{N} \frac{C_i}{(1+d)^i} = 0 \qquad (6)$$

where:

NPV = Net Present Value
C_i = total of all cash flows occurring in year i
N = number of years under consideration
d = discount rate

Solving this equation for d yields the discount rate that makes NPV zero or the Internal Rate of Return. In general, this equation must be solved iteratively. However, we can get a feel for IRR by looking at a graphical example.

Table 1: Alternative Investments

Timing	Investment 1	Investment 2
Now	-$100.00	-$100.00
Year 1	$40.00	$80.00
Year 2	$40.00	$60.00
Year 3	$40.00	$40.00
Year 4	$40.00	$10.00
Year 5	$40.00	$10.00
Total	**$100.00**	**$100.00**

Consider the two investments shown in Table 1. We have two alternatives both of which require an initial investment of $100.00 (the numbers in the first row are negative since they are cash outlays or costs). The investments both return a total of $200.00 but the timing of the returns is different. Figure 2 shows the NPV of these returns as a function of interest rate. Investment 1 has a zero NPV at an interest rate of approximately 30% while Investment 2 has a zero NPV at approximately 45%. Thus, the IRR for Investment 1 is approximately 30% while the IRR for Investment 2 is approximately 45% and Investment 2 is the better choice.

CASE STUDY

Background

WayOut Widgets, Inc. has made several incremental upgrades to its Web site. Following each upgrade, they

have experienced performance problems resulting in numerous customer complaints, lost sales, and increased demand for human operators to take orders over the telephone as customers abandon the sluggish web site.

(Note: While this case study does not represent an actual project or organization, each of the categories of costs and benefits is drawn from our experience on real projects. The dollar amounts have been scaled to be appropriate to the size of the example project.)

Fixing these problems has required hardware upgrades and post-deployment refactoring efforts to tune the software. Refactoring efforts have involved the entire development team for periods ranging from 3 to 12 months. Hardware upgrades have required additional application and database servers.

A group of developers has proposed using SPE to manage performance and try to avoid these problems. Management has indicated that they will consider the proposal *if* it is accompanied by a financial analysis that indicates a favorable return on investment. The following sections describe the costs and benefits identified by the team. Their cost/benefit worksheet is shown in Figure 3. The rationale for each of the line items is given below.

The SPE initiative will be introduced for the development of the next release of the Web application. This project will involve 15 developers and is expected to take 18 months.

This discussion focuses on the Cost/Benefit analysis. A complete business case also needs the topics covered in the Business Case Contents section.

Costs

Tools The team proposed a suite of tools that included a software modeling tool as well as a load driver and performance measurement tools.

The cost of the software modeling tool is $8,500. The annual maintenance contract, including upgrades is $1,600.

The cost of the load driver is $70,000. The annual maintenance cost for this tool is $10,500.

The company already owns the necessary performance measurement tools. The cost of acquiring these tools as well as their annual maintenance fees has already been spent and is thus a sunk cost that has no bearing on the decision to adopt SPE for the next release.

Additional Staff It was decided that the project would need one full-time performance engineer to construct performance models and assist in making performance measurements. The burdened salary for this individual is estimated to be the same as that for a developer—$100,000.

Workstation A workstation for the performance engineer is estimated to cost $4,000. This cost includes an on-site maintenance contract for three years which is longer than the duration of the project.

Note: We could use a Total Cost of Ownership analysis to see whether buying or leasing the workstation would be more economical. We have not included that analysis to keep this case study as simple as possible.

Training The team decided that best approach would be to train each member of the development group in the basic techniques of SPE. A one-week, in-house class to train all 15 developers costs $38,000. The cost of the developer time while attending the class is $28,846 for a total of $66,846,

The cost of sending the performance engineer to a one-week advanced SPE class is also included. The cost of the class, fees and travel, is $4,000 and the cost of the engineer's time is $1,923 for a total of $5,923.

Finally, there is a line item for continuing education. This includes a trip to one conference per year for the performance engineer to keep abreast of new developments. The estimated amount is $2,200 per year.

Consulting/Mentoring To jump start the project, the team plans to bring in external consultants to conduct an architecture review and construct an initial set of software performance models.

The total cost for an architecture assessment and recommendations, a baseline set of software models, and assistance to the performance engineer in taking over the models is $250,000.

Benefits

The benefits of SPE on this project arise from avoiding costs due to poor performance. The team has identified the following costs.

Refactoring As noted above, refactoring efforts for previous releases have required the efforts of the entire development team for periods of 3 to 12 months. For the previous six projects, one required three months refactoring, four required six months, and one required 12 months. For the upcoming project, the amount of time that would be required for refactoring if SPE were

not used can be calculated using a simple expected value formula (weighted average):

Cost/Benefit Worksheet			
One-Time Costs	**$**	**Cost Avoidance**	**$**
Tools		Refactoring	$ 812,500
Performance Modeling Tool	$ 8,000	Hardware Upgrade	$ 600,000
Load Driver	$ 70,000	Lost Revenue	$ 975,000
Workstation	$ 4,000	Telephone Agents	$ 325,000
Training			
In-House Training (15 Developers)	$ 66,846		
Performance Engineer	$ 5,923		
Consulting/Mentoring	$ 250,000		
Total One-Time Costs	**$ 404,769**	**Total Cost Avoidance**	**$ 2,712,500**
Recurring Costs (Annual)	**$**	**Intangible Benefits**	
Software Maintenance (Tools)	$ 12,100	Improved Corporate Image	
Salaries (Including Benefits)		Enhanced Customer Relations	
Performance Analyst (1.0 FTE)	$ 100,000	Improved Employee Morale	
Continuing Education	$ 2,200		
Total Recurring Costs	**$ 114,300**		

Figure 3: WayOut Widgets, Inc. Cost/Benefit Worksheet

$$EV = \frac{3 + 4(6) + 12}{6} = 6.5$$

Thus, the amount of refactoring expected to be saved is 6.5 months. The burdened cost of 15 developers for 6.5 months is $812,500.

Hardware Upgrade For previous projects, post deployment tuning efforts were insufficient to achieve the required performance. In each case, server upgrades were also necessary. The average cost of server upgrades over the previous projects was $600,000.

Note: As with the workstation, it is possible to perform a Total Cost of Ownership analysis for the server upgrades. If this analysis were performed, the overall cost of this line item would be higher. The historical data is sufficient, however and, to keep the case study simple, we have used it.

Lost Revenue Marketing estimated lost revenue by comparing sales figures for times when the web site was performing poorly with those during normal operation. Since some orders that would normally have been placed via the web site were obviously being placed via telephone (see below), these were subtracted from the lost revenue figure.

The marketing estimate is that 100 sales per day were lost due to customers abandoning the web site due to poor performance. These losses would occur every day during the expected 6.5 month refactoring/tuning period. The average sale is $50. Thus, the amount of lost sales revenue that would be avoided is $975,000.

Telephone Agents After deploying each previous release, the company needed to hire 10 temporary agents to handle the increased telephone order volume due to customers abandoning the web site. The burdened cost of a temporary agent is $60,000 per year. These agents would be needed for the expected refactoring time of 6.5 months for a total of $325,000.

Intangible Benefits Intangible benefits of deploying web-site upgrades that meet performance objectives include:

- *Improved corporate image*—The web site is important to presenting a professional corporate image.
- *Enhanced customer relations*—customers, especially repeat customers who use the web site frequently were becoming angry due to long waits.
- *Improved staff morale*—Developers take pride in their work and were becoming discouraged over fielding products with performance problems.

Return on Investment

Table 2 shows the total costs and benefits for an 18-month project.

Table 2: Cost/Benefit Summary

Number of Years		1.5
	Costs	Benefits

Table 2: Cost/Benefit Summary

One Time	$405,269	$2,712,500
Recurring	$171,450	
Total	**$576,719**	**$2,712,500**

Because the project duration is 18 months, the annual recurring costs have been multiplied by 1.5.

The return on investment is:

$$ROI = \frac{\$2,712,500}{\$576,219} = 471\%$$

Case Study Discussion

Given the short time frame for this project (18 months), using a non-discounted Return on Investment is appropriate. Discounting the cash flows would make only a small difference in the overall result.

The 471% return on investment appears to be favorable. However, the decision to proceed with the project will depend on the projected returns for competing proposals. It is worth noting that this return is low compared with other reported projects. Panelist presentations at CMG 2002 reported ROI results ranging from 407% to 18,750% [Williams, et al. 2002].

The costs for this case study are dominated by the startup (one-time) costs. For larger projects that span several years, recurring costs typically surpass the startup costs. Furthermore, startup costs such as tools and workstations may be capital expenses rather than operational expenses. If so, it is worthwhile to differentiate them in the cost/benefit worksheet especially if funds for capital expenses are available or easier to get.

In this case, if there is another suitable project, adding SPE to it would make it possible to amortize the startup costs over two projects. For example, It is likely that the performance modeling tool and load driver could be shared across projects. In addition, since the development project is small, it is likely that the performance analyst could easily handle two projects, thus amortizing the recurring costs as well. Finally, any benefits realized from the second project would increase the return on investment.

Finally, hiring a performance analyst affects the company's organization chart. Successful application of SPE will mean that this position is likely to become permanent. This issue should be addressed in the business plan.

TIPS FOR SUCCESS

1. *Identify and Use a Mentor or Sponsor*—A mentor or sponsor can serve as a sounding board, help you package your business case for maximum effectiveness, identify people who can help, and help you understand the decision-making process [Reifer, 2002]. A mentor can also help you decide which financial analysis tools to use in preparing your case.
2. *Establish an "Advisory" Committee*—While you might be able to prepare a business case for SPE on your own, it's a good idea to recruit additional people from various areas within your organization, such as development, operations, customer service, and sales, to serve as an advisory committee. The advisory committee can help make sure that important line items in the financial analysis are not overlooked, help establish the credibility of your business case, and help "sell" the project [Schmidt 2003b].
3. *Understand Who Pays the Costs and Who Gets the Benefits*—The costs of SPE are often borne by the development organization but, while development receives some of the benefits, others may be distributed to other departments such as operations or sales.

   If project managers are evaluated on how well they meet or exceed their budgets, they may be reluctant to invest something that makes their bottom line look worse even though it benefits the company as a whole. To overcome this, you will need to make your business case to someone who is high enough in the organization to see the overall benefits and help solve this problem (e.g., incentives to project managers).
4. *Understand Your Organization's Budgeting Process*—Understanding the budgeting process will help you construct a better financial model, identify people who have the information you need and/or a stake in the results of your project, and prepare a more focused case. Understanding the budgeting process can also help you know when special money or surplus funds become available [Reifer, 2002] so that you can time your proposal to take advantage of them.
5. *Be Prepared to Defend Your Numbers*—Preparing a business case is not an exact science. It requires assumptions, arbitrary judgements, and development of new data [Schmidt 2003b]. Because of this, it is possible for two people looking at the same information to reach very different conclusions.

   It is important to document the rationale behind each line item in your financial analysis. Discuss potentially controversial items with interested parties early in the process so that problems can be resolved before the business case is presented.

Summary and Conclusions

Shrinking budgets and increased fiscal accountability mean that management needs a sound financial justification before committing funds to software process improvements such as SPE. Preparing a business case for SPE can demonstrate that the commitment is financially worthwhile and win support for an SPE initiative.

This paper has presented an introduction to the use of business case analysis to justify investing in SPE to reduce costs due to performance failures. The case study illustrates how to perform a financial analysis and calculate a projected return on investment.

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