SAAS: Integrating Systems Analysis with Accounting and Strategy for Ex Ante Evaluation of IS Investments

Akhilesh Bajaj
University of Tulsa

Wray E. Bradley
University of Tulsa

Karen S. Cravens
University of Tulsa

ABSTRACT: For many companies, investment in information systems (IS) is one of the largest expenditures in the firm’s capital budget. An important goal of ex ante investment evaluation of an information system is to reasonably determine the return on investment (ROI) of the proposed information system. However, past research has shown that business managers have significant concerns about the soundness of ex ante ROI evaluations of information systems. This relates to the fact that several benefits of an IS are intangible and nonfinancial. In addition, it has long been recognized that, unlike many other capital projects, IS projects exhibit significant contextual interaction. Further, different professionals such as accountants and Information Technology (IT) personnel often use different approaches to evaluate a potential information system. This study develops a framework and methodology that integrates and accommodates the different perspectives of IT personnel, accountants, and business managers. We propose a flexible ex ante framework and methodology that integrates systems analysis, accounting, and strategy (SAAS). The framework evaluates financial and nonfinancial factors and uses analyses that consider investment approaches used by both IT and accounting personnel. The framework is evaluated in two different organizations and recommendations are made for both future research in this area and for the applied use of the framework by professionals.

Keywords: information technology investment evaluation; system analysis; information system business value.

1. INTRODUCTION

Sound ex ante investment evaluation of an information system (IS) is important for several reasons. These include comparison of different competing information system projects before funding them (Irani and Love 2002), provision of a benchmarking...
process that can track the progress of the project and provide early warning signs of failure (Ginzberg and Zmud 1985), and the justification of investment proposal (Dugdale and Jones 1995). An important goal of an ex ante investment evaluation of an information system is to determine the expected return on investment (ROI) associated with the potential adoption of the system. Determining ROI of an IS presents unique difficulties because several benefits of an IS are intangible and nonfinancial. In addition, it has long been recognized that, unlike most traditional capital projects, IS projects are significantly different from each other. In the case of traditional capital projects, the interaction between the organization and the technology is predictable. However, with an IS, the organization-technology interaction is less predictable. Thus, the same IS can lead to different outcomes in two different organizations depending on how it is used. This implies that no single method of investment evaluation will necessarily work across all IS projects (Farbey et al. 1994; Irani et al. 1997).

Irani et al. (2006) indicate that business managers have significant concerns about the ability of information technology (IT) personnel and accountants to provide sound ex ante potential investments in information systems using rules of thumb and intuitive approaches that emphasize how the new IS impacts end-users and whether or not it adds to competitive advantage. On the other hand, accountants typically evaluate potential IS investments using discounted cash flow measures such as net present value (NPV), or profitability measures such internal rate of return (IRR), residual income (RI), or economic value added (EVA)². Neither the IT approach nor the accounting approach has proven to be fully adequate for ex ante IS investment decisions (Greenhill and Pyburn 1985; Dos Santos et al. 2000). In addition, both approaches often fail to communicate to management how the capabilities of a potential IS align with the strategic needs of the business (Van der Zee and De Jong 1999).

Gunasekaran et al. (2006) note the deficiencies in IS selection discussed above and suggest that a balanced approach to IS selection is needed that would include financial factors and nonfinancial factors. The current research is motivated by a desire to bring some clarity to the issue of IS selection by proposing and testing an ex ante framework and methodology that incorporates a balanced approach as suggested by Gunasekaran et al. (2006). The theoretical foundation for this framework is based on the information technology return on investment literature (Dehning and Richardson 2002).

The framework integrates systems analysis, accounting, and strategy (SAAS) in order to ex ante evaluate a proposed IS within its own context. The framework uses information gained from a systems analysis³ to better estimate quantitative measures and qualitative nonfinancial process measures and to conduct organizational capability and accounting analyses. These measures and the results of the analyses are then used to develop metrics that summarize the strategic alignment of the IS and the potential impact that the IS will have on firm performance, in a language that is easily understood by business managers.

Background theory and the development of the framework and associated methodology are discussed in the next two sections. This is followed by a discussion of how the framework was applied and validated at a manufacturing firm and in a local government organization. The last section discusses the developed framework, its limitations, and presents recommendations for future research.

² Conceptually, the authors consider that the term systems analysis (SA) and the construct described as systems analysis and design (SAD) are synonymous.

Journal of Information Systems, Spring 2008

II. OVERVIEW AND THEORY

A decade ago, Ballantyne and Stray (1998) called for the IS/IT and accounting professionals to jointly develop practice guidelines for IS evaluation and selection. Nevertheless, the issue of which technique(s) or methodology to use when selecting a new information system continues to be a subject of debate among practitioners and a subject of continuing research for academics. The polarity of views is perhaps best reflected by the empirical findings of Ballantyne and Stray (1998). They found that the accounting and finance literature was almost entirely focused on using traditional capital budgeting techniques for the selection of information systems while ignoring nonfinancial measures and the problems associated with a strictly financial approach. On the other hand, much of the IS literature outright rejected the use of financial evaluation techniques.

After a comprehensive review of the IT/IS literature, Gunasekaran et al. (2006) conclude that currently there are no generally accepted practice guidelines for the selection of a new information system. They further indicate that there has been little progress made in determining which investment evaluation techniques and methodologies are best suited for IT/IS projects. They note that consideration of intangibles and nonfinancial performance measures remains problematic and the issue of how an IT/IS impacts organizational performance is often overlooked. They suggest that a balanced approach is needed that includes financial and nonfinancial factors.

Our proposed framework offers a balanced approach that builds on the process-oriented model of return on investment discussed in Dehning and Richardson (2002). The determination of return on investment in information technology is a long-standing research issue for both accounting and IT researchers. Dehning and Richardson (2002) (D&R) present a general model that shows key relationships associated with return on investment of IT. They describe five categories (D&R Paths) that researchers have used to investigate relationships between investment in information technology and firm performance. D&R Path 1 researchers hypothesize that the dollar amount of investment in IT is related to firm performance. D&R Path 2 researchers have examined the direct and indirect effects that the IT has on business processes; D&R Path 3 researchers look at the direct impact that business processes have on firm performance; D&R Path 4 researchers examine the link between external factors such as size of firm and business processes; and D&R Path 5 researchers are interested in the link between external factors and firm performance. Dehning and Richardson (2002) suggest that more research is needed concerning the linkage between the effects of the IT on business processes (D&R Path 2) and the linkage between business processes and firm performance (D&R Path 3).

We extend Dehning and Richardson (2002) by further suggesting that the business value or ROI of a proposed information system cannot be fully understood unless both D&R Path 2 (link between the IS and business processes) and D&R Path 3 (link between business processes and firm performance) are evaluated at the micro level. An examination of these two D&R Paths is necessary in order to provide management with ROI analyses that show how a proposed IS creates business value. Figure 1 shows the SSAAS framework that is developed in this study.

The top portion of Figure 1 is a slightly modified version of the Dehning and Richardson (2002) model. Their model indicates that an information system will have both direct and indirect effects on business processes (D&R Path 2) and that outputs from the business processes will directly impact firm performance (D&R Path 3). Our framework describes D&R Path 2 relationships by conducting a systems analysis that considers the impact of a new information system and its relationships to business processes. We note that a proposed IS could support either existing or modified end-user processes and data model
build on the core systems analysis and design outputs that are included in the SAAS framework.

**Business Value of Systems Analysis Outputs**

Once the systems analysis is complete, the outputs provide data that are used in metric-driven organizational capability analyses and accounting based analyses that reveal unique aspects of the business value of an information system. These analyses are shown as Business Oriented Outputs in Figure 1.

**Organizational Capability Analyses**

Melville et al. (2004), using a model similar to the DeHning and Richardson (2002) model, hypothesize that the resource-based view of the firm (RBV) can serve as a theoretical lens that explains and integrates diverse and sometimes conflicting research concerning the business value of IT. Barney (1991) indicates that resource-based theory shows that the impact of an investment on firm performance is a function of context specific unique capabilities. Baldwin and Clark (1994) demonstrate that unique firm capabilities are related to five qualitative organizational capability factors. The five factors are: (1) external integration (how well the potential investment links to the customer), (2) internal integration (how well the investment connects with the internal functions of the business), (3) flexibility (will the investment accommodate change in the business environment?), (4) experimentation (will the investment provide opportunities for experimentation that can lead to improvement in processes and products?), and (5) cannibalization or obsolescence (can the investment be easily modified or is it going to lock the company into maintaining the new investment even in the face of technological changes?). As shown in Figure 1, the second stage of the SAAS framework uses information from the systems analysis to assess the impact of the proposed IS on the five organizational capability factors.

**Accounting Based Analyses**

In addition to providing important information related to organizational capability analyses, the systems analysis outputs also provide accountants with business process information that is not usually available ex ante. The importance of understanding data elements and activity and process models (process mapping), for accountants, has been discussed by several researchers (Jones and Lancaster 2001; Klamm and Weidemüller 2004). Systems analysis outputs provide accountants involved in the investment evaluation process with a relatively simple way to understand the business process impact of a new system, since they specify how the IS will be actually used in the organization. Providing accountants with system analysis outputs prior to their conducting accounting based investment analyses is a means of directly integrating the information systems discipline and the accounting discipline. Understanding the results of the systems analysis enables the accountant to form better business and data process perspectives for evaluation of risk and estimation of cash flows.

Business process information can be directly applied when estimating front-end costs, cost savings, continuing costs, and potential revenue increases. For example, systems analysis outputs will show how extensive the data migration requirements are for the new IS. Using this information, an accountant can develop a better estimate of front-end costs. Similarly, system analysis outputs will reveal continuing data maintenance and data update requirements associated with the new system. This information can be valuable when estimating continuing costs. Systems analysis outputs can also reveal opportunities for cost

**Technical Outputs of Systems Analysis**

As shown in Figure 1, the technical outputs of systems analysis include: (1) a data model schema of the end user domain down to the attribute level using a popular notation such as the entity relationship notation (Chen 1976), (2) an activity or process model schema of the domain decomposed to the "primitive activity" level (Gane and Sarson 1982), (3) role-process links that indicate which roles are responsible for performing each process, and (4) a set of reports that capture the business intelligence produced by the information system. We also assume that a project involving off-the-shelf IS will have a systems analysis that has the data model, process model, and role-process links of the IS. These may be mapped to the existing roles in the organization and the systems analysis will usually include customizable reports (Bajaj 2006).

We note that a systems analysis will usually uncover important aspects of a proposed information system that are not typically considered in an investment analysis, such as usability of the end user interface. For example, Rose and Wolfe (2000) demonstrate that a computerized decision aid system that produced less cognitive load for the user resulted in superior learning. This finding points out the importance of the design of an information system interface. Outputs such as the usability of the end user interface complement and
savings and generation of additional revenues. In summary, using system output analyses when estimating cash flows results in better cash flow estimates and diminishes the risk of overlooking hidden costs. Better cash flow estimates will also result in better traditional capital budgeting analyses.

The SAAS framework supports traditional capital budgeting analyses and it is expected that one or more of these techniques will be used as part of the evaluation process. The cash flow forecasts based on the additional information available from a systems analysis can result in more accurate net present value (NPV) (Dugdale 1991) and more accurate economic value added (Conrath and Sharma 1993) analyses. In addition, the SAAS framework can also support option-pricing models (OPM). An OPM is composed of net present value plus an option value that represents future flexibility of an information system (Tadesse et al. 2000). NPV, as developed by the SAAS framework, is helpful for OPM analysis because it is based on more comprehensive cash flow information than is otherwise usually available ex ante. A comparison of NPV, EVA, and OPM is presented in Table 1.

If future flexibility of an IS is not an overriding concern, then Table 1 suggests that EVA may be more useful for ex ante evaluation than NPV. Where future flexibility is important, then use of an OPM may be warranted. We note that analyses such as NPV, EVA, or OPM are important but under the SAAS framework, they are the final answer. The results of the accounting-based analyses, as well as the organizational capability analyses, are used to develop easily understood metrics that will appear on a balanced scorecard.

### TABLE 1

<table>
<thead>
<tr>
<th>Method</th>
<th>Strengths</th>
<th>Weaknesses</th>
<th>Relationship to Firm Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Present Value (NPV)</td>
<td>Measures the profitability of a potential investment based on required rate of return.</td>
<td>Requires accurate cash flow estimates and the required rate of return must be adjusted for risk.</td>
<td>Measures the absolute profitability impact that a project has on value of the firm.</td>
</tr>
<tr>
<td>Residual Income or Economic Value Added (EVA)</td>
<td>Relates project profit to the resources needed to produce that profit.</td>
<td>Requires calculation of the cost of capital employed.</td>
<td>A positive EVA shows that the project creates wealth for the firm.</td>
</tr>
<tr>
<td>Options Analysis (OPM)</td>
<td>Passive NPV (above) is added to a mathematically computed option value using models such as the binomial or Black-Scholes models. This results in so-called “active” NPV that represents the value of future potential optional decisions related to the project.</td>
<td>Requires estimates of option parameters such as present value of the payoffs of various options, standard deviation of payoffs, and risk-free interest rate.</td>
<td>Enhanced “active” NPV is used to estimate the best time period to invest in a project. Relationship to firm performance depends on the period chosen to implement the project.</td>
</tr>
</tbody>
</table>

*EVA is slightly different and more robust than residual income in that it considers the impact of taxes on residual income.*

---

### Balanced Scorecard Metrics

Balanced scorecards are increasingly being used in an IT context. Van der Zee and De Jong (1999) point out that there is often a communication problem between business managers and IT personnel due to lack of a common language. This problem can result in less than optimal relationships between strategic objectives and the underlying information systems. They suggest a balanced scorecard as a means of ensuring that IT decisions are integrated with business strategy. The balanced scorecard approach has been suggested in previous research as a means of individual project-level evaluation in an IT setting (Edwards 2001). Increasingly, particularly in Europe, companies are using a balanced scorecard for strategic planning and evaluation purposes instead of primarily for performance evaluation (Mooring et al. 1999). The SAAS balanced scorecard is unique in that it is designed to summarize the findings of the preceding organizational capability and accounting based analyses so as to show how the new information system enhances firm performance and aligns with the strategic focus of the business.

The SAAS balanced scorecard measurement dimensions are based on the four traditional strategic perspectives suggested by Kaplan and Norton (1992) (internal business process, customer, financial/business value, and innovation/future readiness) but it is customizable. This means that a balanced scorecard will be firm specific and the evaluation of the information system will be context specific. A key feature of the balanced scorecard approach is that none of the individual metrics will be considered in isolation. Thus, the balanced scorecard approach guards against a one-dimensional assessment of the potential IS investment while encouraging a comprehensive analysis of the affect of the information system on strategy and firm performance. The balanced scorecard is a means of more fully evaluating Path 3 of the Dehning and Richardson (2002) model (Figure 1).

We next consider the specific information linkages between the systems analysis and the metric driven organizational capability and accounting analyses. We then consider the information linkages between the metric driven analyses and the balanced scorecard.

### III. FRAMEWORK INFORMATION LINKAGES

**Systems Analysis Linkages to Organizational Capabilities Analyses**

Qualitative benefits related to organizational capabilities such as improved customer satisfaction and improved product quality can be determined and quantified absent a systems analysis. Improved customer service may result in increased sales. Improved product quality may result in fewer returns and decreased warranty costs. However, systems analysis outputs provide information that is beyond what is normally available for an ex ante evaluation. The outputs explicitly specify the data and processes that the organization will use to interact with the new IS. This information can ground both qualitative and quantitative ex ante analyses of the impacts of the IS. Table 2 presents our proposed linkages between systems analysis outputs and the five organizational capability factors discussed by Baldwin and Clark (1994). We briefly discuss selected highlights of these linkages since the linkages are firm and context specific. This means that, in some cases, only a partial subset of the Table 2 linkages may apply to a particular information system.

Systems analysis outputs are useful in estimating the impact of the IS on external integration. For example, knowledge that the to-be reports include a log of all previous customer conversations which is not in the as-is (current) system can provide a basis to estimate the extent of positive impact on customer service quality. This would be a result of customer service end users having a better understanding of the customer’s background with the firm at the start of the new conversation. The improvement may be measured in
terms of well-accepted customer service metrics such as number of pending cases, age of pending cases, repeat sales to customers, etc. Similarly, knowledge that the to-be role-process links require suppliers to monitor a firm’s internal inventory levels and automatically ship replacements when needed is valuable information when external integration is considered.

For internal integration evaluation, comparisons between the as-is and to-be Data Models can reveal data redundancy by showing that the same information is being input more than once. The systems analysis can reveal that there is multiple entry of new customer orders in the as-is Data Model but one time entry in the to-be Data Model. This type of knowledge is useful in providing a more accurate estimate of internal efficiencies, which may be measured based on person hours saved and/or reduced errors in order entries.

System analysis outputs also offer important insights related to flexibility. For example, the to-be Data Model for a retailer may include a product family class that allows the creation of new product families without changing the underlying data schema. If the Data Model of the IS under consideration does not provide this feature, then this knowledge will lead to a better estimate of the impact of the IS on flexibility.

Experimentation refers to the ability of end users to tweak business processes and data in order to improve performance. Systems analysis outputs are also important here. Consider a customer service unit that would like to be able to finely segment new customers as the customer base increases. If customer interests are stored in the Data Model as a single field in a customers table, then adding multiple interests for a customer will require overloading the single field making it uselessness limited. On the other hand, if customer interests are stored in a separate table as rows linked to specific customers, adding multiple interests for a customer will be easier and the information will be easier to access using standard database access tools. Thus, the Data Model and Process Model outputs of the systems analysis can provide a better estimation of how the new IS can support or prevent end users from improving or customizing business processes.

In the capital budgeting literature, obsolescence refers to the propensity or likelihood that the firm will need to replace an investment in the future. There are two sides to obsolescence. First, being reluctant to replace an existing asset due to large sunk costs can be negative and result in significant market disadvantage. The classic example is the reluctance of the U.S. steel industry to buy new technology and upgrade facilities because they had so much invested in existing facilities (Baldwin and Clark 1994). On the other hand, having to frequently replace information systems may not be the best use of available capital. Systems analysis provides information that can be used to access obsolescence. First, Role-Process links can indicate the level of coordination required between roles that perform different business processes. An information system that requires coordination of a large number of roles implies greater sunk costs and potential resistance to future replacement (Iranii and Love 2000). On the other side, in the case of an off-the-shelf implementation, the gap between the off-the-shelf system outputs and the desired outputs, as shown in the to-be systems analysis, can indicate the likelihood for the need of future replacement (Bajaj 2006; Verville and Halington 2001).

The foregoing discussion presented a few selected examples of systems analysis linkages to organizational capability assessments. It demonstrates the flexibility of the SAAS framework in producing information relevant for es ante organizational capabilities assessment. We next highlight systems analysis linkages to accounting measures.
Systems Analysis Linkages to Accounting Analyses

Table 3 depicts various information from the systems analysis that can be used to estimate the front-end costs of the proposed IS as well as continuing costs, cost savings and revenue generation potential, and project risk.

Information from all of the systems analysis outputs (data model, process model, role-process links, reports) can assist the accountant in better estimating front-end costs. For a customized application development scenario, required table specifications from the to-be Data Model can provide a means to more accurately estimate development costs. For example, if it is known that a system requires 100 tables, each with several columns that require checks on data as well as indexing on multiple columns, then the cost of programming and testing can be reasonably quantified. Without this type of information, estimation of development costs may be little more than a subjective guess. In an off-the-shelf implementation, the vendor provided Data Model can provide information for a "fit-gap" comparison (Verville and Halington 2001) between the fields in the two Data Models and the fields provided by the off-the-shelf database. This "fit-gap" analysis will provide a significantly more accurate estimate of the cost of data migration for an IS implementation (Bajaj 2006). For an application development, the to-be Process Model provides a listing and description of the screens and navigation that will be used as part of the front-end development of the IS (Allier and Browne 2005). Understanding the screens’ specifications allows the accountant to estimate more accurately the costs involved in the actual construction. Similar to the Data Model, the as-is Process Model allows a "fit-gap" analysis between the screens of an off-the-shelf project. A larger gap indicates more costs associated with allocating the off-the-shelf screens to the users. In both application development and off-the-shelf scenarios, screens can be bundled for each role, based on the Role-Process information developed in the systems analysis. The to-be Role-Process links help estimate the cost of bundling, including the cost of providing navigation between screens in a bundle. For example, if the Role-Process output for the proposed system reveals that a particular role will perform 100 processes as opposed to the current 50 processes, then the cost of providing navigation will be higher for the new system because the number of user screens will increase (Thvitrup and Nielsen 1991). In addition, for both application development and off-the-shelf projects, the difference between the as-is Role-Process links and the new Role-Process links helps estimate time and thus the training costs for new users. For instance, if the new information system involves extensive reallocation of processes to roles, training costs will be higher. The report output of a systems analysis also provides valuable cost-related information. A systems analysis output that shows a high degree of report complexity indicates that the front-end costs of the IS will be higher due to increased programming.

Continuing costs can also be better estimated using systems analysis outputs. Continuing costs can be categorized into continuing hardware costs, continuing infrastructure software costs, and continuing application development or implementation costs. In an application development, the to-be Data Model indicates the complexity of the data schema, and hence allows a better estimate of the database administrator overhead required to maintain the database required by the new information system. The Process Model provides information that can be used to estimate cost associated with the complexity of front-end screens; a more complex set of screens will have higher maintenance costs. In an off-the-shelf implementation, the Data Model and screens are usually pre-built. The primary flexibility is the bundling of the pre-built screens in the particular implementation. The to-be Process Model provides information that is useful in estimating the costs that will be
incurred for bundling of the screens. For example, if the bundling for a particular implementa-
tion is sufficiently different from the default bundling available with the standard off-
the-shelf product, then the maintenance costs will be higher. This is because the off-the-
shelf system will need to be customized initially and every time the vendor releases an
update (Bajaj 2006). The to-be Role-Process links provide a better estimate of the coordi-
nation costs of the new information system. Thus, if a particular role currently performs
several activities but the new information system involves unbundling these activities among
different roles, then coordination costs between roles will likely increase after the new
system has been implemented.

The accountant also has information that can result in better estimates of cost savings
and potential revenue generation. For revenue function tasks, such as sales, the difference
between the as-is Role-Process and the new Role-Process links can highlight ways that
revenue might be gained. For example, consider the case where the as-is RP links to
customers indicate that the process of calling on customers is cumbersome. If the new IS
will streamline this and allows productivity of customer calls to increase by a quantifiable
amount, then this knowledge of change in the Role-Process links can lead to a better
estimate of potential increased sales. Similarly, if the task is a pure cost function, the Role-
Process links can provide information leading to better estimates of cost savings associated
with the new system. Comparing the as-is Reports to the Reports generated by the new
information system provides information about additional availability, timeliness, and ac-
curacy of the new reports. More timely and accurate reports can result in cost savings or
revenue enhancements. If the new information system Reports reveal trends in changing
customer behavior earlier than the as-is Reports, and the resulting benefits are quantifiable,
then the impact on future sales can be better estimated. For instance, the new reports may
indicate customers are buying more of a particular product and upward inventory adjust-
ments are required to avoid shortages.

Systems analysis outputs are also helpful in assessing the risks of time and cost overruns
because the information provided is more comprehensive than would normally be available.
For a custom application development project, a comparison of the estimated time and cost
based on the systems analysis compared to the allocated time and budget can yield a more
accurate assessment of the project risk than if the systems analysis outputs were not avail-
able to provide the estimates. For an off-the-shelf project, the difference between the as-is
Data Model, Process Model, and Role-Process links and those of the proposed project will
indicate the time and cost required to implement the new project. For example, if the
underlying Data Model of the off-the-shelf project is significantly different from the as-is
Data Model, then the mapping of current fields to target fields in the new Data Model will
be more difficult, and fields may also need to be dropped or invented to satisfy the new
Data Model. There is also the risk that a new project can cripple the productivity of an
organizational unit. A comparison between the existing system and the to-be system will
help in the estimation of the productivity risk associated with the new project.

As can be seen from Table 3 and the foregoing discussion, a systems analysis provides
information that accountants would not normally have available when they make cost,
revenue, and risk assessments. The SAAS framework linkages between systems analysis
outputs and both organizational capability assessments and accounting estimates (Metric-
Driven Analyses), provide a mechanism for more accurate analyses of quantitative and
qualitative (nonfinancial) factors associated with a new information system. We next con-
sider the linkages between these metric driven analyses and the balanced scorecard.

### FIGURE 2

**Metric Driven Analyses Linkages to Balanced Scorecard**

In Figure 2, we propose a general set of balanced scorecard dimensions that form the
basis for developing firm specific and information system specific metrics that will be used
to *ex ante* summarize how well a proposed information system aligns with the four balanced
scorecard perspectives.

Qualitative information from the organizational capabilities assessment of the five fac-
tors of internal integration, external integration, flexibility, experimentation, and obsoles-
cence are used to develop metrics that are linked to the three balanced scorecard perspec-
tives of internal process, customer, and innovation/future readiness. For example, information related to external integration can result in customer-oriented metrics that de-
termine how well the new information system will meet current customer needs, will result
in increased customer satisfaction, and can be used to attract new customers. Similarly,
assessment information for flexibility, experimentation, and obsolescence can result in met-
rics associated with various dimensions of the internal process and innovation/future read-
iness perspectives. As shown in Figure 2, previously derived quantitative measures from
accounting analyses of front-end costs, continuing costs, cost savings, potential revenue
generation, and project risk provide information needed for balanced scorecard metrics
related to the balanced scorecard perspective of financial and business value.

The SAAS framework balanced scorecard metrics and scoring system can be custom-
ized by management. This will be illustrated by the balanced scorecards for the two case
Use of the Framework and Methodology

We first had an introductory meeting where we met with all the stakeholders in the proposed new web-based project. Next, we constructed the data and process diagrams for the information system over several days of group meetings. This information was input into a computer aided software engineering (CASE) tool that output a code plan for the as-is information system. The process diagrams listed 16 primitive level activities that represented interaction with the proposed new system. Examples of activities included “accept input parameter values from the customer,” “prepare proposals,” and “manage product types.” The role-process links and a listing of the reports to be generated were also created as part of the process model.

Metric Driven Analyses

The outputs of the systems analysis served as a foundation for performing metric driven analyses for the proposed web-based system. We briefly describe selected highlights of these analyses. The Role-Process links detailed the new roles that the various personnel would play in the web-based system. This information gave management a better perspective of how the new system would impact customers (external integration) and sales personnel (internal integration). The role and process information also provided management with better risk amelioration information in that they became more fully aware of the risk due to dependence on the engineer who had developed the original Excel spreadsheet. It became clear that he represented a single point of failure for a critical system.

The data model, the process model, the role-process links, and the reports were used to estimate the front-end costs and cost changes associated with the new system (see Items 2 and 3 of Appendix A). The systems analysis results were especially useful for estimating these costs because they gave a clear understanding of the underlying processes and the extent of application-level coding and annual maintenance costs that would be required to re-create and maintain the sales tool on the web. This type of information is not normally available ex ante for an accounting analysis. In this case, senior management and the company MIS director were surprised by the result, as they had not anticipated several of the categories and amounts of costs.

The systems analysis information also helped us to estimate annual revenue changes associated with the new system. The Process Model indicated that the sales call process would change in that geographical reach would be greater since potential clients could access the website from anywhere, fill in their own requirements, and then have a salesperson or sales partner contact them. When presented with the detailed analysis of the new process, management conservatively estimated that annual sales would increase 5 percent. This information became an important part of the accounting analyses. Once the costs and the potential revenue changes had been computed, an economic value added analysis (EVA) analysis was developed (see Item 4, Appendix A). This demonstrated that the new information system would add positive value to the firm starting in Year 1.

Based on the information gathered from the systems analysis and organizational capabilities assessments and accounting analyses, the following firm-specific balanced scorecard was developed.

---

Bajaj, Bradley, and Cruens

SAAS: Integrating Systems Analysis with Accounting and Strategy

The SAAS Framework Applied at a Manufacturing Company

Emissiontech is a privately owned manufacturing company that specializes in package based emission control solutions for industrial machinery engines. Organizations purchase the emission control packages in order to meet industrial waste emission levels as mandated by the U.S. Federal government and local and State governments. Based on the type of application, the industry, and the current emission regulations, Emissiontech offers a client several choices of custom designed emissions control packages. The company markets its packages using an in-house sales force as well as a nationwide independent network of sales partners. The information system under consideration for this case study was a complex Microsoft Excel™ sales tool. The salespersons, either in-house or sales partners, obtain a detailed understanding of the client’s emission control needs and then use the Excel sales tool to develop a potential set of packages that will satisfy those requirements. The final step, after an initial engineering review, is to offer a price and time quote. The Excel sales tool had been single-handedly developed by one of the engineers. It was estimated that over 3,000 hours of programming had gone into the tool. Since technology and the regulatory environment change frequently, the parameters and components that made up the various packages generated by the Excel tool had to be updated periodically. The updated program was saved on CD-R discs and physically distributed to the sales force every quarter. It required no special software, other than Microsoft Office™ as an underlying platform, and hence could be used on machines with diverse hardware profiles.

The sales tool had several weaknesses. First, the spreadsheet model was not proving scaleable. As the types of emission control packages offered grew in numbers and complexity, the Excel application was slowing down significantly when working on the smaller, portable personal computers that were used by sales personnel. Second, the code was not well documented, and was understood only by the engineer who created it. Given these growing weaknesses, management wanted to determine if they should recreate the Excel based sales tool as a database application that was accessible on the web.

---

Journal of Information Systems, Spring 2008

Use of the Framework and Methodology

We first had an introductory meeting where we met with all the stakeholders in the proposed new web-based project. Next, we constructed the data and process diagrams for the information system over several days of group meetings. This information was input into a computer aided software engineering (CASE) tool that output a code plan for the as-is information system. The process diagrams listed 16 primitive level activities that represented interaction with the proposed new system. Examples of activities included “accept input parameter values from the customer,” “prepare proposals,” and “manage product types.” The role-process links and a listing of the reports to be generated were also created as part of the process model.

Metric Driven Analyses

The outputs of the systems analysis served as a foundation for performing metric driven analyses for the proposed web-based system. We briefly describe selected highlights of these analyses. The Role-Process links detailed the new roles that the various personnel would play in the web-based system. This information gave management a better perspective of how the new system would impact customers (external integration) and sales personnel (internal integration). The role and process information also provided management with better risk amelioration information in that they became more fully aware of the risk due to dependence on the engineer who had developed the original Excel spreadsheet. It became clear that he represented a single point of failure for a critical system.

The data model, the process model, the role-process links, and the reports were used to estimate the front-end costs and cost changes associated with the new system (see Items 2 and 3 of Appendix A). The systems analysis results were especially useful for estimating these costs because they gave a clear understanding of the underlying processes and the extent of application-level coding and annual maintenance costs that would be required to re-create and maintain the sales tool on the web. This type of information is not normally available ex ante for an accounting analysis. In this case, senior management and the company MIS director were surprised by the result, as they had not anticipated several of the categories and amounts of costs.

The systems analysis information also helped us to estimate annual revenue changes associated with the new system. The Process Model indicated that the sales call process would change in that geographical reach would be greater since potential clients could access the website from anywhere, fill in their own requirements, and then have a salesperson or sales partner contact them. When presented with the detailed analysis of the new process, management conservatively estimated that annual sales would increase 5 percent. This information became an important part of the accounting analyses. Once the costs and the potential revenue changes had been computed, an economic value added analysis (EVA) analysis was developed (see Item 4, Appendix A). This demonstrated that the new information system would add positive value to the firm starting in Year 1.

Based on the information gathered from the systems analysis and organizational capabilities assessments and accounting analyses, the following firm-specific balanced scorecard was developed.

---

Bajaj, Bradley, and Cruens

SAAS: Integrating Systems Analysis with Accounting and Strategy

The SAAS Framework Applied at a Manufacturing Company

Emissiontech is a privately owned manufacturing company that specializes in package based emission control solutions for industrial machinery engines. Organizations purchase the emission control packages in order to meet industrial waste emission levels as mandated by the U.S. Federal government and local and State governments. Based on the type of application, the industry, and the current emission regulations, Emissiontech offers a client several choices of custom designed emissions control packages. The company markets its packages using an in-house sales force as well as a nationwide independent network of sales partners. The information system under consideration for this case study was a complex Microsoft Excel™ sales tool. The salespersons, either in-house or sales partners, obtain a detailed understanding of the client’s emission control needs and then use the Excel sales tool to develop a potential set of packages that will satisfy those requirements. The final step, after an initial engineering review, is to offer a price and time quote. The Excel sales tool had been single-handedly developed by one of the engineers. It was estimated that over 3,000 hours of programming had gone into the tool. Since technology and the regulatory environment change frequently, the parameters and components that made up the various packages generated by the Excel tool had to be updated periodically. The updated program was saved on CD-R discs and physically distributed to the sales force every quarter. It required no special software, other than Microsoft Office™ as an underlying platform, and hence could be used on machines with diverse hardware profiles.

The sales tool had several weaknesses. First, the spreadsheet model was not proving scaleable. As the types of emission control packages offered grew in numbers and complexity, the Excel application was slowing down significantly when working on the smaller, portable personal computers that were used by sales personnel. Second, the code was not well documented, and was understood only by the engineer who created it. Given these growing weaknesses, management wanted to determine if they should recreate the Excel based sales tool as a database application that was accessible on the web.

---

Journal of Information Systems, Spring 2008
## Table 4

<table>
<thead>
<tr>
<th>Internal Process</th>
<th>Score</th>
<th>Customer Score</th>
<th>Financial Score</th>
<th>Innovation Score</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordination efficiencies across the organization from the system</td>
<td>5</td>
<td>6</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Ease of system use</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Timeliness of updating the system</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Ability of system to adapt to changes in customer preferences</td>
<td>6</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability of users to modify components in the system</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Likelihood that system components will become obsolete relative to existing user needs</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Scores: 1 = very negative; 2 = somewhat negative; 3 = slightly negative; 4 = neutral; 5 = slightly positive; 6 = somewhat positive; 7 = very positive.*
wireless services could be better estimated once the data and process models were created. We then conducted a cost effectiveness analysis (Phillips and Phillips 2004) appropriate for a governmental organization (see Item 5, Appendix B). An important part of this analysis was the quantification of employee time saved (Item 4, Appendix B). This would not have been possible absent the systems analysis because information from the systems analysis made the end users more aware of the detailed functionality of the system. In addition, our analyses indicated that the new system would likely result in more inspections per day per inspector. Since the city charges for each inspection, more inspections will increase revenue. However, we did not formally quantify this since a primary management objective was to increase the quality of each inspection by spending more time on it, as opposed to merely increasing the number of inspections.

The Balanced Scorecard

Like Emissionstech, previously derived quantitative and qualitative information from the metric driven analyses was used to develop balanced scorecard metrics. The balanced scorecard has often been utilized in the public sector, including the City of Charlotte, the City of Brisbane, Australia, and The United Way of Southeastern New England (Kaplan and Norton 2001). Modifications necessary from a for-profit balanced scorecard include different performance measures on the customer and allowing the mission of the entity to drive the development of specific measures. In the case of Publicworks, the overall mission is the provision of building and neighborhood inspections for the city. The balanced scorecard is described in Table 5.

The balanced scorecard measures naturally focus on the ability of the proposed information system to improve the level of service from the inspectors. From a customer perspective, the metrics were based on a comparison of the adequacy of the current level of service, in terms of targets or benchmarks such as the timeliness of inspections, with the level of service expected to be provided by the new system. This would not have been possible absent information from the systems analysis and metric driven analyses.

The potential difference in time spent on data entry by inspectors between the two systems led to development of the metrics linked to internal process and future readiness. Other measures for these two perspectives include a comparison of the impact of the new information system on the lag time between the inspection and permit issuance to the builders, including a measure that allows for a supervisory assessment of the accuracy of the inspections. Additional future readiness measures focus on the amount of inspector training and time required for learning the technical enhancements of the new system in addition to employee satisfaction with the existing system.

Publicworks management was pleased with the analyses that the SAAS framework provided and it became clear that much of this information would not have been available using capital project evaluation methodologies traditionally used by nonprofit organizations.

VI. DISCUSSION

From a theoretical standpoint, the SAAS framework is grounded in the accounting and information systems literature that discusses return on investment and business value of IS and the literature that links IS to the resource based view of the firm. The challenge for IT personnel, accountants, and business managers is to determine ex ante if a proposed information system has the potential to positively impact firm performance. We suggest that, in order to determine this, analyses need to consider the link between the information system and business processes (D&R Path 2, Figure 1) as well as the link between business processes and firm performance (D&R Path 3, Figure 1). These two Paths are not readily
TABLE 5
Balanced Scorecard for Publicworks

<table>
<thead>
<tr>
<th>Internal Process</th>
<th>Score</th>
<th>Customer</th>
<th>Score</th>
<th>Financial</th>
<th>Score</th>
<th>Innovation</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ease of system use</td>
<td>5</td>
<td>Effect of IS on the time spent</td>
<td>4</td>
<td>Front-end costs</td>
<td>3</td>
<td>Accuracy of inspection</td>
<td>5</td>
</tr>
<tr>
<td>Ease of modifying the system</td>
<td>4</td>
<td>and quality of the inspection</td>
<td></td>
<td></td>
<td></td>
<td>Improvement in</td>
<td>6</td>
</tr>
<tr>
<td>Ability of system to adapt to changes in user</td>
<td>4</td>
<td>Effect of IS on speed of</td>
<td>6</td>
<td>Continuing costs</td>
<td>3</td>
<td>employee utilization</td>
<td>6</td>
</tr>
<tr>
<td>preferences</td>
<td></td>
<td>inspections</td>
<td></td>
<td></td>
<td></td>
<td>Enhancement of</td>
<td></td>
</tr>
<tr>
<td>Ability of users to modify</td>
<td>2</td>
<td>Delay between inspection and</td>
<td>5</td>
<td>Cost savings due to</td>
<td>6</td>
<td>employee skills</td>
<td></td>
</tr>
<tr>
<td>components in the system</td>
<td></td>
<td>issuance of permit</td>
<td></td>
<td>increased efficiency</td>
<td></td>
<td>Ability of system to adapt</td>
<td>5</td>
</tr>
<tr>
<td>Likelihood that system</td>
<td>3</td>
<td>Delays due to system failures</td>
<td>2</td>
<td>Cost effectiveness</td>
<td>5</td>
<td>to technological</td>
<td></td>
</tr>
<tr>
<td>components will become obsolete</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>enhancements or changes</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complaints logged against</td>
<td>4</td>
<td></td>
<td></td>
<td>Ability of inspectors to</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>inspectors</td>
<td></td>
<td></td>
<td></td>
<td>adapt system</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Speed of data entry by inspectors</td>
<td>6</td>
<td></td>
<td></td>
<td>components to improve</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>inspections</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Likelihood that system</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>components will not</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>be sufficient to</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>increase resolution of</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>number of cases</td>
<td></td>
</tr>
</tbody>
</table>

*Scores: 1 = very negative; 2 = somewhat negative; 3 = slightly negative; 4 = neutral; 5 = slightly positive; 6 = somewhat positive; 7 = very positive.

Limitations and Future Research

A study that simultaneously presents a framework of full linkage and a detailed process model that links various information systems to the customer, internal processes, and the financial perspective is needed in the accounting and IS fields. The two case studies included in this chapter provide a strong foundation for further development. However, we acknowledge that the model must be refined before it can be applied to other organizations and situations. The framework developed in this study can be used to develop a theoretical model for the proposed framework in the future research. Theoretical frameworks provide an opportunity to develop and refine the model to support the framework. More research is needed to develop the Accounting and IS fields.

The two case studies involved relatively small information systems. In both cases, the study focused on the proposed framework and included a detailed process model. However, this study was limited to one industry and one organization. The results of the study can be generalized only to a limited extent. Additional information about the organizations and their systems is needed to draw broader conclusions. The results of the study must be further verified in future research before the framework can be applied to other organizations and situations.

The SAAS framework outlined in this chapter is intended to be used by public sector organizations. It is not intended to be applied to other organizations in the same industry. The SAAS framework is designed to be used by public sector organizations and is not intended to be applied to private sector organizations.

The SAAS framework is intended for use in organizations that are concerned with improving the efficiency and effectiveness of their systems. It is not intended to be applied to other organizations in the same industry. The SAAS framework is designed to be used by public sector organizations and is not intended to be applied to private sector organizations.
our work. In addition, future work in more diverse and complex IT settings can yield valuable information as to the consistent applicability of the framework and increase the range of measures by which to assess the strategic alignment of a proposed IS.

The two case studies described here are application-level projects. This may be the area where the framework will work best. Although the SAAS framework will support Option Pricing Models, it offers less support for infrastructure level IS projects. This is because end-users interact with infrastructure through the application layer. For example, if an organization switches from one database management system to another while keeping the same user-level applications, the systems analysis would indicate no change thereby precluding analysis of the effects of the infrastructure change. Further research is needed to determine if modifications to the framework and additional comparative analyses and more customized balanced scorecard measures would work for infrastructure projects.

Finally, given the case-study approach, we only validate a small set of potential measures for the framework. Future work should seek to expand the set of validated measures as the nature of IS evaluation requires consideration of diverse measures that capture a range of intangible benefits. Given the difficulties in quantifying many of the benefits associated with IS in general, it would be desirable to expand our set of customized measures and begin to understand the efficacy of particular measures for various strategic applications. The need for information regarding customization is a limitation of the balanced scorecard approach in general. Kaplan and Norton (1992) acknowledge that they have provided a template, but that the balanced scorecard must not be used as such. It must be customized to the strategy of the individual organization. The same is true for the SAAS framework for ex ante evaluation of IS. In addition, future field studies should consider the impact of the SAAS framework in organizations that have existing balanced scorecard systems in place.

We empirically validated that the framework worked in the two case studies presented here. However, it can be argued that the framework in its present form does not adequately prescribe how to derive the balanced scorecard measures or how to combine qualitative and quantitative measures. The determination of the practical use of SAAS framework for ex ante IS evaluation is another area for future research. As a starting point, this article describes how we implemented the framework and presents suggested step-by-step implementation guidelines in the next section.

Implications for Professionals

In both cases, for the actual implementation of the SAAS framework, we constructed the data model before the process model. Managers in both case studies agreed with this approach. Comments from managers indicated that the data model helped ground their thinking at the lowest granular level, and helped them understand the domain better. The process models helped document the different data-related activities that the end-users performed. However, in both cases stressed that it was the data model that gave them the detailed picture that helped them to better estimate process efficiencies. The Process Model, Role-Process links, and Reports were developed later. This approach can be used in large or small contexts. In a large context, the Data Model can be constructed using several concurrent group sessions and a team of system analysts. In all cases, the final product needs to be a comprehensive Data Model that will allow the design of Reports, the development of the Process Model, and show complete Role-Process information. Our experience with both case studies has led to some generalizable implementation recommendations.

Table 6 outlines the suggested steps to be followed when implementing the SAAS framework. The sequence forms a suggested normative application of the framework for future settings.

VII. CONCLUSION

Accountants and IT personnel often have trouble evaluating information systems before their company invests in them. These problems are caused by several factors including a reluctance to embrace evaluation methodologies used by other professional groups. Neither a strictly financial capital budgeting based approach nor a purely intangible nonfinancial focused approach works very well, in isolation, when it comes to determining whether or not to purchase a new IS. For sound investment ex ante analyses, both financial and intangible nonfinancial aspects of an IS must be considered. Even when all these factors are considered, information technology (IT) personnel and accountants often neglect to determine and communicate to management how well a new information system (IS) can be expected to align with the business strategy of the company.

Business managers can make better IS selection and investment decisions when IS selection methodologies used by both IT personnel and accountants are integrated. For the accountant, a necessary element for this integration is an understanding of how the IS will be used by the organization. This information is available from systems analysis outputs.

**Table 6** Recommended SAAS Framework Implementation

<table>
<thead>
<tr>
<th>The Systems Analysis (SA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction meetings to understand the scope of the IS and the stakeholders involved. Outline resources needed for ex ante evaluation.</td>
</tr>
<tr>
<td>2. Construct &quot;as-is&quot; or &quot;to be&quot; Data Model(s) (DM) and then process Model(s) (PM), role-process links (RP), and reports (R).</td>
</tr>
<tr>
<td>3. In the case of COTS, obtain the COTS DM, PM, RP, and R diagrams and information.</td>
</tr>
<tr>
<td>4. If the scope of the proposed IS is large, then use parallel group sessions for the SA and amalgamate.</td>
</tr>
</tbody>
</table>

Quantitative Analyses

1. Gather core data on costs and revenues.
2. Develop relevant estimates of the cost and revenue impact of the new IS.
3. Using SA outputs (DM, PM, RP, R) and information linkages shown in Table 3, revise the estimates of the cost and revenue impact of the new IS based on a more complete understanding of the new IS.
4. Perform applicable capital budgeting analyses such as EVA and NPV, using the enhanced cost and revenue estimates. See examples in Appendices A and B.

Strategic Analyses

1. Define overall firm strategies and objectives (i.e., cost leader, niche provider, etc.).
2. Use the SA outputs and information linkages to determine the qualitative benefits of the new IS taking into consideration the five categories of organizational capabilities (external integration, internal integration, flexibility, experimentation, cannibalization/obsolescence).
3. Use information and data from the qualitative analyses and the quantitative analyses to develop BSC metrics based on the dimensions shown in Figure 2 and the information linkages shown in Tables 2 and 3. These metrics should estimate the impact that the new IS will have on the four perspectives of Customer Orientation, Finance/Business Value, Internal Process, and Innovation/Future Readiness.
Process relationships are easily shown to both IT personnel and accountants when an ex ante systems analysis of the proposed IS has been conducted. The expertise of each of the disciplines can then be combined to develop organizational capability and accounting analyses and metrics that show management how well the IS aligns with the strategies of the business. The two case studies demonstrate that the integrated systems analysis, accounting, and strategy (SAAS) framework can result in an easily understood report to management (balanced scorecard) that considers financial and intangible nonfinancial aspects of the IS as well as how a proposed IS aligns with business strategy.

APPENDIX A
SELECTED DATA AND ANALYSES PRESENTED TO THE EMISSIONSTECH MANAGEMENT

1. The Data Model (DM)

2. Summary of Front-end Cost for the IS

   Design/coding (23 tables/10 screens)
   500 hrs @ $80 = $40,000 (outsourcing) + 200 hrs @ $50 (Jack) $50,000
   Project management/testing/documentation
   200 hrs @ $125 25,000
   Data migration
   100 hrs @ $80 8,000
   Staff training
   1 person day × 10 persons = 80 hrs @ $70 = 6,800
   1 seminar day (outsourcing) = 10 hrs @ $125

New server hardware and software

Total front-end conversion costs 10,000

3. Annual Cost Changes of Operating the New IS

   Description Current New Change
   Spreadsheet maintenance/updating $24,000 (a) $26,000 (b) + $2,000 S
   Sales persons time on the spreadsheet $22,000 (c) $27,500 (d) + $5,500 S
   Sales Assistant time on the spreadsheet $35,000 (e) $38,500 (f) + $3,500 S
   MIS and outsourced time for server hardware and software upkeep $54,375 (g) $60,500 (h) + $6,125 F
   Increase in rep commissions due to increased sales (new) $18,900 (i) + $18,900 V
   Increase in annual ISP service (new) $3,000 (j) + $3,000 F
   Annual code changes (new) $5,000 (k) + $5,000 S
   Projected Annual Increase in Costs $44,025

(a) 400 hrs @ $60 = $24,000 (Jack, development time excluded)
(b) 400 hrs @ $60 = $12,000 (Jack) + 400 hrs @ $35 = $14,000 (data entry clerk)
(c) 400 hrs @ $55 = $22,000
(d) 500 hrs @ $55 = $27,500 – more proposals, sizing, etc.
(e) 1000 hrs @ $35 = $35,000
(f) 1100 hrs @ $35 = $38,500 – more proposals, sizing, etc.
(g) 1125 hrs @ $40 = $45,000 (Debbie) + 75 hrs @ $125 = $9,375 (outsourcing)
(h) 1200 hrs @ $40 = $48,000 (Debbie) + 100 hrs @ $125 = $12,500 (outsourcing)
(i) 35% of $160,000 increase in sales times 15% commission rate
(j) Estimated annual cost of DSL/TTI service for separate Catalyst server
(k) 40 hrs @ $125 = $5,000

4. EVUA Analysis for the new IS at Emissionstechnk

   Increase in Gross profit* $147,600 $147,600 $147,600 $147,600 $147,600
   Increase in annual costs (44,025) (44,025) (44,025) (44,025) (44,025)
   Costs of conversion (98,850) (98,850)
   Tax Shield* 8,965 8,965 8,965 8,965
   Cost of capital (4,500) (4,500) (4,500) (4,500) (4,500)
   EVUA 9,190 108,040 108,040 99,075 99,075

Definitions:
F = fixed cost; S = semi variable cost; V = variable cost.
* 5 percent increase in average sales of 7.2M = $306,000. 0.41 (net margin) = $147,600.
* Conversion costs (software) amortized over three years. 35 percent effective tax rate assumed.
APPENDIX B
SELECTED DATA AND ANALYSES PRESENTED TO THE PUBLICWORKS MANAGEMENT

1. The Data Model (DM)

2. Front-End Costs Associated with the New Wireless System
   - New Laptops $2,500 \times 53 = \$132,500
   - Vehicle mounting $250 \times 53 = 13,250
   - Mobile printers $300 \times 53 = 15,900
   - Aircards $300 \times 53 = 15,900
   - New cameras $300 \times 18 = 5,400
   - Training costs 4 hr \times 53 \times \$30 = 6,360
   Total: \$189,310

3. Summary of Expected Efficiency Benefits Provided by the New IS
   - Limit inspector office visits to once a day
   - Real time data entry in the field
   - Trip schedule improvements
   - Improved quality (not quantity) of inspections
   - Improved neighborhood documentation
   - Improved inspector workload balance
   - Ability to query the database in the field
   - Improved vehicle usage
   - Potential for more impromptu inspections

4. Quantification of Expected Efficiency Benefits
   The expected employee time saved for Year 1 is less than Year 2 due to time spent on
   start-up and implementation of the wireless system. Once in place the time saved is
   expected to increase in Year 2. Time saved is expected to decrease again in Year 3 as
   expected program benefits stabilize.

   Year 1: 3/4 hr/day time savings for each inspector = 3/4 hr \times 230 days \times 45
   inspectors \times \$30/hr = \$232,875
   Year 2: 1 hr/day time savings for each inspector = 1 hr \times 230 days \times 45
   inspectors \times \$30/hr = \$310,500
   Year 3: 3/4 hr/day time savings per inspector = 3/4 hr \times 230 days \times 45
   inspectors \times \$30/hr = \$232,875

5. Cost Effectiveness Analysis of the IS at Publicworks

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program benefits</td>
<td>$232,875</td>
<td>$310,500</td>
</tr>
<tr>
<td>Initial costs</td>
<td>(189,310)</td>
<td>(135,000)</td>
</tr>
<tr>
<td>Ongoing costs</td>
<td>(135,000)</td>
<td>(135,000)</td>
</tr>
<tr>
<td>Estimated administrative load (15% of initial investment)</td>
<td>(28,397)</td>
<td>(28,397)</td>
</tr>
<tr>
<td>Cost effectiveness ratio (Benefits/costs)</td>
<td>.66</td>
<td>1.9</td>
</tr>
</tbody>
</table>

REFERENCES
Bajaj, A., and S. Ram. 2002. SEAM: A state-entity-activity model for a well defined workflow meth-
———. 2006. Large scale requirements modeling: An industry analysis, a model and a teaching case.
Ballantine, J., and S. Stray. 1998. Financial appraisal and the IS/IT investment decision making
99–120.
Conrath, D. W., and R. S. Sharma. 1993. Evaluation measures for computer based information sys-
Debning, B., and V. Richardson. 2002. Returns on investments in information technology: A research
46–50.