Considering Social Subsystem Costs and Benefits in Information Technology Investment Decisions: A View from the Field on Anticipated Payoffs

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ABSTRACT: Information technology (IT) investment decisions have traditionally focused on financial or technological issues. Responding to what appears to be a lack of payoff in IT investments, researchers as well as practitioners recently have suggested that traditional valuation analyses are incomplete and have called for additional work to identify "hidden" or seldom-considered costs and benefits. The present paper attempts to improve understanding of a chief source of these hidden costs and benefits: those changes in the social subsystem brought about by a new IT.

Fifty IT decision-makers in a broad variety of industries were interviewed to gain insight into what, when, and how often social subsystem considerations are included in IT investment-decision processes. Data from the interviews show that in practice some of those issues are often minimized, excluded, or put off until the IT is implemented—thus affecting optimality of investment choices and IT payoff. The paper extends existing theory by describing systematic patterns of inclusion and exclusion of these costs and benefits. In addition, a decision aid is provided to help IT executives begin thinking about which social subsystem costs and benefits they should

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incorporate in various decisions. Suggestions are also made on how data regarding social subsystem costs and benefits might be gathered. By incorporating social subsystem costs and benefits in the IT investment process, decision-makers gain a greater appreciation for hidden costs and benefits, and thus clarify anticipated IT payoff.

KEY WORDS AND PHRASES: information technology investment, decision-making processes, sociotechnical systems.

BUSINESSES AROUND THE WORLD HAVE MADE ENORMOUS INVESTMENTS in information technology (IT). In the United States alone, over $316 billion is spent annually on IT [37]. Yet questions about the linkage between economic performance and IT investments have puzzled researchers and practitioners over the last decade [29]. Studies indicate that over 50 percent of IT projects cost more than twice their original estimates [74], significantly diminishing their payoff. Although many variables contribute to this problem, a lack of foresight in the IT acquisition or investment decision process has been cited as a major factor [33].

The methods used to evaluate potential IT investments are fundamental to this criticism. The number of U.S. firms requiring executives to use financial quantification measures in their IT acquisition process to demonstrate payoff is on the rise [71]. Yet, Parker and others [52, p. 3] caution:

> Cost has been thought of in discrete fiscal terms such as the cost of programming expressed in hours or payroll dollars. Benefit has been defined in equally discrete fiscal terms. Actual cost reduction through headcount, or direct revenue improvement through interest earned on cash more rapidly collected is an example. Both cost and benefit so defined are too limited to be useful in guiding corporate decisions.

Researchers and practitioners alike (e.g., [32, 60, 61]) have suggested that traditional analysis, focusing only on the financial or technological aspects of the decision, is not complete. This leads directly to incorrect anticipation of IT payoffs. Hitt and Brynjolfsson [29] called for additional research to identify "hidden costs and benefits" that are typically not included in IT value analysis. They underscore that these costs are likely to be nontechnical.

Recent theoretical and empirical research has begun to provide normative guidance to IT executives by augmenting the traditional cost–benefit model with a strategic dimension (e.g., [13, 52, 56]). While strategic considerations are increasingly considered [4], organizational costs and benefits associated with employees in the implementation and postimplementation phases of IT adoption may often be absent or insufficiently considered [62, 75]. For the purposes of this paper, and consistent with the fundamental principles and terminology of sociotechnical systems (STS) theory [69], we define such costs and benefits—stemming from employees' expertise, judgments, decisions, and task interdependencies—as social subsystem costs and benefits [24]. Pasmore et al. [54, p. 1183] state that the social subsystem incorporates "all that is human that members of an organization bring with them to work." Therefore, we view the terms "social subsystem" and "human-related" costs and benefits as synonymous.

When decision-makers ignore these social subsystem costs and benefits in their IT investments, they implicitly assume that social subsystem issues either do not exist or are insignificant. However, decades of work in the IT implementation literature show that significant social subsystem costs and benefits do accrue when systems are acquired (for reviews, see [41, 43]). Therefore, although these outcomes are not recognized or are often "hidden" in the decision-making process, they are incurred during implementation, which is clear from the following example. A material requirements planning (MRP) system was introduced into a small petroleum parts manufacturer. The original planners of the MRP system had either not foreseen or had ignored social subsystem issues that proved to be paralyzing.

> The system had barcode readers and work stations on the shop floor so that parts could be tracked at any point of the manufacturing operation. After 18 months, the software package was still not being used. To rectify the situation a new IS manager was brought in. In addition to some technical issues, he found a key problem was significant resistance by the employees, the majority of whom were lathe operators who were not technically proficient in computers. Other members of the staff were also resistant to the change.

This vignette (taken from one of our interviews with an IS manager) illustrates a case in which social subsystem issues were not adequately addressed as the system was being considered. Investment decision-makers failed to include adequate training funds and entirely ignored costs associated with change management in their acquisition analyses. This oversight in the acquisition process was carried through to the implementation phase, resulting in a severe financial loss for the organization. Although thousands of dollars of benefits were expected, none were realized during an 18-month period while the system sat idle. This delay in the benefit stream caused the original estimate of return on investment to be grossly inaccurate.

A limited amount of prior field research on IT valuation has investigated this potential problem by focusing on specific costs and benefits in the social subsystem. For example, Belcher and Watson [6] incorporated the social subsystem benefits of improved decision-making ability and productivity when assessing the value of Conoco's Executive Information System (EIS). Holden and Wilhelmij [32] used a knowledge value-added technique in a hospital setting to evaluate employee shared knowledge and the skill level of employees. Some investigators have proposed techniques for dealing with other social subsystem valuation issues such as the use of various productivity measures (e.g., [11, 72]). Others have grappled with the concern that indirect social subsystem costs are difficult to quantify [30, 38].

Our investigation continues this stream of research. However, we take a descriptive, inductive approach to understanding how IT decision-makers consider these issues that heretofore have not been given the attention they should command in determining IT payoffs. Our work is motivated by three primary research questions:

- Across industries, organizations, and IT decisions, are there social subsystem issues that decision-makers are more or less likely to consider?
- Are there systematic patterns for which these social subsystem costs and benefits are included or excluded from consideration? That is, what is the general relationship between the technical subsystem or type of IT investment being evaluated and the social subsystem issues that are considered by IT decision-makers?
- What are the methods by which decision-makers gather and combine information regarding these social subsystem costs and benefits?

In investigating these questions, we follow a theory-building process stemming from coded protocols of semistructured interviews with 50 executives in a purposefully broad variety of firms. In discussing our study, we first cast this problem in the framework of sociotechnical systems (STS) theory and related research. It provides the conceptual and normative foundation for why social subsystem costs and benefits should be considered in an IT investment decision and why many investments in IT might not attain their anticipated payoff. Next, we describe the methodology used to conduct our interviews and code the resulting protocols. We then present content analyses of the interview answers and interpret what those analyses convey in terms of the questions listed above and finish with a discussion of both the normative and descriptive implications of our results for future IT investment decisions.

Our findings make several contributions to the literature. First, the interviews highlight which social-subsystem considerations are frequently included in IT investment decision processes and which are seldom considered or omitted entirely. Second, we extend existing theory on the pattern of inclusion and exclusion of social subsystem costs and benefits in IT investment decisions, by inducing a two-dimensional surface that maps type of IT to the degree of change in employee work processes, culminating in a continuum of "social subsystem disruption." Third, our theory-building approach regarding decision types and process change leads to a decision tree. This heuristic tool suggests the types of social subsystem issues that should be considered given particular situations or IT-related contingencies. Fourth, we provide insights into how data regarding these issues can be gathered by IT executives. These findings help guide researchers and practitioners toward a clearer specification of the role that social subsystem costs and benefits should and do play in assessing anticipated payoffs of IT investment.

Normative Theory

THE SOCIOTECHNICAL SYSTEMS (STS) APPROACH IS WIDELY RECOGNIZED for promoting the joint evaluation of both social and technological subsystems of any overarching organizational system [54]. The social subsystem is composed of employees and the knowledge, skills, interrelationships, attitudes, and needs they bring to the work environment. The technological subsystem encompasses the devices, tools, and techniques used within the social subsystem to perform organizational tasks [54]. Joint optimization, the cornerstone principle of the STS approach, states that any organizational system will maximize performance only if the interdependency between social and technological subsystems is explicitly recognized. Each subsystem must be designed to fit the requirements of the other, so that superior results can be achieved through the two subsystems working in unison [53]. In this interdependent relationship, even small problems in fit can often create large systemic impacts [21, 53]. Therefore, an intervention in one subsystem is not only likely to have an impact on the other subsystem, it is virtually guaranteed to do so.

Previous research has applied the STS approach to various aspects of the information technology domain. For example, Bostrom and Heinen [9, 10] used the STS approach to enrich systems analysis and design techniques. Joshi [35] incorporated sociotechnical principles when analyzing role conflict and role ambiguity in systems design. Stylianou et al. [66] integrated STS principles in the development of artificial intelligence systems. Grover et al. [28] framed business process reengineering concerns in light of STS issues. Lyytinen et al. [42] analyzed risk management approaches using a sociotechnical model of organizational change.

These STS principles can also be applied to the IT investment process—so that the anticipated payoffs of IT adoption can be gauged more clearly and accurately. When a decision is made to acquire a new IT, the STS principle of interdependency implies that the effects of the new IT carry through both the technological and the social subsystems. Likewise, the effects in both subsystems have associated costs and benefits. Decision-makers who neglect the social subsystem and evaluate only the benefits and costs associated with the technological subsystem ignore crucial portions of the valuation issue. The expenses associated with a particular IT investment may be much greater than anticipated as a result of the unrecognized social subsystem costs [6].

General Conceptual Frameworks for Analyzing Social Subsystem Costs and Benefits

ALL IT INVESTMENTS OR INNOVATIONS MAY NOT HAVE THE SAME DEGREE of interdependency or associated "spillover" effects in the social subsystem. Using sociotechnical systems theory as a theoretical basis, Daft [17] proposed a dual-core model to explain varying attributes of administrative and technical innovations. Swanson [67] extended this work to account for the unique nature of IS innovation by proposing a tricore model. Type I, or what Swanson called Information Core innovations, focus on the management and administrative support of IS work or the technical IS task itself. Examples include large-scale relational DBMS or CASE tools [27]. Type II, or Administrative Core innovations, support functions of the business such as payroll systems or e-mail. Type III, or Technical Core innovations, are those embedded in the elemental technology for producing the organization's goods and services. Examples in this category include CAD/CAM or MRP systems. Grover et al. [27] found empirical support for these distinctions in the model yet cautioned that there is room and need for further "theoretical refinement, elaboration and extension."

Orlikowski [50] demonstrated that the degree of change resulting from an innovation is not solely dependent on innovation type but is also dependent on other factors such as organizational context. When studying two organizations implementing CASE tools, she discovered that in one firm the CASE tools radically changed their development practices, while another organization experienced increased efficiencies while only incrementally changing its system-development practices. Therefore, organizations installing the same technologies may experience differing degrees of change depending on the purposes of the investment and the organizational and technological environment in which it is implemented. Another example might be the implementation of the same word-processing package (e.g., Microsoft Word 2000) at two firms, one of which previously used only typewriters whereas the other used another vendor's PC-based word-processing package. The degree of change for the first organization would be considerably more, despite the fact that the technologies being implemented are identical.

The degree of change resulting from an IT investment is an important factor when evaluating IT payoff. Implementation research notes that resistance to change affects implementation success [36]. In other words, the degree of change and the end users' response to it affect the cost and benefits that accrue as a result of an IT implementation. Therefore, degree of expected change could be a useful dimension for shedding light on when and why social subsystem costs and benefits are realized and thus when they should be considered.

Taking these two approaches together, we use Swanson's [67] tricore model as a starting point for classifying IT investment decisions and extend his framework to include the degree of change induced by an IT decision [50]. A classification schema frequently used in IT literature categorizes change as incremental or radical (e.g., [22, 50]). Incremental change "represents an extension of the status quo, that is, adjustments or refinements in current products, practices, relationships, skills and norms." Radical change "goes beyond augmenting the status quo, requiring a shift to fundamentally different products, practices, relationships, skills and norms" ([50], p. 331). However, Orlikowski [50] stated that future empirical work would likely require extensions to the dichotomous view of change, and instead recognize three or four rather than two types of change. In a business-process reengineering study, Lucas et al. [40] represented this degree of change as a continuum. In the present investigation, we also conceptualize the degree of change as a continuum but, following Orlikowski's [50] recommendation, we subdivide this continuum into four quartiles.

In sum, STS theory provides strong conceptual and theoretical arguments for why a lack of consideration of possible costs and benefits to the social subsystem in an organization might lead to suboptimal IT investment decisions. However, these considerations may be more likely and more useful for some types of IT acquisition than for others. To help structure what those social subsystem considerations are, as well as to describe when and how often they are made, we combine Swanson's [67] and Orlikowski's [50] respective typologies to form a two-dimensional framework:

1. IT innovation/investment type
   a. Type I—Information Core

   b. Type II—Administrative Core
   c. Type III—Technical Core
2. Degree of process change
   a. No/low (incremental change)
   b. Some/moderate (incremental change)
   c. High/great degree (radical change)
   d. Extreme/total (radical change).

This overall framework provides a rich lens through which actual IT investment decisions and their incorporation of social subsystem issues can be evaluated. Consistent with our theory-building approach, we searched for patterns in an array in which these dimensions were used to structure the amount and type of social subsystem "costing" done for IT investment decisions made by the firms in our sample.

Research Methodology

Sample

FIRMS IN DIVERSE INDUSTRIES AND REGIONS WITH VARYING ORGANIZATIONAL SIZES were selected for this study. This deliberately maximized the breadth and potential generalizability of results from our sample and helped to mitigate against findings being specific to a particular type of firm. Firms from major industry categories such as aerospace, agriculture, construction, government, health care, real estate, and many others were represented. In each firm, we interviewed a decision-maker who had firm- or division-level authority regarding IT investments.

Several sources were used for firm contacts in this research. First, organizations were randomly selected from the 1998 edition of the CORPTECH database, produced by Corporate Technology Information Services. Second, contacts from the researchers' university were used. University contacts have been used in past IT research when descriptive interviews were the principal method of data collection (e.g., [59]). One hundred eight executives were asked to participate in this research and 50 agreed to do so (yielding a 46 percent response rate). Other IT researchers have used a similar number of interviews to explore complex issues and build theory (e.g., [48]).

Eighty-four percent of the interviewed executives were male. Twelve percent were presidents or owners of the firm, and another 38 percent held the title of vice president or chief information officer. Respectively, 24 percent, 22 percent, and 4 percent were directors, managers, or controllers.

Interviews

Initially, several pilot interviews were performed and analyzed. Two external researchers reviewed the interview transcripts and made suggestions on interview flow and question clarity. Modifications were made accordingly. The interviews began with background and broad domain questions, which were subsequently funneled into more specific areas. The executives were asked to discuss their last major IT investment decision, the steps in that decision process, and the issues that they considered in their decision. Because the size of the firms in our sample widely varied, we chose not to define "major IT investment" as a specific dollar value. Instead, we defined it as a significant percentage of firm revenue. The smallest estimated cost of an IT investment decision was $10,000, which is arguably minor. However, this firm employed only three persons and $10,000 represented over 5 percent of the firm's total annual revenue. The largest IT investment, an enterprise resource planning (ERP) system, had a price of over a million dollars for a firm with 7,000 employees. While social subsystem issues were of primary interest, other areas were explored (e.g., financial features of the IT investment decision) to reduce any possible demand cues that might have been associated with a very narrow stream of questions.

Transcript Coding

Interview protocols were tape-recorded and transcribed. The transcripts were first analyzed by a content-analysis technique called open coding [65] in which the data are read, parsed, and categorized into concepts representing different forms of costs, benefits, or a firm's means of ascertaining costs and benefits. This analytical technique relies on the development of categories that emerge from the data rather than forcing the data into a previously defined classification scheme [2]. The resulting categories were reanalyzed using a synthetic technique called axial coding [65], which makes connections between categories to produce a more comprehensive scheme. The data were then iteratively reexamined and the classification scheme refined, yielding a comprehensive set of categories that described the entire set of verbalizations.[1] Orlikowski [50] also used these techniques when analyzing data collected from interviews, documentation review, and observation.

After the coding of the transcripts was complete, we again reviewed the transcripts and classified each IT decision according to (1) the type of IT investment decision and (2) the degree of process change the decision caused. In total, 59 decisions were analyzed because nine executives discussed two different types of IT choices recently made by their firms. To validate classifications, an independent rater not involved in this project was asked to assign the IT decisions to the decision type. The authors and the independent researcher agreed on 82 percent of the classifications. This level of agreement can be compared to the expected classification agreement due to chance alone using Cohen's [14] kappa ($k = 0.82$, $z = 8.6$, $p < 0.01$ [5]). This procedure underscores the soundness and reliability of the classification process. Disagreements were resolved through rounds of discussion and eventual consensus.

Results

Generic Use of Cost–Benefit Analysis in IT Investments

ANALYSES OF OUR INTERVIEW DATA SHOWED THAT FORMAL QUANTITATIVE methods (e.g., return on investment—ROI; internal rate of return—IRR; or net present value—NPV) were used in 31 percent (18) of the IT investment decisions included in our study. Bacon [4] also found that firms using formal methods may not do so for all projects. In our sample, only five executives stated that formal quantitative methods were used to evaluate every IT investment.

Some costs and benefits are difficult to quantify and to include in a financial analysis. Parker and Benson [52] state that there are three types of benefits: (1) tangible benefits, (2) quasi-tangible benefits, and (3) intangible benefits. Of the three types of benefits, only tangible benefits have a known dollar impact on cash flow. That is, these are items that can be easily measured in dollars and with reasonable certainty. They are often included in financial accounting procedures [31]. Quasi-tangible benefits have some directly measurable elements, (e.g., improved accuracy in clerical operations), whereas intangible benefits have only indirectly measurable values and, when quantified, involve a large component of judgment (e.g., better decision-making ability [52]). In our sample, only 18 percent percent attempted to quantify quasi-tangible costs and benefits (e.g., individual productivity improvement). We found evidence that, although some benefits and costs were not included in a formal, financially geared ROI, these quasi- or intangible benefits and costs were sometimes recognized and considered in the IT investment decision process. For example, the VP of a medical device manufacturing company stated:

> We like to have [costs and benefits] quantified because that is a much easier way to judge if the benefits outweigh the costs, but you can't always do that. And it seems like in every proposal, there are always intangible or qualitative benefits that you just can't put a dollar number on. But, we list those out too, and sometimes those are more important than the cost savings.

We therefore took a broad perspective of social subsystem cost and benefit consideration by these decision-makers, documenting not only those that were included in financial analyses (such as in ROI or IRR calculations), but also those social subsystem costs and benefits that decision-makers considered informally but did not quantify.

The decision processes related by the executive interviews show social subsystem considerations were sometimes included, albeit infrequently, in their IT investment decisions. Findings regarding which of these benefits and costs were most or least common are given below; the categories were developed through the iterative content analysis procedures described above. Some of the categories approach the boundary between the social and technical subsystems (e.g., productivity and labor savings). While these costs and benefits are clearly "human related" and result from employee effort, judgments, or presence, they are also highly dependent on the technical tools used by these social subsystem members, demonstrating the high degree of interdependency between the social and technical subsystems. The percentages found in each of the cost and benefit categories discussed below begin to answer the latter part of our first research question: What are the social subsystem costs and benefits that are most or least likely to be considered in IT investment decisions?

Social Subsystem Benefits

Productivity improvement can be defined as increasing output while holding the level of resources or inputs constant [29]. Productivity improvements resulting from acquiring a new IT were far and away the most frequently cited social subsystem benefit. Indeed, it was the only social subsystem benefited mentioned by a majority of those we interviewed, covered in 69 percent of the focal decisions. This was significantly higher than any of the other social subsystem payoffs cited (χ^2 (4) = 45.68, $p < 0.01$). On the other hand, of those decisions only 15 percent of the executives in the sample mentioned attempting to quantify employee productivity gains in their decision processes.

Quality can be viewed in terms of the reduction of defects or the creation of a more substantial, useful product [60]. Two common ways to measure quality improvement are the determination of cost of quality (COQ) and customer satisfaction indices [64]. However, the executives in this sample who considered quality payoffs (25 percent) did so as an intangible benefit rather than a regularly tracked or measured variable. For example, one executive stated:

> We were looking at quality from the end customer perspective. This means giving them (the customer) good solid due dates. . . . We anticipated that there would be some quality improvements, but we didn't specifically go in and quantify it.

Improved decision-making ability, either in the timeliness or accuracy of choices made, is featured predominately in the normative literature (e.g., [51]). Yet, it was cited by executives in only 17 percent of their own IT investments. One such executive mentioned that although improved decision making was an intangible benefit and impossible to quantify, it was still an important factor in their IT investment process:

> The [end user] decisions that have to be made are already made incorrectly if you don't have valid data. All those things are definitely put in . . . it is hard to put a dollar on it, but it is one of the keys in the [IT investment] decision-making process.

Labor savings, which are reflected in the actual reduction of the number of employees or a loss in "headcount" [55], were considered in 15 percent of the decisions. This social subsystem benefit (at least in the short term) is fairly easily quantified in terms of payroll and is traditionally included in formal cost–benefit analyses [52]. Some executives, however, believed their organizations were no longer in a position to gain from IT-enabled headcount reduction because of previous downsizing efforts. For example, an IT executive from a chemical manufacturing firm stated:

> It is not really a big element of our projects. Productivity improvements—information access improvements, effectiveness and efficiency improvements, yes. But there's rarely any opportunity in our organization today for headcount reduction simply on the basis of [information] technology.

Social Subsystem Costs

One of the most striking features of the negative side of the ledger is that all social subsystem costs were asymmetric to benefits. That is, there was no overlap between categories or issues that were seen as potential expenses by some firms, but potential payoffs by others (e.g., it is feasible that one could save money on long-term training costs with some forms of IT, rather than incur more of them). The social subsystem costs considered most often by IT decision makers were predominately tangible ones, those that have budget lines and are included in internal accounting reports. By far, training costs were the most frequently cited by executives as a social subsystem consideration when making an IT investment decision (59 percent), significantly more than any other social subsystem cost (χ^2 (4) = 24.78, $p < 0.01$). These expenses were usually associated with the training vendor, materials, and other purchases from external sources. A few firms did consider the "on the clock" time lost by the employees while attending training courses, but most did not. For example, an executive from a medical products manufacturing company stated:

> We rolled in the cost of the instructor, but we did not roll in the cost of the time of the employee. We had no idea of what it would be. We talked to these companies, but a lot of these companies were not after the level of detail that we were after. And some of the employees, we had to spend more time on, because they had the equivalent of a fifth grade education.

In 17 percent of the IT investment decisions, executives included consideration of *change management*. That is, they incorporated in their investment decision process, costs associated with planning, overseeing, and communicating information to the end users about IT-induced change [3]. Some treated this primarily as an intangible or inestimable cost. Others did attempt to quantify change management costs. For example, an executive from a chemical manufacturing firm mentioned:

> When we look at the total project, for example, the cost of a project, we will include the change management, the training, even the internal resources.

Recognition of an on-the-job learning curve—that is, the time period in which the employees learn and become proficient using an IT [57]—was mentioned by executives in 14 percent of their decisions, in a way that was independent of training. When considered, the learning curve was evaluated as the amount of time required for a posttraining employees to become fully conversant using the new IT, rather than any monetary consequences resulting from decreased productivity during the learning period. For example, one executive mentioned:

> I said I thought it would take the drivers three months to get used to [the new system], be willing to use it properly, and for things to go right. That was just the curve that I gave it in my own mind. I did not expect to see any kind of positive results for at least three months.

Consideration of Social Subsystem Costs and Benefits by IT Innovation Type and Process Change

Our second research question goes beyond univariate descriptions of social subsystem costs and benefits, moving to multivariate relationships between those payoffs/expenses, the type of IT investment under scrutiny, and the change in business processes that it might induce. To assess the contingencies or patterns among these social and technical subsystem considerations, each decision discussed by interviewed executives was categorized in terms of Swanson's [67] tricore model of main innovation types. In a separate categorization, we also classified each decision in terms of the amounts of process change necessary to implement the new IT introduced earlier [40, 50]. These categorizations were then cross-classified with the three main innovations types defined by Swanson. These two dimensions of the IT investment decisions made by executives are shown in a two-dimensional matrix in Table 1, where we have shown their classifications. A clear and expected feature of this matrix of IT investment decisions is the contingency between innovation type and process change. A statistical test revealed a significant relationship (c^2 (6) = 33.23, $p < 0.01$).

The most important attribute of these decisions (for the present paper) deals with the amount of social subsystem consideration brought about by each of the studied IT investments. Those data are shown in Table 2. In each cell of Table 2, we list each social subsystem benefit or cost that was considered, the number of decisions in which it was a consideration, the total number of decisions in that cell, and the average number of social costs and benefits attended to per decision. Once again, a systematic structure is evident, this time reflecting the interdependency of the extent of technical subsystem change inherent in the new IT and the effort or attention given to assessing consequences in the social subsystem. As the IT under consideration moves from Type I (information system) to Type III (core technology) in its impact, the "weight" given to anticipated effects in the social subsystem moves up steadily as well—although there is a substantial amount of variation within types. That variation stems from the process change dimension of the table, which tracks remarkably closely with how much IT executives consider social subsystem costs and benefits in their decisions. This clear and emergent pattern, supported by a chi-square test (χ^2 (6) = 53.36, $p < 0.01$), is the cornerstone of the integrative inductive model we present in our discussion.

Administrative-core and technical-core decisions tended to be spread out to a greater

Table 1. IT Under Consideration by Degree of Change and Innovation Type

Innovation Type	Incremental change		Radical change	
	Degree of Process Change			
	No / Low	Some / Moderate	High / Great degree	Extreme / Total
Type I: Information Systems Core	Purchase of new computer (5) Upgrade computer (4) Upgrade network (3) Purchase workstations (1)	Est. common desktop (1) New database (1) Upgrading engineering workstations (1) Replatforming to client/server (1) Purchase software dev. tools (1) Initially networking PCs (1) Upgrading/rebuilding network (3)		
Type II: Administrative Core	Acct. system upgrade (1)	Document imaging (2) E-mail (1) Accounting system upgrade (1) New accounting financial system (2)	Document imaging (1) Timecard automation (1) New school administration (1) New accounting financial system (2)	
Type III: Technical Core		Appraisal system upgrade (1) Property management system upgrade (1) Claims processing system upgrade (1) CAD system upgrade (1) New inventory mgt. and order processing system (1) New fundraising system (1) New banking audio response system (1) New MRP II system (1) New engineering tools (1) New library system (1)	Electronic billing with outside agency (1) Nurses' documentation system (2) Employee work allocation system (1) Geographical Locating and Trucking System (1) Imaging and workflow control (1) ERP (1) MRP (1) MAPICS (1) Shop floor automation (1) Manufacturing Control (1) Batch plant control (1)	SAP (1) Branch automation (1) Clinical system (1)

Note: The number in parentheses is the number of firms that acquired this technology.

Table 2. Social Subsystem Costs or Benefits Considered by Degree of Change and Innovation Type

	Incremental change		Radical change		
	Degree of Process Change				
Innovation Type	No / Low	Some / Moderate	High / Great degree	Extreme / Total	
Type I: Information Systems Core	Productivity (5) Avg./decision = 0.38 No. of decisions = 13	Productivity (8) Training (8) Labor savings (1) Work quality (1) Change management (1) Learning curve (1) Job satisfaction (1) Avg./decision 2.1 No. of decisions = 9			x̄ = 1.09 SD = 1.27
Type II: Administrative Core	Avg./decision = 0 # of decisions = 1	Productivity (4) Training (4) Change management (2) Labor savings (1) Work quality (1) Avg./decision = 2 No. of decisions = 6	Productivity (5) Training (4) Labor savings (2) Better decisions (4) Change management (1) Learning curve (1) Avg./decision = 3.4 # of decisions = 5		x̄ = 2.41 SD = 1.50
Type III: Technical Core		Productivity (8) Training (8) Work quality (6) Better decisions (3) Learning curve (3) Change management (1) Improved comm. (1) Avg./decision = 2.9 No. of decisions = 10	Training (10) Productivity (9) Labor savings (5) Work quality (4) Change management (4) Learning curve (2) Better decisions (2) Job satisfaction (1) Morale (2) Loss of control (1) Avg./decision = 3.4 No. of decisions = 12	Productivity (3) Training (3) Work quality (3) Labor savings (1) Change management (1) Learning curve (1) Improved comm (1) Loss of control (1) Avg./decision = 4.8 No. of decisions = 3	x̄ = 3.36 SD = 1.25
	x̄ = 0.35 SD = 0.50	x̄ = 2.40 SD = 1.19	x̄ = 3.41 SD = 1.23	x̄ = 4.70 SD = 1.15	

Social Subsystem Disruption

degree on the process change dimension. While our data showed no decisions in the administrative core (Type II) in the most radical change column, it is conceivable that some IT investments, such as business process reengineering changes involving a firm's accounts receivable unit, would be in this category. Likewise, although our sample included no technical-core (Type III) decisions that caused minimal process disruptions, it is likely that minor software upgrades to existing systems, such as a hospital's patient information system, might be in this category.

Size and Sector Influence on Social Subsystem Consideration

Because of the deliberate variation (broad sampling) in firms built into our study design, it was also possible to investigate whether organizational size and industry sector are associated with patterns of inclusion or exclusion of social subsystem costs and benefits in IT investments. Chau [12] found that, in small firms, qualitative information related to the opinions of end users significantly affect IT decision-maker choices in selecting application software. In these cases, social subsystem benefits and costs were more strongly taken into consideration. These results raise the question of whether size might be a factor associated with social subsystem consideration. Past research has also shown that industry sector is an important factor when considering the relationship between the employees (social subsystem) and IT (the technical subsystem) [16].

Therefore, we classified the firms in our sample into three size categories: small (fewer than 250 employees), medium (251–1,000 employees), and large (more than 1,000 employees) [49]. In doing so, 20 firms were classified as small, 7 as medium, and 23 as large. We also identified firms as either service (34 firms) or manufacturing (16 firms) [16]. A contingency analysis was used to examine whether firm size and industry sector were jointly associated with social subsystem cost and benefit inclusion. We did not find a significant relationship (χ^2 (2) = 0.004, $p > 0.10$). We also investigated whether size or industry sector was individually related to the number of social subsystems costs and benefits included in investment decisions. Using one-dimensional count chi-square tests, again, no significant relationships were found, (χ^2 (2) = 4.28, χ^2 (1) = 0.01; both $p > 0.10$).

Gathering Social Subsystem Cost and Benefit Information

Our final research question dealt with the "how," or the process of obtaining social subsystem cost and benefit estimates for an IT investment. While many organizations had formal plans and followed schedules for seeking end-user input (59 percent), these efforts often concentrated on obtaining functional requirements for the IT. They typically did not involve gathering information about the social subsystem costs and benefits that might result from acquiring an IT. This trend perhaps illustrates some success in researchers' emphasizing the importance of end-user involvement in the development process (e.g. [15]). However, it underscores the lack of awareness or emphasis on evaluating social subsystem costs and benefits *a priori*, so that IT payoffs can be more accurately assessed and factored into the investment decision. For example, one CIO stated:

> The business analysts, when they interview people, they are getting information on functionality. They are not getting feedback in terms of potential resistance, and how it's going to impact productivity and quality of work, etc. All they are gathering is, what functions do you do? What are your inputs and what are your outputs?

A frequent justification for not including many social subsystem costs and benefits in the IT decision process is the inability to conceptualize the type or magnitude of those costs and benefits. This problem is one of the bases of our third research question. Among firms who do consider the social subsystem in their IT investment decisions, how do they go about it? Our findings are summarized in Table 3.

Discussions with functional managers were the method used most frequently for obtaining social subsystem cost and benefit information (46 percent). Reference site visits were mentioned in 31 percent of the decisions, and informal and formal methods of obtaining these costs and benefits directly from the end users were each mentioned about one-fourth of the time. Vendors or consultants tended to be used more often when the IT under consideration was vital to the organization's core business functioning (mentioned in 17 percent of the decisions.) A few organizations obtained social subsystem cost and benefit information by prototyping or having the users test the IT (7 percent).

Table 4 presents the methods used to gather social subsystem costs and organized by our analysis framework (described earlier). Once again, a definitive pattern appears, reflecting the interrelationship between the type of IT, the degree of process change, and the effort given to evaluating costs and benefits in the social subsystem (χ^2 (6) = 39.30, $p < 0.01$). That is, the number of methods used gathering social subsystem costs and benefits is contingent on both IT type and degree of process change. Decision-makers employed a few, primarily informal, methods of gathering social cost and benefit information for Type I, low-process-change investment decisions. As the decisions moved further along the process-change continuum (toward radical change), and toward IT associated with the organization's core competencies (Type III decisions), a greater number of more formalized methods were used.

Although methodologies for gathering information regarding these costs and benefits varied, our interviews revealed that visits to reference sites were a common and important method of gathering social cost and benefit information for high-process-change decisions. That is, they talked with and visited other organizations that had installed one of the proposed ITs in the choice set. In fact, 72 percent of those who use reference sites stated that they were a critical part of their decision process. Although vendors may have claimed a particular system was easy to install, operated smoothly, was well accepted by the users, and so on, reference sites offer deeper insight into the veracity of those claims. For example, the VP of an insurance firm stated:

Table 3. Methods of Gathering Input on Social Subsystem Costs and Benefits

Gathering input on social subsystem benefits and costs	Example
Discussions with functional managers (46%)	"We have a combination of workers and managers involved."
Reference site visits (31%)	"You have to see how other companies are using the software. A picture is worth a 1000 words sometimes. A vendor can sit here and tell you all day long what his system can do. But, unless you go out there and test it, you don't really know."
Informal conversations with the end user (25%)	"I probably get 3/4 of the input through the actual end users."
User involvement (in task forces, requirement meetings, etc.) (25%)	"We have brainstorming sessions with the users, and talk about all sorts of issues."
Assistance/advice from consultants/ vendors (17%)	"The consultant interviewed people at different levels of the company"
Users involved in trying prototypes or "pretesting" the product (7%)	"In some cases we will build prototypes and have user focus groups work with them."
User group meetings (2%)	"In retrospect, we would have pushed even harder and asked vendors to get us access to users groups where we could sit in on gripe sessions and hear what real users were griping about."
Impact analysis (2%)	"We go through an interview and observation process to figure out all the processes that are going to be impacted, . . . it's an impact analysis."

Number in parenthesis is the number of firms that used this information-gathering technique.

We have been to some other businesses that have [installed imaging and work flow control system], and they have had a culture shock. That's what everybody generally calls it. They don't have as much opportunity or need to get up and move around as they used to. So they have less personal contact with other employees. It really gets to be a big problem, a morale problem. Some places we've been, they've removed the walls between the cubicles, so they can at least see the other people that are sitting around near them, so if they have a spare minute they can talk to them, without having to get up. Otherwise, they're sitting in their cubicle with no paper and nothing but their PC sitting there all day long, waiting for some work to do. So, we're aware that there's a problem.

Table 4. Methods of Gathering Social Cost and Benefit information by Decision Type and Degree of Change

Innovation Type	Incremental change		Radical change	
	Degree of Process Change			
	No / Low	Some / Moderate	High / Great degree	Extreme / Total
Type I: Information Systems Core	Discussions with functional managers (2) Informal conversations with end users (1)	Informal conversations with end users (5) Discussions with functional managers (4) End user involvement (task forces) (1)		
	No. of decisions = 13	No. of decisions = 9		
Type II: Administrative Core		End user involvement (task forces) (4) Discussions with functional managers (4) Reference site visits (3) Assistance/Advice from Consultants/Vendors (1)	End user involvement (task forces) (3) Assistance/Advice from Consultants/Vendors (3) Informal conversations with end users (3) Discussions with functional managers (2) Reference site visits (1)	
		No. of decisions = 6	No. of decisions = 5	
Type III: Technical Core		Reference site visits (4) Discussions with functional managers (4) Informal conversations with end users (3) End user involvement (task forces) (2) Assistance/Advice from Consultants/Vendors (2) User pretesting" IT or prototype (1) User group meetings (1)	Reference site visits (8) Discussions with functional managers (8) End user involvement (task forces) (4) Assistance/Advice from Consultants/Vendors (3) User "pretesting" IT or prototype (2) Informal conversations with end users (3) Impact analysis (1)	Reference site visits (3) Discussions with functional managers (3) Assistance/Advice from Consultants/Vendors (2) End user involvement (task forces) (1) User "pretesting" IT or prototype (1)
		No. of decisions = 10	No. of decisions = 12	No. of decisions = 3

Note: The number in parentheses is the number of firms that used this information-gathering technique.

Discussion

What Social Subsystem Costs and Benefits Are Evaluated in IT Investment Decisions?

What's Considered?

OUR FINDINGS SHOW THAT UNDER MEANINGFUL, CONSEQUENTIAL CONDITIONS, fairly few executives making IT investment decisions attempted to quantify many of the social subsystem costs and benefits that a new IT can bring about. When they were included in the decision process, training expense and labor savings were almost always assigned some tangible value. Productivity, quality of work, and change management (included in 69 percent, 25 percent, and 17 percent of the decisions, respectively) were quantified by only a few decision makers (15 percent, 7 percent, and 7 percent, respectively). Other social subsystem costs and benefits were rarely considered and even more rarely given a numerical estimate. These results suggest that a germane feature relative to social subsystem consideration deals with the tangibility of these costs and benefits.

In contrast with the social subsystem, many of the technical subsystem costs and benefits are tangible. Some technical subsystem costs and benefits (e.g., depth of integration with current software platform) might be quasi-tangible. However, few costs and benefits would be completely intangible. The social subsystem costs that might be viewed as sitting close to the boundary of social and technical subsystems (e.g., productivity and labor savings) were more often quantified than were other social subsystem costs or benefits (e.g., employee job dissatisfaction). These results suggest that, although tangibility is not bound up completely with the technical versus social subsystem classification, they are likely to be correlated in practice.

What's Missing?

Many social subsystem costs and benefits prescribed as crucial considerations in the implementation literature were not mentioned by any member of this sample of IT executives (e.g., increased role conflict [36] and greater employee empowerment [76]). Better communication, defined as enhanced interaction enabling greater lateral coordination [46], was incorporated into only 3 percent of the investment scenarios. Very few executives (5 percent) mentioned that they included the impact of IT on employees' feeling of loss of power or control [1]. And executives mentioned only 3 percent of decisions considering employee morale and job dissatisfaction, which has been defined as an increase in a negative emotional state resulting from the assessment of one's job or job experiences [39].

The majority of these "neglected" benefits and costs can be thought of as second-order or longer-term effects. The equity-implementation model [36] is a useful framework that can help decision-makers identify these second-order or longer-term effects. IT itself may not always directly cause these outcomes, but rather, they are mediated by other factors such as implementation practices and may not be realized immediately [58]. Therefore, time also appears to be a relevant factor in the consideration of social subsystem costs and benefits.

These second-order social subsystem costs and benefits were characterized by some executives as "management issues" that were considered after the IT acquisition, but prior to or during system implementation. A principal problem is that if these management issues are not formally considered in the acquisition decision, yet are realized during implementation, the total anticipated benefit or cost of the project may vary from original projections. This underscores the need for decision-makers to carefully evaluate a well-developed implementation plan and thoroughly consider both first- and second-order social subsystem costs and benefits resulting from IT-induced changes.

In contrast with the seldom considered social subsystem costs and benefits, many long-term technical costs and benefits are factored into IT valuation, including the expected duration that the system will be used, its anticipated depreciation (hardware), need for future maintenance, expected costs of updates and upgrades, expandability, and so on [52]. Although the time at which costs and benefits accrue is conceptually different from the sociotechnical dimension, it appears, in operation, to overlap somewhat. That is, social subsystem considerations tend to be longer term as well as less tangible in practice.

Another notable trend is the lack of consideration of change management issues, even for decisions causing an overhaul in an important business process (only 17 percent of all decisions, and one-third of the decisions involving radical change, assessed change management costs). Within this domain of costs to the social subsystem, Robey and Sahay [58] found that the acceptance and usage of geographical information systems (GIS) in a single organization differed as a result of implementation practices. This underscores the importance of planning for and managing change during IT implementation and highlights the concern that costs associated with change management are often not included in IT investment. Grover et al. [27] found that change management is critical to business process reengineering (BPR) success. Furthermore, their data revealed that not recognizing the need for managing change was a serious problem. Without adequate attention given to the anticipated costs of change management during implementation efforts, BPR efforts may be at risk of failing.

The literature also suggests that human resource (HR) policy changes are often needed when radical IT-induced change occurs [18, 44]. Markus and Keil [44] showed that HR practices are important to IT success. An example of this type of policy change would be the restructuring of compensation plans to reward behaviors and output facilitated by new IT and business processes. The cost, time, and effort of making such policy changes is nontrivial and should not be overlooked when IT investments are being considered.

What Patterns Are There Between the IT Being Evaluated and Consideration of Social Subsystem Costs and Benefits?

Our results indicate that there is indeed a pattern by which decision-makers either include or exclude social subsystem issues in their IT investment choices. Table 2 shows that number and types of social subsystem costs and benefits decision-makers consider vary by type of innovation and by the degree of process change that the IT will invoke. Taken together, these two dimensions imply a single, more abstract dimension that could be characterized as social subsystem disruption (as superimposed in Table 2). We describe and develop this idea more fully below, ending with a decision tree that characterizes when social subsystem issues acquire their greatest salience to IT decision makers.

Inductive Model

A continuum of social subsystem disruption incorporates the idea that not all decisions about the same type of IT engender the same degree of (social subsystem) cost and benefit consideration. The organizational context matters fundamentally. In other words, the amount of change in the technological subsystem is not linked one-to-one with consequences for the social subsystem. A complete change-out of servers, LAN software, and cabling for everyone in a newspaper publishing office may have no appreciable impact on how the journalists, editors, and staff members get their work done. On the other hand, a switch in word-processing packages might stymie their work efforts and cause major delays in production. What appears critical from our interview data is the degree or amount of change in behavior expected from employees as a result of implementing the chosen IT, as well as the breadth by which the IT affects the core business processes of the organization.

At the low end of the continuum, some Type I IT investments that induce little process change also tend to cause little or no social subsystem disruption. They go essentially unnoticed by end users and engender little consideration of concomitant costs and benefits within the social subsystem. For example, one executive stated:

> The only impact that it was going to have on [the users] was that they were going to work faster, because they were speedier machines. They would still do their work the same way.

Other Type I decisions, such as establishing a common desktop, induce greater change, and therefore should and do evoke greater social subsystem consideration. As IT investments are characterized as further along the disruption continuum, executives tend to incorporate more social subsystem issues in their decision processes. For example, one executive stated:

> I think particularly when you are dealing with user processes, the user has to be involved in those decisions. Certainly when you're talking about applications you've got to do that.

Around the middle of the continuum, Type II IT investments causing moderate levels of change focus on extending the functionality of existing IT to meet the current needs of the business. These decisions do not change the work flow in the social subsystem at a macro level, but they will affect the way in which a particular task gets accomplished. For example, the CIO-level executive at an irrigation equipment manufacturer stated:

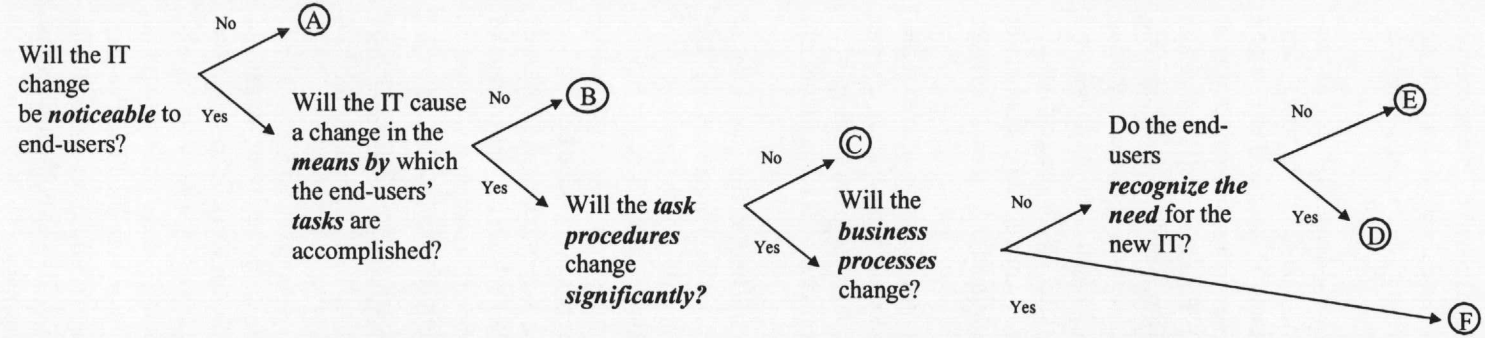
> Our direction in terms of implementing this system is not to do any radical reengineering at the same time. We made a conscious decision that we are going to take advantage of new features of the software where it makes sense to do that to improve our business. But, we are purposely not going to reengineer our processes along with the implementation.

Other IT investment decisions, positioned at the high end of the disruption continuum, will be associated with a radical change or major reengineering of core business processes. Such changes in IT will also cause greater scrutiny of social subsystem costs and benefits because the actual work and transfer of information will be altered dramatically. Fiedler et al. [25] stated that employees may find it difficult to accept the radical changes resulting from business process reengineering. Yet their acceptance of the new business processes is critical to the project's success and realization of anticipated financial payoffs [18].

Social Subsystem Cost–Benefit Impact Decision Tree

As our preceding discussion has illustrated, the disruption continuum (Table 2) implies that evaluating social subsystem costs and benefits is more critical for some types of IT investment decisions. A joint consideration of innovation type and degree of anticipated change will map the decision to the amount of social subsystem consideration it will prompt. Using specific examples given by the executives and expanding on some of the choice points within the IT investment process, we developed a decision tree that tracks pivotal considerations in the social subsystem (see figure 1).

Decision trees have often been used to aid managerial decision-making. For example, Vroom and Yetton [73] created a decision model to help leaders determine the appropriate means of soliciting input from peers or subordinates. Clemons and Weber [13] used decision-tree analysis for strategic IT investments. While our decision tree is a starting point for helping decision-makers assess social subsystem costs and benefits, it is not meant to be overly mechanical or to replace a thorough implementation plan. We briefly discuss each choice point in our decision tree below, along with relevant comments from our executive interviews. Note that the nodes of the decision tree are arranged along the social subsystem disruption continuum from least to greatest disruption. The critical costs and benefits considered at each node as well as possible actions (described in figure 1) are cumulative. For example, social subsystem costs and benefits considered at node B should also be considered at nodes C, D, E, and F.



	A	B	C	D	E	F
***Critical* Cost/Benefit**	None	-Productivity -Timeliness of decisions -Labor savings	-Training +All listed in B	-Quality of work -Learning curve -Change management + All listed in C	+All listed in D but to a greater degree	-HR policy changes +All listed in E but to a greater degree
Possible Actions	Inform functional managers	-Perform productivity improvement benchmarks -Discuss changes with functional managers	-Talk with vendors regarding the amount of training required +All listed in B	-Solicit end-user involvement (task forces and "pretesting" the IT) -Visit reference sites (especially focusing on the training/ learning curve impact) +All listed in C	-Strategize with managers how to "sell" the new IT. -Discuss with trainers the costs and importance of adding a "sales pitch" into training. +All listed in D	-Perform an impact analysis -Obtain advice from consultants -Work with functional managers and HR department to enact HR policy changes +All listed in E

Social Subsystem Disruption Continuum

Figure 1. Social Subsystem Cost/Benefit Impact Decision Tree

Will the IT change be noticeable to end users? This initial question identifies IT decisions positioned low on the disruption continuum (see node A). These decisions are unnoticeable to users. They produce no appreciable social subsystem costs and benefits (although one executive suggested that functional managers be kept informed).

Will the IT cause a change in the means by which the end users' tasks are accomplished? Even if the IT under consideration results in no changes to the users' daily work flow, its implementation may be noticeable in terms of the speed with which end-user tasks are accomplished as in the case of upgrading a mainframe server or changing the networking infrastructure (see node B). Potential social subsystem issues to consider are productivity, timeliness of decisions, and labor savings. Although in some cases the impact may be marginal, in others the change may bring significant financial payoffs as explained by the CIO of a mail-order business, "We have hundreds of people on the telephone. If I can pick up 15–20 seconds out of a sales call, without any reduction in quality of service, I can add huge amounts of money to the bottom line." In this case, IT fills its traditional role of making work activity more efficient [76].

Will the task procedures change significantly? If task procedures are altered somewhat, but not wholesale (see node C), the decision-maker should consider whether training is required. Providing an overview of changed features is always helpful. If more extensive training is needed, the vendor of a purchased or leased product can typically supply training information.

Will business processes change? A business process has been defined as "a set of logically related tasks performed to achieve a defined business outcome [19]. The way in which individual tasks are accomplished may change, but the business process may remain the same. For decisions in which the business processes do not change, figure 1 shows that the decision-maker should proceed to the next choice point question. For decisions that do involve such a change, see the relevant section below.

Do the end users recognize the need for new IT? When end users themselves see a need for new IT, change meets with less resistance (see node D). For example, the manager of corporate information services for a medium-sized manufacturing company, who was in the process of acquiring an enterprise resource planning package, stated:

> I think the general feeling throughout the company is they've suffered for a number of years with our antiquated systems, so they're really looking forward to something that's going to make things better for them.

Nevertheless, if task procedures change significantly, productivity, improved decision-making ability, labor savings, training, quality of work, learning curve, and change management costs all should be considered. To assess these, end users can be involved in task forces or actual "pretesting" of the contending ITs. Decision-makers may also want to visit reference sites where the IT under consideration is already installed. Business area managers, and not just technical managers or employees, should be included in the visit. Through discussions with successful and unsuccessful implementers, information such as the length of time it took for the users to learn the new IT and become productive, their change in productivity once the system was mastered, the impact on work quality, and so on, can be assessed. Change management costs are also significant when the IT change will significantly alter users' tasks or business processes. While management information systems are sometimes justified on the basis of managerial time savings, the opposite condition, managerial time expenditure, is rarely considered.

If users do not see the utility in a new technological system, they may be unwilling to accept it [20] (see node E). For example, the owner of a trucking company spoke about installing onboard tracking and monitoring devices on their freight trucks, saying, "If the people don't like it, and they get resistant to the idea, they will sabotage it. They will find a way to make it not work. So, you have to get people to buy into the idea before you actually do it." Past research has shown the importance of effective communication to the acceptance of technological change [45]. Decision makers can strategize with first-line managers on how to "sell" the new IT to the users. User input into the formulation and customization of the IT is also desirable [15]. Managers can also help assess the costs of communication. Depending on the strategies chosen, the costs could differ substantially. Many of the decision-makers interviewed saw training as a key vehicle for overcoming resistance to a new technology. Indeed, training has been shown to affect computer usage through user satisfaction and confidence [68].

Business Process Changes

When business processes do change (node F), the decision-maker should be aware of the social subsystem considerations discussed in nodes A through E (see figure 1), as well as considering needed HR policy changes. Markus and Keil [44] showed that HR policy changes can be important to IT success. An example of this type of policy change is the restructuring of compensation plans to reward behaviors and output facilitated by new IT and business processes. The cost, time, and effort of making HR policy changes may be significant.

The decision tree tracks social subsystem costs and benefits and methods for gathering them across the full spectrum of the disruption continuum. While not every possible social subsystem cost or benefit is listed, the decision tree can serve as a useful starting point for recognizing salient social subsystem costs and benefits. In turn, these anticipated costs and benefits can and be brought into initial decisions about making a major IT investment.

Gathering Social Subsystem Cost and Benefit Information

The interviews revealed that, for IT investment decisions on the low end of the disruption continuum, decision-makers used a few informal methods for gathering social subsystem costs and benefits. A larger number of information-gathering techniques were used for IT decisions high on the continuum, with more formal methods folded into the IT valuation. It is interesting to note that all three decisions in the Technical core/Extreme radical change cell involving the greatest amount of disruption gathered social subsystem costs and benefit information by visiting other firms that had installed the proposed technology, as well as discussing the IT with internal sources such as their own functional managers (see Table 4). One explanation for the importance of reference site visits is that decision-makers perceive them to narrow the gap between the anticipatory and the experiential utility of the proposed IT. As decisions moved toward greater social subsystem disruption, there was also some tendency for firms to seek advice or assistance from outside consultants or vendors.

Limitations and Research Directions

AS WITH ALL RESEARCH, THIS INVESTIGATION HAS SEVERAL POSSIBLE limitations. First, our sample size is relatively small (fifty firms), although this is typical of qualitative or inductive research (e.g., [48, 70]). Second, we used interviews that relied on retrospective recall. This procedure has been criticized in the past by those claiming that such a data-collection technique yields invalid results [26]. Yet recent reexamination of the evidence suggests that retrospective reporting is a viable research methodology [47], especially for collecting qualitative data and doing theory building. To improve the validity of retrospective recall, Miller et al. [47] suggest several procedures that we followed. First, they state that informants should not be asked to recall information from the distant past. In the present study, we specifically asked our interviewees about their most recent and most salient major investment decision. Next, Miller et al. [47] recommend that researchers focus on facts or events. In our interviews we asked about the steps (events) in the executives' decision process regarding a specific, real acquisition and what was actually considered in this process rather than what they would do under generic or hypothetical circumstances. Third, Miller et al. [47] state that researchers should encourage their interviewees to provide accurate information by (a) ensuring the confidentiality of the interview, (b) minimizing the inconvenience of the data collection, and (c) providing explanations of the usefulness of the project. For our project, we (a) assured the executives that their comments would not be attributed directly to them or to their company, (b) held the interviews at a time and date specified by the executive, and (c) not only explained the project but also offered the executives a copy of the research results.

A third limitation of the present investigation is that, by deliberately selecting firms in diverse industries and regions with varying organizational sizes, we sacrificed the depth of detail for the breadth of sampling [23]. As Stone [63] states, there are advantages and disadvantages to this depth versus breadth trade-off inherent in every research strategy. No single strategy is optimal on all dimensions. Benbasat [7] recommends selecting a strategy on the basis of the purpose of the research. In our case, (and in keeping with the broad applicability of this special issue), we wanted to extend the applicability of our results across a broad spectrum of organizations by identifying potentially common or shared threads of the valuation of social subsystem costs and benefits in a very diverse fabric of sizes, industries, and locations.

That is, we wanted to know something about this issue, in general. Jenkins [34] suggests that this approach strengthens the external validity of the results.

This study highlights that, while interdependencies between the social and technical subsystems exist, the degree of interdependency is not the same in every situation. Our research found that the degree of disruption in the social subsystem is jointly determined by the type of IT under consideration and the amount of change it brings about. This continuum provides a basis by which future research can explore the inclusion of social subsystem issues in the investment decision. For example, future research could investigate whether using the social subsystem disruption continuum to anticipate costs and benefits helps firms reap IT payoffs. That is, does such consideration result in different investment decisions? More importantly, will it improve system-, unit-, or firm-level performance?

Our research also found that the contextual situation, in terms of how much change an IT might engender in a particular organization, affected the amount of consideration that decision-makers afforded social subsystem issues. Future research could investigate whether characteristics of the overarching organizational system, such as culture, formalization of processes, or decentralization of structure, have an impact on the inclusion or exclusion of social costs and benefit consideration in IT investment decisions.

Although our study was intentionally broad-based, a more focused investigation of a single industry or a single type of decision (e.g., the decision to participate in e-commerce) could provide valuable insights. We therefore recommend that future research include a focused, multiple-case study approach, investigating firms in a single industry that are considering similar types of technologies. This type of study might track firms as they go through their decision process and compare the firms' decision parameters, methods of gathering information, and valuation processes.

Conclusion

SOCIAL SUBSYSTEM COSTS AND BENEFITS ACCRUE WHEN AN IT IS ACQUIRED. Those costs and benefits are not likely to be equivalent among IT investment alternatives, but they are likely to be pivotal in determining the IT's effectiveness. Therefore, to evaluate IT payoffs more completely, these social subsystem costs and benefits must be incorporated into IT investment decisions. However, for some types of IT decisions, this assessment is more critical than for others. Our findings indicate the more social subsystem disruption the IT under consideration will induce (characterized as a combination of innovation type and degree of change in work flow), the greater consideration IT decision makers should give to costs and benefits in that subsystem. Our proposed decision tree can aid decision-makers in determining the critical social subsystem costs and benefits for a given decision and suggests methods for gathering this information. By being aware of and formally assessing social subsystem costs and benefits, these issues are no longer "hidden," surfacing only in the implementation or postimplementation phase of a project, thus minimizing unanticipated social subsystem costs and benefits and clarifying anticipated IT payoff.

NOTE

1. A qualitative data analysis tool, (QSR Nud*ist, standing for Non-numerical Unstructured Data Indexing, Searching, and Theorizing) was used to assist with this process.

REFERENCES

1. Abdul-Gader, A.H., and Kozar, K.A. The impact of computer alienation on information technology investment decisions: an exploratory cross-national analysis. *MIS Quarterly, 19*, 4 (1995), 535–559.

2. Agar, M.H. *The Professional Stranger: An Informal Introduction to Ethnography*. New York: Academic Press, 1990.

3. Ahituv, N.; Neumann, S.; and Riley, H.N. *Principles of Information Systems for Management*, 4th ed. Dubuque, IA: Wm. Brown Communications, 1994.

4. Bacon, C.J. The use of decision criteria in selecting information systems/technology investments. *MIS Quarterly, 16*, 3 (1992), 335–349.

5. Bakeman, R., and Gottman, J.M. *Observing Interaction: An Introduction to Sequential Analysis*. New York: Cambridge University Press, 1996.

6. Belcher, L.W., and Watson, H.J. Assessing the value of Conoco's EIS. *MIS Quarterly, 17*, 3 (1993), 239–253.

7. Benbasat, I. An analysis of research methodologies. In F.W. McFarlan (ed.), *The Information Systems Research Challenge*. Boston: Harvard Business School Press, 1984, pp. 47–88.

8. Benbasat, I.; Goldstein, D.K.; and Mead, M. The case research strategy in studies of information systems. *MIS Quarterly, 11*, 3 (1987), 369–384.

9. Bostrom, R.P., and Heinen, S.J. MIS problems and failures: a sociotechnical perspective. Part I: the causes. *MIS Quarterly, 2*, 3 (1977), 17–33.

10. Bostrom, R.P., and Heinen, S.J. MIS problems and failures: a sociotechnical perspective. Part II: the application of sociotechnical theory. *MIS Quarterly, 2*, 4 (1977), 17–33.

11. Brynjolfsson, E. The productivity paradox of information technology. *Communications of the ACM, 35*, 12 (1993), 66–77.

12. Chau, P.Y.K. Factors used in the selection of packaged software in small businesses: views of owners and managers. *Information and Management, 29*, 2 (1995), 71–78.

13. Clemons, E.K., and Weber, B.W. Strategic information technology investments: guidelines for decision making. *Journal of Management Information Systems, 7*, 2 (1990), 9–28.

14. Cohen, J.A Coefficient of agreement of nominal scales. *Education and Psychological Measurement, 20*, (1960), 37–46.

15. Conger, S. *The New Software Engineering*. Belmont, CA: Wadsworth, 1994.

16. Culpan, O. Attitudes of end-users towards information technology in manufacturing and service industries. *Information and Management, 28*, 3 (1995), 167–176.

17. Daft, R.L. A dual-core model of organizational innovation. *Academy of Management Journal, 21*, 2 (1978), 193–210.

18. Davenport, T.H. *Process Innovation: Reengineering Work Through Information Technology*. Boston: Harvard Business School Press, 1993.

19. Davenport, T., and Short, J. The new industrial engineering: information technology and business process redesign. *Sloan Management Review, 31*, 4 (1990), 11–27.

20. Davis, F.D.; Bagozzi, R.P.; and Warshaw, P. R. User acceptance of computer technology: a comparison of two theoretical models. *Management Science, 35*, 8 (1989), 982–1003.

21. DeGreene, K.B. *Sociotechnical Systems: Factors in Analysis, Design, and Management*. Englewood Cliffs, NJ: Prentice Hall, 1973.

22. Dewar, R.D., and Dutton, J.E. The adoption of radical and incremental changes: an empirical analysis. *Management Science, 32*, 1 (1986), 1422–1433.

23. Eisenhardt, K. Building theories from case study research. *Academy of Management Review, 14*, 4 (1989), 532–550.

24. Emery, F. Characteristics of sociotechnical systems. Tavistock Institute of Human Relations, Doc. T–42, 1962.

25. Fiedler, K.D.; Grover, V.; and Teng, J.T.C. Information technology-enabled change: the risks and rewards of business process redesign and automation, *Journal of Information Technology, 9,* 4 (1994), 267–275.

26. Golden, B. The past is the past—or is it? The retrospective accounts as indicators of past strategy. *Academy of Management Journal, 35,* 4 (1992), 848–860.

27. Grover, V.; Fiedler, K.; and Teng, J. Empirical evidence on Swanson's tri-core model of information systems innovation. *Information Systems Research, 8,* 3 (1997), 273–287.

28. Grover, V.; Jeong, S.R.; Kettinger, W.J.; and Teng, J.T.C. The implementation of business process reengineering. *Journal of Management Information Systems, 12,* 1 (1995), 109–144.

29. Hitt, L.M., and Brynjolfsson, E. Productivity, business profitability, and consumer surplus: three different measures of information technology value. *MIS Quarterly, 20,* 2 (1996), 121–141.

30. Hochstrasser, B. Evaluation of IT investments—matching techniques to projects. *Journal of Information Technology, 5,* 4 (1990), 215–221.

31. Hoffer, J.A.; George, J.F.; and Valacich, J.S. *Modern Systems Analysis and Design*, 2d ed. Reading, MA: Addison-Wesley, 1999.

32. Holden, T., and Wilhelmij, P. Improved decision making through better integration of human resource and business process factors in a hospital situation. *Journal of Management Information Systems, 12,* 3 (Winter 1995–96), 21–41.

33. Holme, M.R. Procurement reform and MIS project success. *International Journal of Purchasing and Materials Management, 33,* 1 (1997), 2–7.

34. Jenkins, A.W. Research methodologies and MIS research. In E. Mumford (ed.), *Research Methods in Information Systems*. Amsterdam: North-Holland, Elsevier Science, 1985, pp. 103–118.

35. Joshi, K. Role conflict and role ambiguity in systems design. *Omega: The International Journal of Management Science, 17,* 4 (1989), 369–380.

36. Joshi, K. A model of users' perspective on change: the case of information technology implementation. *MIS Quarterly, 15,* 2 (1991), 229–242.

37. Judge, P.C.; Burrows, P. ; and Rheinhardt, A. Tech to the rescue? *Business Week* (1998), 30–31.

38. Keen, P.G.W. *Shaping the Future: Business Design Through Information Technology.* Boston: Harvard Business School Press, 1991.

39. Locke, E.A. The nature and causes of job satisfaction. In M. Dunnette (ed.), *Handbook of Industrial and Organizational Psychology.* Chicago: Rand McNally, 1976, pp. 28–54.

40. Lucas, H.C.; Berndt, D.J.; and Truman, G. A reengineering framework for evaluating a financial imaging system. *Communications of the ACM, 39,* 5 (1996), 86–100.

41. Lucas, H.C.; Ginzberg, M.J.; and Schultz, R.L. *Information Systems Implementation: Testing a Structural Model.* Norwood, NJ: Ablex, 1990.

42. Lyytinen, K.; Mathiassen, L.; and Ropponen, J. Attention shaping and software risk—a categorical analysis of four classical risk management approaches. *Information Systems Research, 9,* 3 (1998), 233–255.

43. Markus, M.L., and Benjamin, R.I. Change agentry—the next frontier. *MIS Quarterly, 20,* 4 (1996), 385–407.

44. Markus, M.L. and Keil, M. If we build it, they will come: designing information systems that people want to use. *Sloan Management Review, 35,* 4 (1994), 11–25.

45. Manzoni, J., and Angehrn, A.A. Understanding organizational dynamics of IT-enabled change: a multimedia simulation approach. *Journal of Management Information Systems, 14,* 3 (Winter 1997–98), 109–140.

46. Migliarese, P. , and Paolucci, E. Improved communications and collaborations among tasks induced by groupware. *Decision Support Systems, 14,* 3 (1995), 237–250.

47. Miller, C.C.; Cardinal, L.B; and Glick, W.H. Retrospective reports in organizational research: a reexamination of the evidence. *Academy of Management Journal, 40,* 1 (1997), 189–204.

48. Niederman, F.; Beise, C.; and Beranek, P. Issues and concern about computer-supported meetings: the facilitator's perspective. *MIS Quarterly, 20,* 1 (1996), 1–22.

49. Neumann, S.; Ahituv, N.; and Zviran, M. A measure for determining the strategic relevance of IS to the organization. *Information and Management, 22,* 5 (1992), 281–299.

50. Orlikowski, W.J. CASE tools as organizational change: investigation of incremental and

radical changes in systems development. *MIS Quarterly, 17*, 3 (1993), 309–341.

51. Osterman, P. Impact of IT on jobs and skills. In S. Morton (ed.), *The Corporation of the 1990s*. New York: Oxford University Press, 1991, pp. 80–91.

52. Parker, M.M., and Benson, R.J., with Trainor, H.E. *Information Economics: Linking Business Performance to Information Technology*. Englewood Cliffs, NJ: Prentice Hall, 1988.

53. Pasmore, W.A. Social science transformed: the sociotechnical perspective. *Human Relations, 48*, 1 (1995), 1–21.

54. Pasmore, W.; Francis, C.; and Haldeman, A. Sociotechnical systems: a North American reflection on empirical studies of the seventies. *Human Relations, 35*, 12 (1982), 1179–1204.

55. Porter, M.E. *Competitive Advantage*. New York: Free Press, 1985.

56. Post, G.V.; Kagan, A.; and Lau, K.N. A modeling approach to evaluating strategic uses of information technology. *Journal of Management Information Systems, 12*, 2 (Fall 1995), 161–187.

57. Robertson, P. J.; Roberts, D.R.; and Porras, J.I. Dynamics of planned organizational change: assessing empirical support for a theoretical model. *Academy of Management Journal, 36*, 3 (1993), 619–634.

58. Robey, D., and Sahay, S. Transforming work through information technology: a comparative case study of geographic information systems in county government. *Information Systems Research, 7*, 1 (1996), 93–110.

59. Sabherwal, R., and Robey, D. An empirical taxonomy of implementation processes based on sequences of events in information system development. *Organization Science, 4*, 4 (1993), 548–575.

60. Semich, J.W. Here's how to quantify IT investment benefits. *Datamation, 40*, 1 (1994), 45–48.

61. Simms, I. Evaluating IT, where cost-benefit analysis fails. *Australian Accountant, 67*, 4 (1997), 29–31.

62. Slater, S.F. Learning to change. *Business Horizons, 38*, 6 (1995), 13–20.

63. Stone, E. *Research Methods in Organizational Behavior*. Santa Monica, CA: Goodyear, 1978.

64. Strassmann, P. *Information Payoff*. New York: Free Press, 1985.

65. Strauss, A., and Corbin, J. *Basics of Qualitative Research: Grounded Theory, Procedures, and Techniques*. Newbury Park, CA: Sage, 1968.

66. Stylianou, A.C.; Madey, G.R.; and Smith, R.D. Selection criteria for expert system shells: a sociotechnical taxonomy. *Communications of the ACM, 35*, 10 (1992), 30–48.

67. Swanson, E.B. Information systems innovation among organizations. *Management Science, 40*, 9 (1994), 1069–1086.

68. Torkzadeh, G., and Dwyer, D.I. A path analytic study of the determinants of information systems usage. *Omega, 22*, 4 (1994), 339–348.

69. Trist, E.L. The evolution of sociotechnical systems: a conceptual framework and action research program. Occasional paper no. 2, Ontario Quality of Working Life Centre, Ontario, Canada, 1981.

70. Vandenbosch, B., and Huff, S.L. Searching and scanning: how executives obtain information from executive information systems. *MIS Quarterly, 21*, 1 (1997), 81–107.

71. Violino, B. ROI in the real world. *InformationWeek, 679* (1998), 60–72.

72. Vora, J.A. Productivity and performance measures: who uses them? *Production and Inventory Management Journal, 33*, 1 (1992), 46–49.

73. Vroom, V.H., and Yetton, P. W. *Leadership and Decision-Making*. Pittsburgh: University of Pittsburgh Press, 1973.

74. Webb, G. Make IT work. *Airfinance Journal, 197*, (1997), 52–53.

75. Willcocks, L., and Lester, S. Information systems investments, evaluation at the feasibility stage of projects. *Technovation, 11*, 5 (1991), 283–302.

76. Zuboff, S. *In the Age of the Smart Machine: The Future of Work and Power*. New York: Basic Books, 1988.