Communications of the Association for Information Systems

Volume 2 Article 20

November 1999

Dimensions of Information Systems Success

Peter B. Seddon
The University of Melbourne, peterbseddon@gmail.com

Sandy Staples
Queen's University, sstaples@business.queensu.ca

Ravi Patnayakuni
Temple University, patnayak@Joda.cis.temple.edu

Matthew Bowtell
Ernst & Young, matthew.bowtell@ernstyoung.com.au


Communications of the Association for Information Systems

Volume 2, Article 20
November 1999

DIMENSIONS OF INFORMATION SYSTEMS SUCCESS

Peter B. Seddon
Department of Information Systems
The University of Melbourne

Sandy Staples
Queen's School of Business
Queen's University

Ravi Patnayakuni
CIS Department
Temple University

Matthew Bowtell
Ernst & Young
p.seddon@dis.unimelb.edu.au

RESEARCH: METHODOLOGY

DIMENSIONS OF INFORMATION SYSTEMS SUCCESS

Peter B. Seddon
Department of Information Systems
The University of Melbourne

Sandy Staples
Queen's School of Business
Queen's University

Ravi Patnayakuni
CIS Department
Temple University

Matthew Bowtell
Ernst & Young
p.seddon@dis.unimelb.edu.au

ABSTRACT

The value added by an organization's IT assets is a critical concern to both research and practice. Not surprisingly, a large number of IS effectiveness measures can be found in the IS literature. What is not clear in the literature is what measures are appropriate in a particular context. In this paper we propose a two-dimensional matrix for classifying IS Effectiveness measures. The first dimension is the type of system studied. The second dimension is the stakeholder in whose interests the system is being evaluated. The matrix was tested by using it to classify IS effectiveness measures from 186 empirical papers in three major IS journals for the last nine years. The results indicate that the classifications are meaningful. Hence, the IS Effectiveness Matrix provides a useful guide for conceptualizing effectiveness measurement in IS research, and for choosing appropriate measures, both for research and practice.

Keywords: IS research frameworks, user satisfaction, effectiveness, IS success

I. INTRODUCTION

Total annual worldwide expenditure on information technology (IT) probably exceeds one trillion US dollars per year[1] and is growing at about 10% compounded annually. With these huge sums of money being spent on IT, one might expect that managers and researchers would devote considerable efforts to assessing which forms of IT expenditure are most effective. Indeed, there is a thriving industry consisting of trade publications, consultants, in-house IT experts, and academic researchers offering answers to questions about

- new information technologies such as client-server computing, Windows NT vs. Unix, and Enterprise Resource Planning (ERP) systems,
- new ways for organizations to manage IT, such as outsourcing, and
- new ways of designing and building more effective information systems.

However, few clear guidelines exist about how effectiveness should be measured. The purpose of this paper is to provide a clear set of guidelines for IS success measurement.

In their influential article, DeLone and McLean [1992], reviewed 100 papers containing empirical IS success measures that had been published in seven publications during the seven years 1981-1987. They classified the huge range of IS success measures they found into six categories, and towards the end of their paper present their six categories of success measures in the model shown in Figure 1. DeLone and McLean [1992, p. 87] argue that when measuring IS success, researchers should "systematically combine" measures from their six IS success categories.

---

[1] Total revenue for the Datamation (1997) top 100 IT-producing firms in the world was US$502 billion in 1996 (up 13% from $443 billion in 1995). If in-house expenditure on staff and system development and output from smaller IT firms is included, it seems safe to assume that worldwide IT expenditure is at least double this amount. Hence the estimate of annual expenditure of one trillion US dollars on IT.

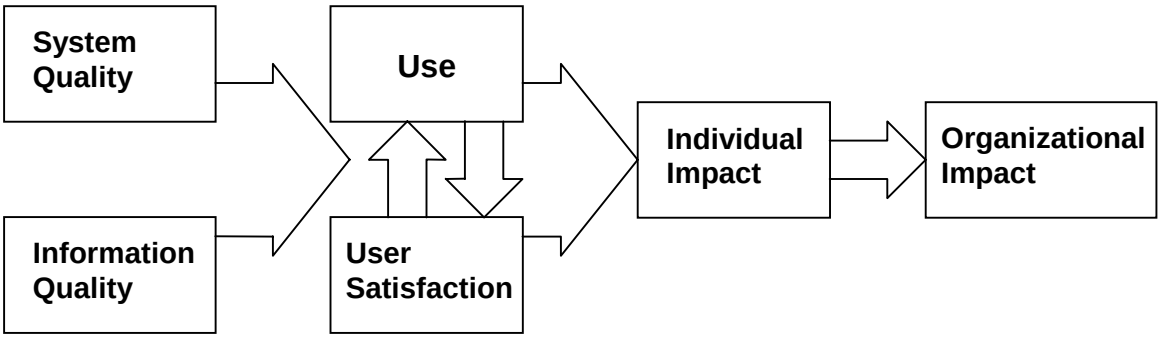


Figure 1: DeLone and McLean's Model of IS Success
[DeLone and McLean [1992], Figure 2, p.87]

DeLone and McLean's paper is an important contribution to the literature on IS success measurement because it was the first study that tried to impose some order on IS researchers' choices of success measures. However, although it distinguishes between individual impact and organizational impact, the paper does not recognize explicitly that different stakeholders in an organization may validly come to different conclusions about the success of the same information system. By contrast, Seddon's [1997] re-specification of DeLone and McLean's model posits that different individuals are likely to evaluate the consequences of IT use in different ways: "IS Success is thus conceptualized as a value judgement made by an individual, from the point of some stakeholder" [Seddon 1997, p.248].

II. RESEARCH FRAMEWORK

Building on both the preceding studies and the work of Grover et al. [1996], the purpose of this paper is to present an alternative to DeLone and McLean's model of IS success that we have found useful for framing most questions about IS effectiveness. Our framework is based on the seven questions shown in Table 1 that organizational psychologists, Cameron and

Whetten [1983, pp. 270-274], argue must be answered when measuring organizational effectiveness.

Table 1: Seven Questions to Answer when Measuring Organizational Performance
[Cameron and Whetten, 1983]

1. From whose perspective is effectiveness being judged?
2. What is the domain of activity? (depends on tasks emphasized in the organization, competencies of the organization, and demands from external forces)
3. What is the level of analysis? (individual, subunit, organization, population, societal)
4. What is the purpose of evaluation?
5. What is time frame is employed? (short, long)
6. What types of data are to be used? (objective or perceptual)
7. Against which referent is effectiveness to be judged? (effectiveness of this organization compared to: some other organization; some ideal level of performance; stated goals of the organization; past performance of the organization; or certain desirable characteristics)

When evaluating information systems (IS), we find that all seven questions in Table 1 are just as relevant to IT professionals measuring IS Effectiveness as they are to psychologists measuring organizational effectiveness. In particular, when evaluating IT systems it is often convenient to combine questions 1 and 3 in one dimension, which we call Stakeholder.[2] A stakeholder is a person or group in whose interest the evaluation of IS success is being performed. Cameron and Whetten [1983] list five "levels of analysis": individual, subunit, organizational, industrial, and societal, and note that "the appropriateness of the level depends on the constituency being used, the domain being focused on, the purpose of the evaluation, and so on" [p.271]. Grover et al. [1996, p.182] list four different classes of evaluation perspective: (1) users, (2) top management, (3) IS personnel, and (4) external entities. Our list of stakeholders differs slightly from both Cameron and Whetten and Grover et al[3]. According to our reading of the

[2] It is not always useful to combine these two questions. For example, at the organizational unit of analysis, studies of outsourcing often report that a firm's IT manager and the chief executive officer (CEO) may have a different views of IT effectiveness.

[3] We did not use Cameron and Whetten's "Industry" group, nor Grover et al.'s "IS Personnel".

literature, evaluation of IS effectiveness is generally based on one or more of the following five points of view:

- The independent observer who is not involved as a stakeholder.
- The individual who wants to be better off
- The group, which also wants to be better off
- The managers or owners who want the organization to be better off
- The country which wants the society as a whole to be better off.

We then use question 2 in Table 1 to define a second dimension, which we call System, that is used to classify the type of system that is being evaluated. This dimension has the following six components:

- an *aspect* of IT use (e.g., a single algorithm or form of user interface)
- a *single* IT application (e.g., a spreadsheet, a PC, or a library cataloging system)
- a *type* of IT or IT application (e.g., TCP/IP, a GDSS, a TPS, a data warehouse, etc.)
- *all* IT applications used by an organization or sub-organization
- an aspect of a system development *methodology*
- the *IT function* of an organization or sub-organization[4].

Classifying IS effectiveness measures by these two dimensions results in the 5*6 = 30 possible classes of measures shown in Table 2. The unit of analysis in each cell of Table 2 is "the system, evaluated from the point of view of some stakeholder". Note that it would be possible to make even finer-grained

[4] The IT function is a *system* for making IT resources more readily available to other parts of the organization.

Table 2: IS Effectiveness Measures Used For Different Combinations of Stakeholder and System: Some Examples

	Stakeholder/ interest group	(1) An **aspect** of IT design or use (e.g., algorithm, query language, or user interface)	(2) a **single** IT application in an organization (e.g., this GDSS)	(3) a **type** of IT or IT application (e.g., **any** GDSS, data warehouse, etc.)	(4) **all** IT applications used by an organization or sub-organization	(5) an aspect of a system development **methodology** (including reengineering)	(6) an **IT function** (or its management) in an organization
(1)	**Independent observer** (stakeholder independent)	*Accuracy or speed of algorithm* [Mookerjee, Mannino and Gilson 1995]	*Performance outcome expectations* after learning to use spreadsheet or word processing package [Compeau and Higgins 1995]	*Communication effectiveness* choice between e-mail and face to face [Zack 1993]	*Cumulative abnormal returns* of firms following IT investment announcements by 97 firms, 1981-1988 [Dos Santos, Peffers, and Mauer 1993]	*Accuracy and consistency* of software estimates [Mukhopadhyay, Vicinanza, and Prietula 1992]	*Important skills for EIS developers* from survey of current practices [Watson, Ranier, and Koh 1991]
(2)	**Individual Primary focus:** Individual better-offness	*User acceptance of Expert System advice* for expert systems with explanation facilities [Ye and Johnson 1995]	*Creative Performance (fluency, novelty, value), satisfaction* of students using creativity enhancement software [Massetti 1996]	*Work-Family conflict* due to after-hours work-related home computer use [Duxbury, Higgins and Mills 1992]	*Self-rated job performance* of users of up to five systems in 25 departments [Goodhue and Thompson 1995]	*User Satisfaction* as consequence of User participation and four moderator variables. [McKeen, Guimaraes, and Wetherbe 1994]	*Service Quality* [Pitt, Watson, and Kavan 1995] (3 firms)
(3)	**Group Primary focus:** Group better-offness	*Post- meeting consensus, degree of confrontiveness, quality of recommendations* in variations in GDSS design [Sambamurthy and Poole 1992]		*Equality of participation, Perceived group performance* in GDSS [McLeod and Liker 1992]			
(4)	**Management or Owners (of a firm) Primary focus:** Organizational better-offness	*Perceived usefulness of computer-based information* for financial and operations management [Kraemer, Danzinger, Dunkle, and King 1993]	*Price premium per gallon* for fuel sold via the Cardlock system [Nault and Dexter 1995]	*Reduced inventory holding costs, Reduced premium freight costs* at Chrysler, following introduction of EDI [Mukhopadhyay, Kekre and Kalathur 1995]	*Sales growth, ROA, labor productivity* [Weill 1992] (33 firms)	*Cost savings, quality improvement, customer satisfaction* from Business Process Reengineering [Caron, Javenpaa and Stoddard 1994]	*Benefits to the firm* flowing from IT outsourcing: [Lacity and Hirscheim 1993]* * not from the three IS journals analyzed.
(5)	**A Country Primary focus:** Society's better-offness			*Evolution of electronic market* for computerized loan origination. [Hess and Kemerer 1994]	*Productivity, and Consumer Surplus* [Hitt and Brynjolfsson 1996] (370 firms, one country)		Not applicable

classifications of these two dimensions. For example, the "managers" part of "managers and owners" might usefully be classified into "senior managers" and "IT managers", since judgments about effectiveness may differ considerably for these two types of stakeholder. However, the 5*6 classification in Table 2 is sufficient to make our point about the need for different measures of IS effectiveness for different combinations of system and stakeholder.

Looking at Table 2, it is immediately evident that measures of effectiveness appropriate for one cell might be quite inappropriate for another. For example, the IS effectiveness measures appropriate for evaluating the benefits to an individual user of some aspect of a system (row 2, column 1 in Table 2) might be increased speed of task completion and/or increased decision quality. By contrast, the IS effectiveness measures used by Hitt and Brynjolffson [1996] for evaluating the value to a *nation* of *firms' investments in IT* (row 5, column 4) involve macroeconomic estimates of United States consumer surplus. By the nature of their subject matters and stakeholders, the measures in these two types of study need to be very different. Yet both are measures of IS effectiveness.

All but one of the measures shown in Table 2 were selected from the studies examined later in this paper in attempting to test the generality of the matrix[5]. Our purpose in selecting these particular measures was to try to convey, in this simple two-dimensional representation, some sense of the range of different effectiveness measures that have been used in the past by different researchers. All the example effectiveness measures in the studies in the body of Table 2 were used by their respective researchers as indicators of whether some stakeholder, be it a person, organization, or nation, was better-off as a result of an investment of time or money in some type of endeavor involving IT.

---

[5] The one study not selected from the three journals (ISR, JMIS, and MISQ) is Lacity and Hirschheim's [1993] book on outsourcing. Judgements concerning the effectiveness of outsourcing arrangements provide an excellent example of senior management evaluation of the effectiveness (row 4) of an IT function (column 6). Lacity and Hirschheim's work provides a better example of what we mean by a row 4, column 6 study than any of the papers published in the journals studied during 1988-1996. Another good example of a row 4, column 6 study is Lacity and Willcocks [1998], but it is outside the timeframe of this survey.

As one looks at the range of measures in Table 2, it seems obvious that very different measures are necessary for measuring IS Effectiveness in different contexts, and that a "systematic combination" of six different types of measure as suggested by DeLone and McLean [1992], quoted earlier, is not going to work. Based on this observation, we propose that:

- diversity of IS effectiveness measures is to be encouraged, and
- Cameron and Whetten's seven questions in Table 1 together with the matrix in Table 2 provides a useful framework for selecting *appropriate* measures for future IS research.

The rest of this paper examines these propositions in more detail.

The different columns in Table 2 describe different types of "system". Moving across the table from left to the right, the focus changes from aspects of information technology, to individual information systems, to types of IT system, and to a firm's portfolio of IT-based systems. Heavier lines separate the last two columns because, unlike columns 1-4, the systems of interest in these studies are not applications of IT. Column 5 studies are interested in the effectiveness of different methodologies for developing information systems, where the methodology is thought of as "the system". Column 6 studies treat an organization's IT function as "the system" of interest.

The different rows of Table 2 describe the different stakeholders in whose interests IS effectiveness is measured. Row 1 is used for studies where IS effectiveness is thought to be independent of the needs and wants of different stakeholders. It seems most appropriate for studies where objective measures of effectiveness, such as speed or accuracy, are available. Row 1 is also appropriate for most experiments, where the investigator, not some stakeholder with a personal interest in the system, makes the judgments of effectiveness on some reasonably objective basis. Neither Cameron and Whetten [1983] nor Grover et al. [1996] include independent stakeholders in their frameworks, yet there seems to be a need for such a class of stakeholder in a discipline where

objective measures of effectiveness, such as response times and levels of transaction security, are valid measures for some studies. This row was not initially in our matrix, but during pilot testing, we discovered it helped resolve a number of classification difficulties.

Row 2 in Table 2 is for studies that focus on benefits from the point of view of individuals. Benefits individuals receive from use of information technology include increased productivity, better decision-making, faster promotion (if the system helps them perform more effectively than others), and possibly, political advantage. In the research we reviewed, individual benefits were explored for all six types of system in Table 2. Therefore, no cells are empty in row 2.

Row 3 concerns effectiveness measures that relate to groups. Although one could argue that groups are just short-term organizations, the measures in the group decision support (GDSS) literature are so group-specific (e.g., equality of participation) that it seems better to introduce a special class of stakeholder that recognizes the distinctive characteristics of groups. GDSS studies often collect information about both group performance and individual performance/satisfaction. As a result, many GDSS studies use measures of effectiveness from both row 2 and row 3.

Row 4 is for studies where IS Effectiveness is measured from the point of view of the management or owners of an organization. Although the potential difficulties of achieving goal congruence between management at different levels of an organization and the owners is well known, it is assumed in Table 2 that these interests are similar enough to be grouped in one row. IS Effectiveness measures appropriate for row 4 tend to have a strong economic flavor. For example, Weill [1992] says “the focus of this paper is on the firm’s portfolio of systems” [p.311], and he measures firm growth, return on assets, % change in labor, and market share. It is clear that Weill’s measures are based on the point of view of management and owners of the firms, and that because they relate to all IT applications in the 33 firms he studied, they belong in row 4, column 4 of the matrix.

In the last row of Table 2, the interests involved are now those of a country, and the choice of the most appropriate IS Effectiveness measure is expected to change again. As shown in Table 2, e.g., the Hitt and Brynjolfsson [1996] study, the measures of effectiveness most useful for evaluating the impact of different information systems or technologies for a *country* are very different from those one would use in, say, the top row of Table 2.

The reason for drawing this row-by-row distinction among the different types of stakeholder in Table 2 is when one system is evaluated, by one person, on behalf of different stakeholders, different responses can be obtained. To illustrate, Table 3 shows a small sample of responses from data collected for a recent study of data warehousing success [Seddon & Benjamin 1998]. Column headings show the exact questions asked. Entries in the table are from the tape-recorded transcript. The units of analysis are, first, the data warehousing system evaluated from the organization's point of view, and second, the same system evaluated from respondent's point of view. Note that the responses in the right-hand column are more frank, identify different salient issues, shift in focus from "they" to "I", and may come to opposite conclusions! Table 3 demonstrates that those evaluating computer systems must make it very clear (to the respondent, themselves, and their readers) on whose behalf the evaluation is performed.

The discussion so far focused on measures of effectiveness of the different IT applications in columns 1-4 of Table 2. The measures in columns 5 and 6 are also measures of system effectiveness, but the "system" is now either an aspect of a methodology for building systems, or the IT function in an organization. Recall that column 5 is concerned with the effectiveness of systems for changing information systems. In Column 5 of Table 2, McKeen et al. [1994] measured satisfaction of individual users in their study of the effect of user participation on system effectiveness. Therefore, their effectiveness measure is classified in row 2, column 5. By contrast, Caron et al. [1994] measured cost savings, quality improvement, and customer satisfaction in their study of reengineering at CIGNA insurance. Because their effectiveness measures reflect the (presumed)

Table 3. Transcript Responses from Interviewees about Data Warehousing Success

Respond-ent	"From the point of view of your firm, would you describe the data warehousing project a success?"	"From your own personal point of view, would you regard your firm's data warehousing project a success?"
Sales trainee, Firm A	Yes, helps people get the information they want when they want it. Think that it would be very hard to cope without it.	Yes, it would be very hard for me to get information without it. Although get frustrated with it, it is more success than not.
Business analyst, Firm B	Wouldn't have thought so yet, because don't think there are many people on it. Know there was work being done a few months ago to try to introduce new users to it, but don't know..	Yes, largely I would. Have some concerns now because of incomplete data, but generally has from my point of view. Has made data far more accessible.
IT informant, Firm C	Yes, absolutely. The fact that they want to do more is a good indicator. Decision has been made to "warehouse the world".	Yes, as above, but has taken longer than expected, and will never be finished.
Senior Manager Marketing, Firm C	Yes, achieved the objects it set out to achieve.	Yes and no, was a success but … In my opinion project was far too technically driven.

interests of management, not the individual employee, their measures are classified in row 4, column 5. Column 5 is included in the IS Effectiveness matrix because of the importance of system development methodologies in the application of IT, and the need to compare the effectiveness of different change practices.

In Column 6, the system of interest is the IS/IT function itself. How effective is it? Pitt et al.'s [1995] use of "Service Quality" for evaluating the effectiveness of the central IT functions of three firms is a row 2, column 6 measure. Pitt et al. collected opinions from some hundreds of individual users in each firm, so the stakeholders in their study were classified as individual users. By contrast, Lacity and Hirschheim's [1993] book on outsourcing, which also involves the assessment of the effectiveness of central IT functions (in 21 organizations), adopts the point of view of senior management. Hence, Lacity and Hirschheim's measures are classified as more economics-oriented row 4, column 6 effectiveness measures. Although the opinions of individuals within a

firm may inform the judgments of senior management in Lacity and Hirschheim's study, the nature of the evaluations is much more concerned with accounting profitability and return on investment than the opinions of individual users.

III. TESTING THE IS EFFECTIVENESS MATRIX FRAMEWORK

The classification scheme in Table 2 looks plausible, but does it work for *all* studies of IS effectiveness? To test the generality of the matrix, we followed DeLone and McLean [1992], and Grover et al. [1996], and attempted to use our framework (the matrix) to classify the IS effectiveness measures used in prior studies. DeLone and McLean's research methology involved

1. proposing a list of 6 categories of IS Success measure that seemed, from their point of view, to make sense, then
2. classifying the measures found in a sample of the literature those six categories.

They note that classification was often not clear cut: "all of these classification decisions are somewhat arbitrary" (DeLone and McLean 1992, pp. 63-4). Where a study used multiple measures, they classified it into more than one category. Our methodology is similar. Based on the theoretical work of Cameron and Whetten (1982), we proposed a classification scheme that seemed to make sense (Table 2). Then we analyzed a sample of papers from the literature attempting to classify the measures used in those papers in terms of our two dimensions.

DeLone and McLean reviewed the literature for the seven years from 1981 to 1987. We decided to review the next nine recent years, from 1988 to 1996. The three journals we decided to review were all major U.S. journals: *Management Information Systems Quarterly (MISQ), Information Systems Research (ISR)* (from 1990), and the *Journal of Management Information Systems (JMIS)*. These three leading IS journals seemed likely to reveal the best of IS Effectiveness

measurement practice used during the last decade. Our objective was to identify and classify all empirical studies where IS Effectiveness was the dependent variable, and in particular, to identify any cases where the variables used did not fit readily into the IS Effectiveness Matrix.

Step 1 in this review process was to identify empirical papers that used IS effectiveness measures as dependent variables. Step 2 was to classify the measures. For both steps, two co-authors of this paper reviewed each article in each journal independently, then met to resolve disagreements. The five cases shown in Table 4 illustrate some of the more difficult decisions we encountered in Step 1.

The reason for presenting these five borderline-classification examples is to give the reader some idea of the range of measures included in the analysis. In particular, the last two examples illustrate the broad notion of "system" used in this study. We debated whether the column 5 and 6 measures of effectiveness belonged in the framework at all. On balance, we decided they were worth including because:

- studies in columns 5 and 6 need effectiveness measures of some kind, and
- it is helpful to maintain awareness

  -that these measures exist, and

  -that they are different from the effectiveness measures for the IT applications in columns 1-4.

Table 4. Five Case Examples of Decisions Faced in Step 1

Case	Authors	Discussion
1	Bretchneider and Wittmer [1993]	Diffusion of innovation theory and data from 1,005 surveys were used to study organizational adoption of microcomputer technology. The dependent variable was Organizational Penetration of Microcomputer Technology, measured by Computers per employee. One co-author classifier argued that increasing use of microcomputer technology is an indicator of the effectiveness of this technology compared to the others. The other classifier argued that the purpose of this study was to understand a social and economic phenomenon, namely, diffusion of an innovation, and not to study effectiveness. The decision made in this case was to exclude this paper from further analysis.
2	Compeau and Higgins [1995]	Data from 1,020 mail surveys was used to explore determinants of self-efficacy. One classifier argued that since self-efficacy is an attribute of a person, not an information system, the paper should be excluded. The other argued that according to Compeau and Higgins [1995: 191], "computer self-efficacy represents an individual's perceptions of his or her ability to use computers in the accomplishment of a task", which is surely a sign of IS effectiveness. We decided to retain this paper for further analysis.
3	Davis [1989]	Two measures for predicting future IS use were developed. One classifier argued that Davis's dependent variable, Future Use, is not an IS effectiveness measure. The other argued that the underlying idea of the study was that people would only choose to use systems that they thought would make them better off, so the two proposed instruments are measures of perceived future effectiveness. In this case, the latter argument prevailed, and the paper was accepted for further analysis. Davis's measures, Ease of Use and Perceived Usefulness, were eventually classified in row 2, column 2.
4	Lederer and Sethi [1996]	The opinions of 105 senior IS managers about the factors that they believe are the keys to success in IS planning were reported. The classifiers' question was: Does success in IS planning constitute any sort of IS effectiveness? We decided that from the point of view of the IS department, IS planning is very important to the delivery of IS services to the users. Accordingly, this paper was included in the study. Its measure, IS strategic planning effectiveness, was eventually classified into row 4, col. 6.
5	Barki and Hartwick [1994]	The relationship between user participation, conflict, influence, and a dependent variable called Satisfactory Conflict Resolution was explored. After some debate, we decided that this paper was sufficiently concerned with IS change processes to justify its inclusion in the analysis. The measure, Satisfactory Conflict Resolution, was eventually classified as a row 2, column 5 measure.

Although not everyone will agree with our decisions about which papers contained IS effectiveness measures and which did not, the broad definition of effectiveness used forced us to consider a wide range of measures in Step 2. Over-all, about 30% of studies examined (186 of 630) passed through our first filter as being empirical studies that used some form of IS effectiveness as a dependent variable. Of these, 77 of 220 (35%) were from *MISQ*, 49 of 122 (40%) were from *ISR*, and 60 of 288 (21%) were from *JMIS*.

The purpose of Step 2 in the analysis was to see if measures of IS effectiveness from the 186 papers selected could be classified "comfortably" into a cell in the matrix in Table 2. Again, the choices were not always clear cut. The five cases shown in Table 5 illustrate some of the more difficult decisions.

The examples in Table 5 give some idea of the range of different IS effectiveness measures used in the different studies, and of difficulties we had, as readers of the 186 papers, in deciding what "the system" was, and in whose interests the evaluation was being made. The research papers we reviewed represent thousands of hours of careful work by some hundreds of leading IS researchers, so initially it seemed more likely that the classification difficulties we encountered were due to weaknesses in our classification scheme (the matrix), not weaknesses in the research studies themselves. But in a small number of cases it was not clear who the stakeholder was, nor what type of "system" was being studied. Here, we decided that if we could not identify the stakeholder/system unit of analysis from reading the paper, there is a distinct risk that the researchers did not make it clear, either to themselves or their respondents. . In these cases, we argue, the papers would have been stronger (both more precise in their measurement, and easier for the reader to understand), if they had identified the unit of analysis (the stakeholder and system) more clearly. More important, we concluded that it was possible to classify the measures in all the papers studied in terms of the two key dimensions of the matrix.

Table 5. Five Case Examples of Decisions Faced in Step 1

Case	Authors	Discussion
1	Compeau and Higgins[1999}	In the study from example 2 above, the authors measured performance expectations of individuals evaluating single packages. However, no individual had any particular stake in the outcome. We decided to classify their performance measure as stakeholder-independent (row 1) not individual effectiveness (row 2).
2	Cronan and Douglas [1990]	The effectiveness of end-user training on the value of systems built by end-users was reported in this study. Questionnaires on effectiveness were completed by both users *and* their supervisors. Because of the dual nature of evaluation, we classified the measures in this study as *both* row 2 and row 4. Also, because individual users appeared to be evaluating only one system at a time (although they were evaluating *different* systems), we included the measures in column 2 of the matrix.
3	Alavi, Wheeler, and Valacich [1995]	This study was concerned with the use of IT and collaborative learning processes to improve learning effectiveness. Dependent variables here include self-reported levels of knowledge acquisition and satisfaction with the learning process. These evaluations are clearly from the point of view of individual stakeholders. However, the system column of the matrix was harder to specify. The system used involved Windows-based PCs equipped with personal video cameras and software to allow display of images of collaborators as well as a shared spreadsheet. Is this one system (column 2) or an instance of a type of system (column 3)? Because the focus of the study was on learning, not the technology, we decided to treat this system as an instance of a type of system (row 2, column 3).
4	Zubramarian and Zarnich [1996]	The effectiveness of two computer-aided software engineering tools in 40 projects was examined in this study. The dependent variable was the effort required (measured in months) to develop a given number of software function points. We judged “months of effort” to be a stakeholder-independent measure of effectiveness (row 1), but there was some argument about the appropriate column. The three candidates were column 2, because each project used a particular CASE tool (IEF or INCASE), column 3, because the study was about CASE tools generally not the two packages in particular, and column 5 “some aspect of a system development methodology”. Our decision in this case was to use column 3, but the choice really seems to depend on what decision makers want to do with the information.
5	Leidner and Elam [1993]	The impact of executive information systems (EIS) on executive decision making was examined. Responses were from 46 senior managers in 23 firms. Effectiveness measures included speed of problem identification, decision making speed, and extent of analysis. Since the respondents were senior managers, should these measures be classified as judgments about effectiveness from the point of view of the senior managers as individual stakeholders (row 2), or as judgments from the point of view of management (row 4)? Because the questionnaire asked: “To what extent has the EIS helped *you* do to the following” [p.146, emphasis added) we decided to classify the measures in the study as belonging to row 2, but it is hard to be sure.

The result of our classification efforts is available as a 200-row table in the Appendix. A summary of the data is presented in Table 6. Table 6 shows the frequency of occurrence of IS effectiveness measures for each combination of stakeholder and system. The sum of entries in the cells in Table 6 adds to 200, not 186 (the number of papers analyzed), because some papers used measures from the point of view of more than one stakeholder.

Table 6: Frequency of Occurrence of IS Effectiveness Measures For Each Combination Of System And Stakeholder

	(1)	(2)	(3)	(4)	(5)	(6)	
Stakeholder/ interest group	An **aspect** of IT design or use	a **single** IT applicati on	a **type** of IT or IT application	**all** IT applications used by an organization	An aspect of a system development **methodology**	an **IT function**	Total measures for this type of stakeholder
Independent observer	21	5	12	1	8	1	48
Individual	10	11	25	3	11	10	70
Group	1		26		1		28
Management or Owners	1	6	15	9	6	13	50
A Country			2	2			4
Total measures for this type of system	33	22	80	15	26	24	200

Based on the review of empirical measures in 186 studies in three journals (MISQ, ISR, And JMIS) for the nine year period 1988-1996 presented in the Appendix.

IV. CONCLUSIONS

DeLone and McLean [1992] analyzed 100 empirical papers containing IS effectiveness measures, from 1981-1987, and found a multitude of different

measures. After arguing that a reduction in the number of measures was desirable, they classified these measures into six categories. In this paper, we analyzed 186 empirical papers from 1988-1996, and we, too, found a multitude of measures. However, unlike DeLone and McLean, we do not believe that this diversity of measures is a problem.

This paper's first insight is that in a world of conflicting human interests and vastly different systems, different sharply-focused measures of IS effectiveness are likely to be needed for different purposes. While we adopted a positivist perspective in our research, we do not mean to imply that the impact of a system could be constrained to one group of stakeholders. As the IS research community knows, introducing a system can have unforeseen social and political impacts. Our message is simply that different measures are likely to be needed to assess the impact and effectiveness of a system for different groups of stakeholders. We suggest this is an important message given the growth of empirical IS research studies [Farhoomand & Drury 1999]. Table 2 and the Appendix can assist in identifying:

- appropriate measures that should be combined in a study to assess effectiveness from different stakeholders' views,
- units of analysis that received little attention from researchers previously.

The second insight of this paper is that :

- Cameron and Whetten's [1983] seven questions (Table 1) define the construct space for IS effectiveness measurement, and
- two key dimensions of this construct space are the Stakeholder and the type of IT System being evaluated.

These two dimensions define the IS effectiveness matrix shown in Table 2. Table 3 in this paper (from a study of data warehousing success) illustrates how

subtle differences in stakeholder perspective can produce significantly different evaluations of systems.

Combining the above two insights, we suggest that Cameron and Whetten's seven questions and the two-dimensional IS Effectiveness matrix presented in this paper (Tables 1 and 2) provide useful ways of framing most discussions about IS Effectiveness measurement. The matrix approach is simpler than Grover et al.'s [1996] -- simple enough to go in a textbook discussion on IS effectiveness -- yet it captures the essence of IS Effectiveness measurement. It contributes to the IS literature because it helps researchers organize the huge diversity of measures used in IS effectiveness research into a simple two-dimensional framework. Certainly, the IS Effectiveness matrix was useful in clarifying our own thinking when studying and discussing IS effectiveness. Other researchers also report that they found it to be of value.

We also found the matrix useful when talking with practitioners. For example, recently the IT executive from a local government authority approached the first author of this paper concerned that in a recent survey his IT organization had been criticized as being unresponsive to user needs. He was worried, but the survey had been very general, and he really had no idea of what was wrong. His question to us was: "Did we know of a questionnaire he could use to get a clearer understanding of what was wrong?" When asked if he wanted to assess one particular system, all systems, system development methodologies, or service provided to users by his IT department (i.e., the columns of the matrix), it was clear that he had never thought in such terms. Yet we as researchers knew that the questions needed for these different measurement goals are very different! A brief discussion based around the matrix helped us clarify what was needed. The executive wanted individual user views about quality of service offered by his IT department. We pulled out the literature on SERVQUAL [Watson, Pitt & Kavan, 1998] and SERVPERF [Kettinger & Lee, 1997], and he was soon on his way. The IS Effectiveness Matrix helped to clarify his thinking about what sort of measures were required.

For the future, we recommend that anyone requiring an IS Effectiveness measure should endeavor to answer all seven questions from Table 1 before commencing their evaluation. Further, we strongly recommend that when reporting results of IS effectiveness evaluations, authors of reports should always make clear what type of system they were studying, and on whose behalf the evaluation was conducted.

ACKNOWLEDGEMENTS

An earlier version of this paper was published in the Proceedings of the International Conference on Information Systems (ICIS) 1998 held in Helsinki, Finland in December, 1998. We wish to thank the anonymous reviewers and editors of both ICIS and CAIS for their helpful comments and suggestions.

Editor's Note: This article was received on July 5, 1999. It was with the authors approximately 1 month for 1 revision. The article was published on November 6, 1999.

REFERENCES

EDITOR'S NOTE: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that
1. these links existed as of the date of publication but are not guaranteed to be working thereafter.
2. the contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.
3. the authors of the Web pages, not CAIS, are responsible for the accuracy of their content.
4. the author(s) of this article, not CAIS, is (are) responsible for the accuracy of the URL and version information.

Alavi, M., B.C. Wheeler, and J.S. Valacich (1995) "Using IT to Reengineer Business Education: An Exploratory Investigation of Collaborative Telelearning", *Management Information Systems Quarterly*, (19)3, pp. 293-312.

Barki, H. and J. Hartwick (1994) "User participation, conflict, and conflict resolution: the mediating roles of influence", *Information Systems Research,* (5)4, pp. 422-438.

Bretchneider, S. and D. Wittmer (1993) “Organizational adoption of microcomputer technology: the role of sector”, *Information Systems Research* (4)1, pp. 88-108.

Cameron, K.S. and D.A. Whetten, (1983) “Some conclusions about organizational effectiveness”, in K.S. Cameron, and D.A Whetten, (eds). *Organizational Effectiveness: A Comparison of Multiple Models*, New York: Academic Press, pp. 261-277.

Caron J.R., S.L. Javenpaa, and D.B. Stoddard (1994) “Business reengineering at CIGNA corporation: experience and lessons from the first five years”, *MIS Quarterly,* (18)3, pp. 233-250.

Compeau, D.R. and C.A. Higgins (1995) “Application of social cognitive theory to training for computer skills”, *Information Systems Research*, (6)2, pp. 118-143.

Cronan, T.P. and D.E. Douglas (1990) “End-user Training and Computing Effectiveness in Public Agencies: An Empirical Study”, *Journal of Management Information Systems*, (6)4, pp. 21-39.

Davis, F.D. (1989) “Perceived usefulness, perceived ease of use, and user acceptance of information technology”, *MIS Quarterly,* (13), pp. 319-340.

DeLone, W.H., and E.R. McLean (1992) “Information systems success: the quest for the dependent variable”, *Information Systems Research,* (3), pp. 60-95.

Dos Santos, B.L., K. Peffers and D.C. Mauer (1993) “The impact of information technology investment announcements on the market value of the firm”, *Information Systems Research*, (4)1, pp. 1-23.

Duxbury, L.E., C.A. Higgins, and S. Mills (1992) “After-Hours Telecommuting and Work-Family Conflict: A Comparative Analysis”, *Information Systems Research,* (3)2, pp. 173-196.

Farhoomand, A.F. and D.H. Drury (1999) “A Historiographical Examination of Information Systems”, *Communications of the Association for Information Systems*, (1)19. URL: http://cais.aisnet.org/contents.asp.

Goodhue, D.L. and R.L. Thompson (1995) “Task-Technology Fit and Individual Performance”, *Management Information Systems Quarterly* (19)2, pp. 213-236.

Grover, V., S.R. Jeong, and A.H. Segars (1996) “Information systems effectiveness: The construct space and patterns of application”, *Information and Management*, (31), pp. 177-191.

Hess, C.M. and C.F. Kemerer (1994) “Computerized Loan Origination Systems: An Industry Case Study of the Electronic Markets Hypothesis”, *MIS Quarterly* (18)3, pp. 251-276.

Hitt, L.M. and E. Brynjolfsson (1996) “Productivity, business profitability, and consumer surplus: three different measures of information technology value”, *MIS Quarterly,* (20)2, pp. 121-142.

Kettinger, W.J. and C.C. Lee (1997). “Pragmatic Perspectives on the Measurement of Information Systems Service Quality”, *MIS Quarterly,* (21)2, pp. 223-240.

Kraemer, K.L., J.N. Danziger, D.E. Dunkle, and J.L. King (1993) “The Usefulness of Computer-Based Information to Public Managers”, *MIS Quarterly*, (17)2, pp. 129-148.

Lacity, M.C. and R. Hirschheim (1993) *Information Systems Outsourcing: Myths, Metaphors, and Realities*, Wiley.

Lacity, M.C. and L.P. Willcocks (1998) “An Empirical Investigation of Information Technology Sourcing Practices: Lessons from Experience”, *MIS Quarterly*, (22)3, pp. 363-408.

Lederer, A.L. and V. Sethi (1996) “Key Prescriptions for Strategic Information Systems Planning”, *Journal of Management Information Systems*, (13)1, pp. 35-62.

Leidner, D.E. and J.J. Elam (1993) “Executive Information Systems: Their Impact on Executive Decision Making”, *Journal of Management Information Systems*, (10)3, pp. 139-155.

Massetti, B. (1996) “An Empirical Examination of the Value of Creativity Support Systems on Idea Generation”, *Management Information Systems Quarterly,* (20)1, pp. 83-98.

McKeen, J.D., T. Guimaraes, and J.C. Wetherbe (1994) “The relationship between user participation and user satisfaction: an investigation of four contingency factors”, *MIS Quarterly* (18), pp. 427-451.

McLeod, P.L. and J.K. Liker (1992) “Electronic Meeting Systems: Evidence from a Low Structure Environment”, *Information Systems Research* (3)3, pp. 195-223.

Mookerjee, V.S., M.V. Mannino, and R. Gilson (1995) “Improving the Performance Stability of Inductive Expert Systems Under Input Noise”, *Information Systems Research* (6)4, pp. 328-356.

Mukhopadhyay, T., S. Kekre, and S. Kalathur (1995) “Business Value of Information Technology: A Study of Electronic Data Interchange”, *Management Information Systems Quarterly* (19)2, pp. 137-156.

Mukhopadhyay, T., S.S. Vicinanza and M.J. Prietula (1992) “Examining the Feasibility of a Case-Based Reasoning model for Software Effort Estimation”, *Management Information Systems Quarterly* (16)2, pp. 155-171.

Nault, B.R. and A.S. Dexter (1994) “Added Value and Pricing with Information Technology”, *Management Information Systems Quarterly* (19)4, pp. 449-464.

Pitt, L.F, R.T. Watson, and C.B. Kavan (1995) “Service quality: a measure of information systems effectiveness”, *MIS Quarterly* (19), pp. 173-188.

Sambamurthy, V. and M.S. Poole (1992) “The Effect of Variations in Capabilities of GDSS Designs on Management of Cognitive Conflict in Groups”, *Information Systems Research* (3)3, pp. 224-251.

Seddon, P.B. (1997) “A Respecification and Extension of the DeLone and McLean model of IS Success”, *Information Systems Research* (8)3, pp. 240-253.

Seddon, P.B. and N. Benjamin (1998) “What do we know about Successful Data Warehousing?” *Australasian Conference on Information Systems*, Sydney, Australia.

Subramanian, G.H. and G.E. Zarnich (1996) “An Examination of Some Software Development Effort and Productivity Determinants in ICASE Tool Projects”, *Journal of Management Information Systems*, (12)4, pp. 143-160.

Watson, H.J., R.K. Rainer Jr., and C.E. Koh (1991) “Executive Information Systems: A Framework for Development and a Survey of Current Practices”, *Management Information Systems Quarterly* (15)1, pp. 13-30.

Watson, R.T., L.F. Pitt, and C.B. Kavan (1998). “Measuring Information Systems Service Quality: Lessons from Two Longitudinal Case Studies”, *MIS Quarterly,* (22)1, pp. 61-79.

Weill, P. (1992) “The relationship between investment in information technology and firm performance: a study of the valve manufacturing sector”, *Information Systems Research*, (3)4, pp. 307-333.

Ye, L.R. and P.E. Johnson (1995) “The Impact of Explanation Facilities on User Acceptance of Expert Systems Advice”, *Management Information Systems Quarterly* (19)2, pp. 157-172.

Zack, M.A. (1993) “Interactivity and Communication Mode Choice in Ongoing Management Groups”, *Information Systems Research*, (4)3, pp. 207-239.

APPENDIX

CLASSIFICATION OF IS SUCCESS MEASURES

Classification of measures by stakeholder and type of system, papers sorted alphabetically. Row and column refer to Table 2. The following abbreviations are used:

ISR *Information Systems Research*

JMIS *Journal of Management Information Systems*

MISQ *Management Information Systems Quarterly*

Paper	Stake-holder (row)	System (col)	Journal
Adams, D.A., Nelson, R.R., and Todd, P.A 1992. Perceived Usefulness, Ease of Use, and Usage of Information Technology: A Replication. Management Information Systems Quarterly, 16:2 (June): 227-247.	2	2	MISQ
Agarwal, R. and Tanniru, M.R 1990. Knowledge Acquisition Using Structured Interviewing: An Empirical Investigation. Journal of Management Information Systems, 7:1 (Summer): 123-140.	1	5	JMIS
Ahrens, J.D. and Sankar, C.S 1993. Tailoring Database Training for the End Users. Management Information Systems Quarterly, 17:4 (December): 419-440.	3	3	MISQ
Alavi, M 1994. Computer-Mediated Collaborative Learning: An Empirical Evaluation. Management Information Systems Quarterly, 18:2 (June): 159-174.	2	3	MISQ
Alavi, M., Wheeler, B.C., and Valacich, J.S 1995. Using IT to Reengineer Business Education: An Exploratory Investigation of Collaborative Telelearning. Management Information Systems Quarterly, 19:3 (September): 293-312.	2	3	MISQ
Amoroso, D.L. and Cheney, P.H 1991. Testing a Causal Model of End-User Application Effectiveness. Journal of Management Information Systems, 8:1 (Summer): 63-89.	2	5	JMIS
Ang, S., Cummings, L.L., Straub, D.W., and Earley, P.C 1993. The Effect of Information Technology and the Perceived Mood of the Feedback Giver on Feedback Seeking. Information Systems Research, 4:3 (September): 240-261.	1	1	ISR
Apte, U., Sankar, C.S., Thakur, M., and Turner, J.E 1990. Reusability-Based Strategy for Development of Information Systems: Implementation Experience of a Bank. Management Information Systems Quarterly, 14:4 (December): 421-433.	1	5	MISQ
Asahi, T., D. Turo, and B. Schneiderman 1995. Using treemaps to visualize the analytic hierarchy process. Information Systems Research, 6,4 (December): 357-375.	1	1	ISR
Banker, R.D. and Kauffman, R.F 1991. Reuse and Productivity in Integrated Computer Aided Software Engineering: An Empirical Study. Management Information Systems Quarterly, 15:3 (September): 375-401.	1	5	MISQ
Banker, R.D., Kauffman, R.J., and Morey, R.C 1990. Measuring Gains in Operational Efficiency from Information Technology: A Study of the Positran Deployment at Hardee's Inc. . Journal of Management Information Systems, 7:2 (Fall): 29-54.	4	2	JMIS
Barki, H., and Hartwick, J. 1994b. User participation, conflict, and conflict resolution: the mediating roles of influence. Information Systems Research, 5,4 (December): 422-438.	2	5	ISR
Barua, A., C.H. Kriebel, and T. Mukhopadhyay 1995. Information technologies and business value: an analytic and empirical investigation. Information Systems Research, 6,1 (March): 3-23.	4	3	ISR
Beath, C.M. 1991. Supporting the Information Technology Champion. Management Information Systems Quarterly, 15:3 (September): 355-372.	2	6	MISQ

Belcher, L.W. and Watson, H.J 1993. Assessing the Value of Conoco's Executive Information System. Management Information Systems Quarterly, 17:3 (September): 239-254.	4	2	MISQ
Bergeron, F., Buteau, C., and Raymond, L 1991. Identification of Strategic Information Systems Opportunities: Applying and Comparing Two Methodologies. Management Information Systems Quarterly, 15:1 (March): 89-103.	4	6	MISQ
Bergeron, F., Rivard, S., and De Serre, L 1990. Investigating the Support Role of the Information Center. Management Information Systems Quarterly, 14:3 (September): 247-260.	2	6	MISQ
Blanton, J.E., Watson, H.J. and Moody, J 1992. Towards a Better understanding of Information Technology Organization: A Comparative Case Study. Management Information Systems Quarterly, 16:4 (December): 531-555.	2	6	MISQ
Bostrom, R.P., Olfman, L., and Sein, M.K 1990. The Importance of Learning Style in End-User Training. Management Information Systems Quarterly, 14:1 (March): 101-119.	1	1	MISQ
Boynton, A.C., Zmud, R.W., and Jacobs, G.C 1994. The Influence of IT Management Practice on IT Use in Large Organizations. Management Information Systems Quarterly, 18:3 (September): 299-318.	4	6	MISQ
Brynjolfsson, E. (1996). The contribution of information technology to consumer welfare. Information Systems Research, 7,3 (September): 281-300.	5	4	ISR
Burton, F.G., Chen, Y., Grover, V., and Stewart, K.A 1992. An Application of Expectancy Theory for Assessing User motivation to Utilize an Expert System. Journal of Management Information Systems, 9:3 (Winter): 183-198.	2	3	JMIS
Byrd, T.A 1992. Implementation and Use of Expert Systems in Organizations: Perceptions of Knowledge Engineers. Journal of Management Information Systems, 8:4 (Spring): 97-116.	4	3	JMIS
Carlsson, S.A 1988. A Longitudinal Study of Spreadsheet Program Usage. Journal of Management Information Systems, 5:1 (Summer): 82-100.	2	2	JMIS
Caron, J.R., Jarvenpaa, S.L., and Stoddard, D.B 1994. Business Reengineering at CIGNA Corporation: Experience and Lessons From the First Five Years. Management Information Systems Quarterly, 18:3 (September): 233-250	4	5	MISQ
Cats-Baril, W.L. and Jelassi, T 1994. French Videotex System Minitel: A Successful Implementation of a National Information Technology Infrastructure. Management Information Systems Quarterly, 18:1 (March): 1-20.	5	3	MISQ
Cerveny, R.P., Garrity, E.J., and Sanders, G.L 1990. A Problem-solving Perspective on Systems Development. Journal of Information Systems Management, 6:4 (Spring): 103-122.	2	5	JMIS
Chan, H.C., Wei, K.K., and Siau, K.L 1993. User-Database Interface: The Effect of Abstraction Levels on Query Performance. Management Information Systems Quarterly, 17:4 (December): 441-464.	2	1	MISQ
Chidambaram, L 1996. Relational Development in Computer-Supported Groups. Management Information Systems Quarterly, 20:2 (June): 143-165.	3	3	MISQ

Chidambaram, L. and Jones, B 1993. Impact of Communication Medium and Computer Support on Group Perceptions and Performance: A Comparison of Face-to-Face and Dispersed Meetings. Management Information Systems Quarterly, 17:4 (December): 465-492.	3	3	MISQ
Chidambaram, L., Bostrom, R.P., and Wynne, B.E 1990. A Longitudinal Study of the Impact of group Decision Support Systems on Group Development. Journal of Management Information Systems, 7:3 (Winter) -1991: 7-25.	3	3	JMIS
Chin, W.W. and P.R. Newsted 1995. The importance of specification in causal modeling: the case of end-user computing satisfaction. Information Systems Research 6,1 (March): 73-81.	2	2	ISR
Choe, J 1995. The Relationship among Performance of Accounting Information Systems, Influence Factors, and Evolution Level of Information Systems. Journal of Management Information Systems, 11:4 (Spring): 215-239.	2	3	JMIS
Clemons, E.K. and B.W. Weber 1996. Alternative securities trading systems: tests and regulatory implications of the adoption of technology. Information Systems Research, 7,2 (June): 163-188.	1	3	ISR
Clifford, J., H.C. Lucas Jr., and R. Srikanth 1992. Integrating Mathematical and Symbolic models through AESOP: an expert for stock options pricing. Information Systems Research, 5,4 (December): 359-378.	1	2	ISR
Compeau, D.R. and C.A. Higgins 1995a. Computer self-efficacy: development of a measure and initial test. MIS Quarterly 19 (June): 189-211.	1	2	MISQ
Compeau, D.R. and C.A. Higgins 1995b. Application of social cognitive theory to training for computer skills. Information Systems Research, 6,2 (June): 118-143.	1	2	ISR
Cronan, T.P. and Douglas, D.E 1990. End-user Training and Computing Effectiveness in Public Agencies: An Empirical Study. Journal of Information Systems Management, 6:4 (Spring): 21-39.	2	2	JMIS
Davis, F.D 1989. Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. Management Information Systems Quarterly, 13:3 (September): 319-340.	2	2	MISQ
Davis, S.A. and Bostrom, R.P 1993. Training End Users: An Experimental Investigation of the Roles of the Computer Interface and training Methods. Management Information Systems Quarterly, 17:1 (March): 61-85.	2	1	MISQ
Dean, D.L., Lee, J.D., Orwig, R.E., and Vogel, D.R 1994. Technological Support for Group Process Modeling. Journal of Management Information Systems, 11:3 (Winter): 43-63.	1	3	JMIS
Deephouse, C., Mukhopadhyay, T., Goldenson, D.R., and Kellner, M.I 1995. Software Process and Project Performance. Journal of Management Information Systems, 12:3 (Winter): 187-205.	4	5	JMIS
Dekleva, S.M 1992. The Influence of the Information Systems Development Approach on Maintenance. Management Information Systems Quarterly, 16:3 (September): 355-372.	1	5	MISQ

Dennis, A.R., Daniels, Jr., R.M., Hayes, G., and Nunamaker, Jr., J.F 1993. Methodology-Driven Use of Automated Support in business Process Re-Engineering. Journal of Management Information Systems, 10:3 (Winter): 117-138.	2	5	JMIS
Dennis, A.R., J.S. Valacich, T. Connolly, and B.E. Wynne 1996. Process structuring in electronic brainstorming. Information Systems Research, 7,2 (June): 268-277.	3	3	ISR
Dennis, A.R., Nunamaker, Jr., J.F., and Paranka, D 1991. Supporting the Search for Competitive Advantage. Journal of Management Information Systems, 8:1 (Summer): 5-36.	2	3	JMIS
DeSanctis, G., Poole, M.S., Lewis, H., and Desharnais, G 1991. Using Computing in Quality Team Meetings: Initial Observations from the IRS-Minnesota Project. Journal of Management Information Systems, 8:3 (Winter): 7-26.	3	3	JMIS
Dickson, G.W., Partridge, J.L., and Robinson, L.H 1993. Exploring Modes of Facilitative Support for GDSS Technology. Management Information Systems Quarterly, 17:2 (June): 173-194.	3	3	MISQ
Doll, W.J., T.S. Raghunathan, J-S. Lim, and Y.P. Gupta 1995. A confirmatory factor analysis of the user information satisfaction instrument. Information Systems Research 6,2 (June): 177-188.	2	4	ISR
Doll, W.J., W. Xia, and G. Torkzadeh 1994. A confirmatory factor analysis of the end-user computer satisfaction instrument. Management Information Systems Quarterly 18,4 (December): 453-461.	2	2	MISQ
Dos Santos, B.L., K. Peffers, and D.C. Mauer 1993. The impact of information technology investment announcements on the market value of the firm. Information Systems Research, 4,1 (March): 1-23.	1	4	ISR
Duxbury, L.E., Higgins, C.A., and Mills, S 1992. After-Hours Telecommuting and Work-Family Conflict: A Comparative Analysis. Information Systems Research, 3:2 (June): 173-196.	2	3	ISR
Earl, M.J 1993. Experience in Strategic Information Systems Planning. Management Information Systems Quarterly, 17:1 (March): 1-24.	4	6	MISQ
Easton, G.K., George, J.F., Nunamaker, Jr., J.F., and Pendergast, M.O 1990. Using Two Different Electronic Meeting System Tools for the Same Task: An Experimental Comparison. Journal of Management Information Systems, 7:1 (Summer): 85-100.	3	3	JMIS
Edberg, D.T. and Bowman, B.J 1996. User-Developed Applications: An Empirical Study of Application Quality and Developer Productivity. Journal of Management Information Systems, 13:1 (Summer): 167-185.	1	5	JMIS
Elam, J.J. and Mead, M. 1990. Can Software Influence Creativity? Information Systems Research, 1:1 (March): 1-22.	1	2	ISR
Ewusi-Mensah, K. and Przasnyski, Z.H. 1991. On Information Systems Project Abandonment: An Exploratory Study of Organizational Practices. Management Information Systems Quarterly, 15:1 (March): 67-86.	4	5	MISQ
Finlay, P.N. and Mitchell, A.C 1994. Perceptions of the Benefits From the Introduction of CASE: An Empirical Study. Management Information Systems Quarterly, 18:4 (December): 353-370.	4	5	MISQ

Floyd, S.W. and Woolridge, B 1990. Path Analysis of the Relationship between Competitive Strategy, Information Technology, and Financial Performance. Journal of Management Information Systems, 7:1 (Summer): 47-64.	4	4	JMIS
Fuller, M.K. and Swanson, E.B 1992. Information Centers as Organizational Innovation: Exploring the Correlates of Implementation Success. Journal of Management Information Systems, 8:4 (Summer): 47-67.	4	6	JMIS
Galegher, J. and R.E. Kraut 1994. Computer-mediated communication for intellectual teamwork: an experiment in group writing. Information Systems Research, 5,2 (June): 110-138.	1	3	ISR
George, J.F., Easton, G.K., Nunamaker, J.F., Jr., and Northcraft, G.B 1990. A Study of Collaborative Group Work With and Without Computer-Based Support. Information Systems Research, 1:4 (December): 394-415.	3	3	ISR
Gill, G.T 1996. Expert Systems Usage: Task Change and Intrinsic Motivation. Management Information Systems Quarterly, 20:3 (September): 301-329.	4	3	MISQ
Gill, T.G 1995. Early Expert Systems: Where Are They Now?. Management Information Systems Quarterly, 19:1 (March): 51-82.	4	3	MISQ
Goodhue, D.L. and Thompson, R.L 1995. Task-Technology Fit and Individual Performance. Management Information Systems Quarterly, 19:2 (June): 213-236.	2	4	MISQ
Gopal, A., Bostrom, R.P., and Chin, W.W 1992. Applying Adaptive Structuration Theory to Investigate the Process of Group Support Systems. Journal of Management Information Systems, 9:3 (Winter): 45-69.	2	3	JMIS
Griffith, T.L. and Northcraft, G.B 1996. Cognitive Elements in the Implementation of New Technology: Can Less Information Provide More Benefits?. Management Information Systems Quarterly, 20:1 (March): 99-110.	2	1	MISQ
Grohowski, R., McGoff, C., Vogel, D., Martz, B., and Nunamaker, J 1990. Implementing Electronic Meeting Systems at IBM: Lessons Learned and Success Factors. Management Information Systems Quarterly, 14:4 (December): 369-383.	4	3	MISQ
Grover, V., Cheon, M.J., and Teng, J.T.C 1996. The Effect of Service Quality and Partnership on the Outsourcing of Information Systems Functions. Journal of Management Information Systems, 12:4 (Spring): 88-116.	4	6	JMIS
Grover, V., Jeong, S.R., Kettinger, W.J., and Teng, J.T.C 1995. The Implementation of Business Process Reengineering. Journal of Management Information Systems, 12:1 (Summer): 109-144.	4	5	JMIS
Harris, S.E. and Katz, J.L 1991. Firm Size and the Information Technology Investment Intensity of Life Insurers. Management Information Systems Quarterly, 15:3 (September): 333-352.	4	5	MISQ
Henderson, J.C. and Cooprider, J.G. 1990. Dimensions of IS Planning and Design Aids: A Functional Model of CASE Technology. Information Systems Research, 1:3 (September): 227-254.	4	3	ISR
Hess, C.M. and Kemerer, C.F. 1994. Computerized Loan Origination Systems: An Industry Case study of the Electronic Markets Hypothesis. Management Information Systems Quarterly.	5	3	MISQ

18,3 (September): 251-275.			
Hightower, R, and L. Sayeed 1996. Effects of communication mode and prediscussion information distribution characteristics on information exchange in groups. Information Systems Research 7,4 (December): 451-465.	3	3	ISR
Hitt, L.M. and Brynjolfsson, E 1996. Productivity, Business Profitability, and Consumer Groups: Three Different Measures of IT Value. Management Information Systems Quarterly, 20:2 (June): 121-142.	5	4	MISQ
Ho, T.H. and Raman, K.S. "The Effect of GDSS and Elected Leadership on Small Group Meetings. Journal of Management Information Systems, 8:2 (Fall): 109-133.	3	3	JMIS
Horton, M. and Biolsi, K 1993. Coordination Challenges in a Computer-Supported Meeting Environment. Journal of Management Information Systems, 10:3 (Winter): 7-24.	2	3	JMIS
Horton, M., Rogers, P., Austin, L., and McCormick, M 1991. Exploring the Impact of Face-to-Face Collaborative Technology on Group Writing. Journal of Management Information Systems, 8:3 (Winter): 27-48.	1	3	JMIS
Igbaria, M., Guimaraes, T., and Davis, G.B. 1995. Testing the determinants of microcomputer usage via a structural equation model. Journal of Managenent Information Systems, 11,4 (Spring): 87-114.	2	3	JMIS
Jarvenpaa, S.L., Rao, V.S., and Huber, G.P 1988. Computer Support for Meetings of Groups Working on Unstructured Problems: A Field Experiment. Management Information Systems Quarterly, 12:4 (December): 645-666.	3	3	MISQ
Jarvenpaa, S.L. and Ives, B 1991. Executive Involvement and Participation in the Management of Information Technology. Management Information Systems Quarterly, 15:2 (June): 205-227.	4	6	MISQ
Jelassi, T. and Figon, D 1994. Competing Through EDI at Brun Passot: Achievements in France and Ambitions for the Single European Market. Management Information Systems Quarterly, 18:4 (December): 337-352.	4	3	MISQ
Jessup, L.M., Connolly, T., and Galegher, J 1990. The Effects of Anonymity on GDSS Group Process With an Idea-Generating Task. Management Information Systems Quarterly, 14:3 (September): 313-321.	3	3	MISQ
Jobber, D., Saunders, J., Gilding, B., Hooley, G., and Hatton-Smooker, J 1989. Assessing the Value of a Quality Assurance Certificate for Software: An Exploratory Investigation. Management Information Systems Quarterly, 13:1 (March): 19-31.	2	5	MISQ
Joshi, K 1989. The Measurement of Fairness or Equity Perceptions of Management Information System Users. Management Information Systems Quarterly, 13:3 (September): 343-358.	2	6	MISQ
Kasper, G.M. and Morris, A.H 1988. The Effect of Presentation Media on Recipient Performance in Text-based Information Systems. Journal of Management Information Systems, 4:4 (Spring): 25-43.	1	1	JMIS

Kattermann, J.E. and Remus, W.E. 1989. A Study of the Relationship between Decision Model Naturalness and Performance, Management Information Systems Quarterly, 13,2 (June): 171-181.	1	3	MISQ
Katton, M.W., Adams, D.A., and Parks, M.S 1993. A Comparison of Machine Learning with Human Judgement. Journal of Management Information Systems, 9:4 (Spring): 37-57.	1	5	JMIS
Keil, M 1995. Pulling the Plug: Software Project Management and the Problem of Project Escalation. Management Information Systems Quarterly, 19:4 (December): 421-448.	4	3	MISQ
Kiang, M.Y., Chi, R.T., and Tam, K.Y 1993. DKAS: A Distributed Knowledge Acquisition System in a DSS. Journal of Management Information Systems, 9:4 (Spring): 59-82.	1	1	JMIS
Kim, K.K. and Umanath, N.S 1992. Structure and Perceived Effectiveness of Software Development Subunits: A Task Contingency Analysis. Journal of Management Information Systems, 9:3 (Winter): 157-181.	2	6	JMIS
Kottemann, J.E. and Remus, W.E 1989. A Study of the Relationship Between Decision Model Naturalness and Performance. Management Information Systems Quarterly, 13:2 (June): 171-181	1	1	MISQ
Kraemer, K.L., Danziger, J.N., Dunkle, D.E., and King, J.L 1993. The Usefulness of Computer-Based Information to Public Managers. Management Information Systems Quarterly, 17:2 (June): 129-148.	4	1	MISQ
Lamberti, D.M. and Wallace, W.A 1990. Intelligent Interface Design: An Empirical Assessment of Knowledge Presentation in Expert Systems. Management Information Systems Quarterly, 14:3 (September): 279-311.	2	1	MISQ
Lawrence, M. and Low, G 1993. Exploring Individual User Satisfaction Within User-Led Development. Management Information Systems Quarterly, 17:2 (June): 195-208.	2	5	MISQ
Le Blanc, L.A. and Kozar, K.A 1990. An Empirical Investigation of the Relationship Between DSS Usage and System Performance: A Case Study of a Navigation Support System. Management Information Systems Quarterly, 14:3 (September): 263-277.	4	2	MISQ
Lederer, A.L. and Sethi, V 1996. Key Prescriptions for Strategic Information Systems Planning. Journal of Management Information Systems, 13:1 (Summer): 35-62.	4	6	JMIS
Lee, S 1991. The Impact of Office Information Systems on Potential Power and Influence. Journal of Management Information Systems, 8:2 (Fall): 135-151.	2	3	JMIS
Leidner, D.E. and Elam, J.J 1993. Executive Information Systems: Their Impact on Executive Decision Making. Journal of Management Information Systems, 10:3 (Winter): 139-155.	2	2	JMIS
Leidner, D.E. and S.L. Jarvenpaa 1993. The information age confronts education: case studies on electronic classrooms. Information Systems Research, 4,1 (March): 24-54.	1	3	ISR
Leitheiser, R.L. and March, S.T 1996. The Influence of Database Structure Representation on Database System Learning and Use. Journal of Management Information Systems, 12:4 (Spring): 187-213.	2	5	JMIS

Li, E.Y., McLeod, Jr., R., and Rogers, J.C 1993. Marketing Information systems in the Fortune 500 Companies: Past, Present, and Future. Journal of Management Information Systems, 10:1 (Summer): 165-192.	2	3	JMIS
Liberatore, M.J., Titus, G.J., and Dixon, P.W 1988. The Effects of Display Formats on Information Systems Design. Journal of Management Information Systems, 5:3 (Winter): 85-99.	2	1	JMIS
Liou, Y.I. and Chen, M 1993. Using Group Support Systems and Joint Application Development for Requirements Specifications. Journal of Management Information Systems, 10:3 (Winter): 25-41.	3	3	JMIS
Magal, S.R 1991. A Model for Evaluating Information Center Success. Journal of Management Information Systems, 8:1 (Summer): 91-106.	2	6	JMIS
Massetti, B 1996. An Empirical Examination of the Value of Creativity Support Systems on Idea Generation. Management Information Systems Quarterly, 20:1 (March): 83-98.	2	2	MISQ
Massetti, B. and Zmud, R.W 1996. Measuring the Extent of EDI Usage in Complex Organizations: Strategies and Illustrative Examples. Management Information Systems Quarterly, 20:3 (September): 331-345.	2	2	MISQ
Massey, A.P. and Clapper, D.L 1995. Element Finding: The Impact of a Group Support System on a Crucial Phase of Sense Making. Journal of Management Information Systems, 11:4 (Spring): 149-176.	1	3	JMIS
McKeen, J.D., Guimaraes, T., and Wethebe, J.C 1994. The Relationship Between User Participation and User Satisfaction: An Investigation of Four Contingency Factors. Management Information Systems Quarterly, 18:4 (December): 427-452.	2	5	MISQ
McLean, E.R. and Kappelman, L.A 1992. The Convergence of Organizational and End-User Computing. Journal of Management Information Systems, 9:3 (Winter): 145-155.	4	3	JMIS
McLeod, P.L. and Liker, J.K 1992. Electronic Meeting Systems: Evidence from a Low Structure Environment. Information Systems Research, 3:3 (September): 195-223.	3	3	ISR
Mirani, R. and King, W.R 1994. Impact of End-User and Information Center Characteristics on End-User Computing Support. Journal of Management Information Systems, 11:1 (Summer): 141-161.	2	6	JMIS
Money, A., Tromp, D., and Wegner, T 1988. The Quantification of Decision Support Benefits Within the Context of Value Analysis. Management Information Systems Quarterly, 12:2 (June): 223-236.	2	3	MISQ
Montazemi, A.R., Cameron, D.A., and Gupta, K.M 1996. An Empirical Study of Factors Affecting Software Package Selection. Journal of Management Information Systems, 13:1 (Summer): 89-105.	2	6	JMIS
Mookerjee, V.S. and B.L. Dos Santos 1993. Inductive experts system design: maximizing system value. Information Systems Research, 4,2 (June): 111-140.	1	1	ISR

Mookerjee, V.S., Mannino, M.V., and Gilson, R 1995. Improving the Performance Stability of Inductive Expert Systems Under Input Noise. Information Systems Research, 6:4 (December): 328-356.	1	1	ISR
Morris, A.H., G.M. Kasper, and D.A. Adams 1992. The effects and limitations of automated text condensing on reading comprehension performance. Information Systems Research, 3,1 (March): 17-35.	1	3	ISR
Moynihan, T 1990. What Chief Executives and Senior Managers want From Their IT Departments. Management Information Systems Quarterly, 14:1 (March): 15-25.	4	4	MISQ
Mukhopadhyay, T., Kekre, S., and Kalathur, S 1995. Business Value of Information Technology: A Study of Electronic Data Interchange. Management Information Systems Quarterly, 19:2 (June): 137-156.	4	3	MISQ
Mukhopadhyay, T., Vicinanza, S.S., and Prietula, M.J 1992. Examining the Feasibility of a Case-Based Reasoning model for Software Effort Estimation. Management Information Systems Quarterly, 16:2 (June): 155-171.	1	5	MISQ
Nault, B.R. and Dexter, A.S 1995. Added Value and Pricing With Information Technology. Management Information Systems Quarterly, 19:4 (December): 449-464.	4	2	MISQ
Nidumolu, S 1995. The Effect of Coordination and Uncertainty on Software Project Performance: Residual Performance Risk as an Intervening Variable. Information Systems Research, 6:3 (September): 191-219.	4	4	ISR
Niederman, F., Beise, C.M., and Beranek, P.M 1996. Issues and Concerns About Computer-Supported Meetings: The Facilitator's Perspective. Management Information Systems Quarterly, 20:1 (March): 1-22.	1	1	MISQ
Ocker, R., Hiltz, S.R., Turoff, M., and Fjermestad, J 1995. The Effects of Distributed Group Support and Process Structuring on Software Requirements Development Teams: Results on Creativity and Quality. Journal of Management Information Systems, 12:3 (Winter): 127-153.	1	3	JMIS
Olfman, L. and Mandviwalla, M 1994. Conceptual Versus Procedural Software Training for Graphical User Interfaces: A Longitudinal Field Experiment. Management Information Systems Quarterly, 18:4 (December): 405-426.	1	1	MISQ
Pitt, L.F., Watson, R.T., and Kavan, C.B 1995. Service Quality: A Measure of Information Systems Effectiveness. Management Information Systems Quarterly, 19:2 (June): 173-188.	2	6	MISQ
Post, B.Q 1992. A Business Case Framework for Group Support Technology. Journal of Management Information Systems, 9:3 (Winter): 7-26.	3	3	JMIS
Premkumar, G. and W.R. King 1994. Organizational characteristics and information systems planning: an empirical study. Information Systems Research, 5,2 (June): 75-109.	4	6	JMIS
Premkunar, G. and King, W.R 1992. An Empirical Assessment of Information Systems Planning and the Role of Information Systems in Organizations. Journal of Management Information Systems, 9:2 (Fall): 99-125.	4	6	ISR

Raghunathan. B. and T.S. Raghunathan 1994. Adaptation of a planning system success model to information systems planning. Information Systems Research, 5,3 (September): 326-340.	4	6	ISR
Ramirez, R.G., Kulkarni, U.R., and Moser, K.A 1992. Performance Analysis of "What-If" Databases Using Independently Updated Views. Journal of Management Information Systems, 9:1 (Summer): 185-203.	1	1	JMIS
Rao, H.R., A. Chaudhury, and M. Chakka 1995. Modeling team processes: issues and a specific example. Information Systems Research, 6,3 (September): 255-285.	1	1	ISR
Rasch, R.H. and Toshi, H.L 1992. Factors Affecting Software Developers' Performance: An Integrated Approach. Management Information Systems Quarterly, 16:3 (September): 395-413.	2	6	MISQ
Raymond, L 1990. Organizational Context and Information Systems Success: A Contingency Approach. Journal of Management Information Systems, 6:4 (Spring): 5-20.	4	3	JMIS
Reich, B.H. and Benbasat, I 1990. An Empirical Investigation of Factors Influencing the Success of Customer-Orientated Strategic Systems. Information Systems Research, 1:3 (September): 325-347.	4	3	ISR
Ricketts, J.A 1990. Powers-of-Ten Information Biases. Management Information Systems Quarterly, 14:1 (March): 63-77.	2	1	MISQ
Robertson, D.C 1989. Social Determinants of Information Systems Use. Journal of Management Information Systems, 5:4 (Spring): 56-71.	2	4	JMIS
Robey, D., Smith, L.A., and Vijayascrathy, L.R 1993. Perceptions of Conflict and Success in Information Systems Development Projects. Journal of Management Information Systems, 10:1 (Summer): 123-139.	3	5	JMIS
Roy, M.C. and F.J. Lerch 1996. Overcoming ineffective mental representations in base-rate problems. Information Systems Research, 7,2 (June): 233-247.	1	1	ISR
Saarinen, T. and Vepsalainen, A.P.J 1994. Procurement Strategies for Information Systems. Journal of Management Information Systems, 11:2 (Fall): 187-208.	4	6	JMIS
Saharia, A.N. and G. Diehr, 1990. A refresh scheme for remote snapshots. Information Systems Research, 1,3 (September): 277-308.	1	1	ISR
Saleem, N 1996. An Empirical Test of the Contingency Approach to User Participation in Information Systems Development. Journal of Management Information Systems, 13:1 (Summer): 145-166.	2	5	JMIS
Salzinger, J.W. and Olfman, L 1995. Computer Support for Group Work: Perceptions of the Usefulness of Support Scenarios and End-User Tools. Journal of Management Information Systems, 11:4 (Spring): 115-148.	2	3	JMIS
Sambamurthy, V. and Poole, M.S 1992. The Effect of Variations in Capabilities of GDSS Designs on Management of Cognitive Conflict in Groups. Information Systems Research, 3:3 (September): 224-251.	3	1	ISR
Santhanam, R. and M.K. Sein 1994. Improving end-user proficiency: effects of conceptual training and nature of interaction. Information Systems Research, 5,4 (December): 378-399.	1	2	ISR

Schocken, S. and Y-M. Wang 1993. A comparative analysis of the empirical validity of two rule-based languages. Information Systems Research, 4,4 (December): 359-382.	2	1	ISR
Sengupta, K. and Te'eni, D 1993. Cognitive Feedback in GDSS: Improving Control and Convergence. Management Information Systems Quarterly, 17:1 (March): 87-113.	2	3	MISQ
Sheffield, J. and Gallupe, R.B 1993. Using Electronic Meeting Technology to Support Economic Policy Development in New Zealand: Short-Term Results. Journal of Management Information Systems, 10:3 (Winter): 97-116.	2	3	JMIS
Sikora, R. and M.J. Shaw 1996. A computational study of distributed rule learning. Information Systems Research, 7,2 (June): 189-197.	1	1	ISR
Simon, S.J., V. Grover, J.S. Teng, and K. Whitcomb (1996). The relationship of information system training methods and cognitive ability to end-user satisfaction, comprehension, and skill transfer: a longitudinal study. Information Systems Research 7,4 (December): 466-490.	2	2	ISR
Sinha, A.P. and J.H. May 1996. Providing design assistance: a case-based approach. Information Systems Research, 7,3 (September): 363-387.	2	1	ISR
Smith, J.Y. and Vanecek, M.T 1990. Dispersed Group Decision Making Using Nonsimultaneous Computer Conferencing: A Report of Research. Journal of Management Information Systems, 7:2 (Fall): 71-92.	1	1	JMIS
Straub, D. 1990. Effective IS security: an empirical study. Information Systems Research, 1,3 (September): 255-276.	4	4	ISR
Straub, D.W 1994. The Effect of Culture on IT Diffusion: E-Mail and FAX in Japan and the US. Information Systems Research, 5:1 (March): 23-47.	2	3	ISR
Straub, Jr., D.W. and Beauclair, R.A 1988. Current and future Uses of Group Decision Support System Technology: Report on a Recent Empirical Study. Journal of Management Information Systems, 5:1 (Summer): 101-116.	4	3	JMIS
Subramanian, G.H. and Zarnich, G.E 1996. An Examination of Some Software Development Effort and Productivity Determinants in ICASE Tool Projects. Journal of Management Information Systems, 12:4 (Spring): 143-160.	1	3	JMIS
Suh, K.S. and Jenkins, A.M 1992. A Comparison of Linear Keyword and Restricted Natural Language Data Base Interfaces for Novice Users. Information Systems Research, 3:3 (September): 252-272.	1	1	ISR
Sviokla, J.J 1990. An Examination of the Impact of Expert Systems on the Firm: The CASE of XCON. Management Information Systems Quarterly, 14:2 (June): 127-140.	2	2	MISQ
Swanson, K., McComb, D., Smith, J., and McCubbrey, D 1991. The Application Software Factory: Applying Total Quality Techniques to Systems Development. Management Information Systems Quarterly, 15:4 (December): 567-579.	1	5	MISQ
Szajna, B. and Scamell, R.W 1993. The Effects of Information System User Expectations on Their Performance and Perceptions. Management Information Systems Quarterly, 17:4 (December):	2	5	MISQ

493-516.			
Tam, K.Y. 1990. Automated construction of knowledge-bases from examples. Information Systems Research, 1,2 (June): 144-167.	1	1	ISR
Taylor, J.R. and Tucker, C.C 1989. Reducing Data Processing Costs Through Centralized Procurement. Management Information Systems Quarterly, 13:4 (December): 487-499.	4	6	MISQ
Thompson, R.L., Higgins, C.A., , and Howell, J.M 1991. Personal Computing: Toward a Conceptual Model of Utilization. Management Information Systems Quarterly, 15:1 (March): 125-143.	2	3	MISQ
Thong, J.Y.L., C-S. Yap, and K.S. Raman 1996. Top management support, external expertise, and information systems implementation in small businesses. Information Systems Research, 7,2 (June): 248-267.	4	4	ISR
Thong, J.Y.L., Yap, C., and Raman, K.S 1994. Engagement of External Expertise in Information systems Implementation. Journal of Management Information Systems, 11:2 (Fall): 209-231.	4	4	JMIS
Todd, P. and Benbasat, I 1992. The Use of Information in Decision Making: An Experimental Investigation of the Impact of Computer-Based Decision Aids. Management Information Systems Quarterly, 16:3 (September): 373-393.	2	3	MISQ
Todd, P. and I.Benbasat, 1991. An experimental investigation of the impact of computer based decision aids on decision making strategies, Information Systems Research 2,2 (June): 87-115.	1	1	ISR
Torkzadeh, G 1988. The Quality of User Documentation: An Instrument Validation. Journal of Management Information Systems, 5:2 (Fall): 99-108.	2	1	JMIS
Torkzadeh, G. and Xia, W 1992. Managing Telecommunications by Steering Committee. Management Information Systems Quarterly, 16:2 (June): 187-199.fs	4	6	MISQ
Tyran, C.K., Dennis, A.R., Vogel, D.R., and Nunamaker, J.F., Jr 1992. The Application of Electronic Meeting Technology to Support Strategic Management. Management Information Systems Quarterly, 16:3 (September): 313-334.	3	3	MISQ
Vandenbosch B. and C. Higgins 1996. Information acquisition and mental models: an investigation into the relationship between behavior and learning. Information Systems Research, 7,2 (June): 198-214.	2	3	ISR
Venkatraman, N. and Zaheer, A 1990. Electronic Integration and Strategic Advantage: A Quasi-Experimental Study in the Insurance Industry. Information Systems Research, 1:4 (December) , 377-393.	4	3	ISR
Vessey, I. and D. Galletta 1991. Cognitive fit: an empirical study of information acquisition. Information Systems Research, 2,1 (December): 63-84.	1	1	ISR
Watson, H.J. and Frolick, M.N 1993. Determining Information Requirements for an EIS. Management Information Systems Quarterly, 17:3 (September): 255-270.	2	5	MISQ
Watson, H.J., Rainer, R.K., Jr., and Koh, C.E 1991. Executive Information Systems: A Framework for Development and a Survey of Current Practices. Management Information Systems Quarterly, 15:1 (March): 13-30.	1	6	MISQ

Watson, R.T., DeSanctis, G., and Poole, M.S 1988. Using a GDSS to Facilitate Group Consensus: Some Intended and Unintended Consequences. Management Information Systems Quarterly, 12:3 (September): 463-478.	3	3	MISQ
Webster, J. and Martocchio, J.J 1992. Microcomputer Playfulness: Development of a Measure With Workplace Implications. Management Information Systems Quarterly, 16:2 (June): 201-226.	1	1	MISQ
Weill, P and Olson, M.H. 1989. Managing Investment in Information Technology: Mini Case Examples and Implications, Management Information Systems Quarterly, 13,1 (March): 3-17.	4	4	MISQ
Weill, P. 1992. The relationship between investment in information technology and firm performance: a study of the valve manufacturing sector. Information Systems Research, 3,4 (December): 307-333.	4	4	ISR
Wheeler, B.C. and J.S. Valacich 1996. Facilitation, GSS, and training as sources of process restrictiveness and guidance for structured group decision making: an empirical assessment. Information Systems Research 7,4 (December): 429-450.	3	3	ISR
Ye, L.R. and Johnson, P.E 1995. The Impact of Explanation Facilities on User Acceptance of Expert Systems Advice. Management Information Systems Quarterly, 19:2 (June): 157-172.	2	1	MISQ
Yoon, Y. and Guimaraes, T 1995. Assessing Expert Systems Impact on Users' Jobs. Journal of Management Information Systems, 12:1 (Summer): 225-249.	2	3	JMIS
Yoon, Y., Guimaraes, T., and O'Neal, Q 1995. Exploring the Factors Associated with Expert Systems Success. Management Information Systems Quarterly, 19:1 (March): 83-106.	2	3	MISQ
Zack, M.A 1993. Interactivity and Communication Mode Choice in Ongoing Management Groups. Information Systems Research, 4:3 (September): 207-239.	1	3	ISR
Zigurs, I., DeSanctis, G., and Billingsley, J 1991. Adoption Patterns and Attitudinal Development in Computer-Supported Meetings: An Exploratory Study with SAMM. Journal of Management Information Systems, 7:4 (Spring): 51-70.	3	3	JMIS
Zmud, R.W., Lind, M.R., and Young, F.W 1990. An Attribute Space for Organizational Communication Channels. Information Systems Research, 1:4 (December): 440-457.	2	3	ISR
Total Number of Papers	186		

ABOUT THE AUTHORS

Peter B. Seddon is senior lecturer in Information Systems at The University of Melbourne, Australia, where he teaches organizational processes, business process engineering, and electronic commerce. After some years studying accounting information systems, Dr. Seddon's research now focuses on understanding the impact of various applications of information technology on

individual and organizational effectiveness. He has published articles in *British Accounting Review, Accounting and Business Research, Journal of Information Systems, International Conference on Information Systems, Australian Journal of Information Systems,* and *Information Systems Research*. Web home page: < http://www.dis.unimelb.edu.au/staff/peter/>.

Sandy Staples is assistant professor of MIS in the School of Business at Queens University, Kingston, Canada. His research interests include the enabling role of IT for virtual work and knowledge management, business process reengineering, and assessing the effectiveness of information systems. Dr. Staples has published articles in the *Journal of Computer-Mediated Communications, Australian Journal of Information Systems, Business Quarterly, International Conference on Information Systems, Journal of Business and Psychology, OMEGA*, *Organization Science* and the *Journal of End User Computing* Web home page: < http://qsilver.queensu.ca/~ss32/>.

Ravi Patnayakuni, is assistant professor in the CIS Department at Temple University, Philadelphia, USA. His research interests include the systems development process, and the adoption and diffusion of technology. Dr. Patnayakuni has published articles in the *Communications of the ACM, OMEGA,* and the *Journal of Management Information Systems*. Web home page: < http://ww2.cis.temple.edu/ravi/Personal/index.htm>.

Matthew Bowtell, is a management consultant with Ernst & Young in Melbourne, Australia.

LETTERS TO THE EDITOR

THE SIAMESE TWIN PROBLEM: A CENTRAL ISSUE IGNORED BY "DIMENSIONS OF INFORMATION SYSTEM EFFECTIVENESS"

Steven Alter
School of Business Administration
University of San Francisco
San Francisco, CA 94117, USA
alter@usfca.edu

In the abstract to their paper "Dimensions of Information System Effectiveness," [Seddon *et al*, 1999] say … "A large number of IS effectiveness measures can be found in the IS literature. What is not clear in the literature is what measures are appropriate in a particular context. In this paper we propose a two-dimensional matrix for classifying IS Effectiveness measures. The first dimension is the type of system studied. The second dimension is the stakeholder in whose interests the system is being evaluated. The matrix was tested by using it to classify IS effectiveness measures from 186 empirical papers in three major IS journals for the last nine years. The results indicate that the classifications are meaningful. Hence, the IS Effectiveness Matrix provides a useful guide for conceptualizing effectiveness measurement in IS research, and for choosing appropriate measures, both for research and practice."

I believe that Seddon *et al* have made a valuable contribution by presenting the two dimensions; showing that the combinations of different levels along the dimensions generate 30 different contexts that might call for different IS effectiveness measures; and demonstrating that 24 of the 30 contexts have actually appeared in the IS literature. The dimension concerning different types of stakeholders resonates in many other areas beyond the scope of their paper,

such as understanding why "system requirements" might be quite different for different observers regardless of the formal or informal compromises incorporated into an official requirements statement.

While recognizing their contribution, I believe it is possible to provide a better guide "for conceptualizing effectiveness measurement in IS research, and for choosing appropriate measures, both for research and practice." Combining their two dimensions yields 30 different contexts, but the conceptualization of effectiveness measures should be based not on a classification of contexts, but on a model providing genuine insight about whatever reality is being measured. In particular, their two dimensions ignore a central problem in understanding information system effectiveness, namely, that information systems are increasingly becoming integral parts of other work systems. Information systems and the work systems they support are increasingly like Siamese twins that are inextricably connected:

- Remove the information system and the work system can't operate.
- Ignore the work system and the information system has no meaning.

Conceptualizing information system effectiveness without looking at the work system that is being supported is increasingly like evaluating one twin but consciously ignoring the other. Why would today's practitioners or researchers really want to do that?

A DIFFERENT WAY TO LOOK AT INFORMATION SYSTEM EFFECTIVENESS

We will use five steps to try to extend the discussion of information system effectiveness and to introduce the Siamese twins problem. The indented comments in the following list of steps explain how each step is related to ideas in [Seddon et al, 1999].

1. Propose a simplified model that separates system performance measurement from the evaluation of system effectiveness or success.

- Regardless of how past research can be categorized, the two dimensions and 30 contexts of IS effectiveness may not be necessary for conceptualizing IS effectiveness.

2. Recognize that an information system is a special type of work system and that information systems typically exist to support other work systems.

- If used for conceptualizing IS effectiveness, the “type of system” dimension should focus on the inherent nature of information systems.

3. Identify typical measures of performance for the elements of any work system, which therefore includes any information system.

- The measures of performance for elements of a work system provide a valuable starting point for selecting and tailoring measures of performance appropriate for any particular context or situation. In practice, this starting point is more useful than 30 contexts in Seddon, et. al. [1999]

4. Discuss the Siamese twin problem and how it is related to information system effectiveness.

- The concept of IS effectiveness should somehow reflect the increasing degree of overlap between information systems and the work systems they support.

5. As an afterthought, show how awareness of the distinction between information systems and work systems they support reveals shortcomings of the widely cited Information System Success Model [DeLone and McLean, 1992]

that was a starting point for [Seddon *et al*, 1999].

SEPARATING SYSTEM PERFORMANCE FROM THE EVALUATION OF SYSTEM EFFECTIVENESS

Seddon *et al* identify the type of system and type of stakeholder as two dimensions that determine the context for selecting IS effectiveness measures. The stakeholder dimension includes five viewpoints and the type of system dimension includes six components, giving 30 different possible contexts for measuring IS effectiveness. Note that specific effectiveness measures such as accuracy and productivity might be used in many different contexts.

Figure 1 collapses their two dimensions into a simple picture and does not rely on classifications that might be problematical. It shows an observer looking at a system and its performance and trying to evaluate the system's success. The system may be an information system or may be a work system that the information system supports. (More about that later). The system's performance may be measured in terms of any number of related or unrelated performance variables. The observer is cognizant of both the system and its performance as gauged using specific performance measures. The observer evaluates the system's effectiveness or success.

The picture looks trivial but it reflects a number of points that Seddon *et al* present with a more elaborate justification: First, the evaluation of system success depends on the observer. Different observers might look at different variables when evaluating system success and might have different criteria for assessing any particular variable. Personal values and expectations of some observers might be consistent or inconsistent with those of other observers.

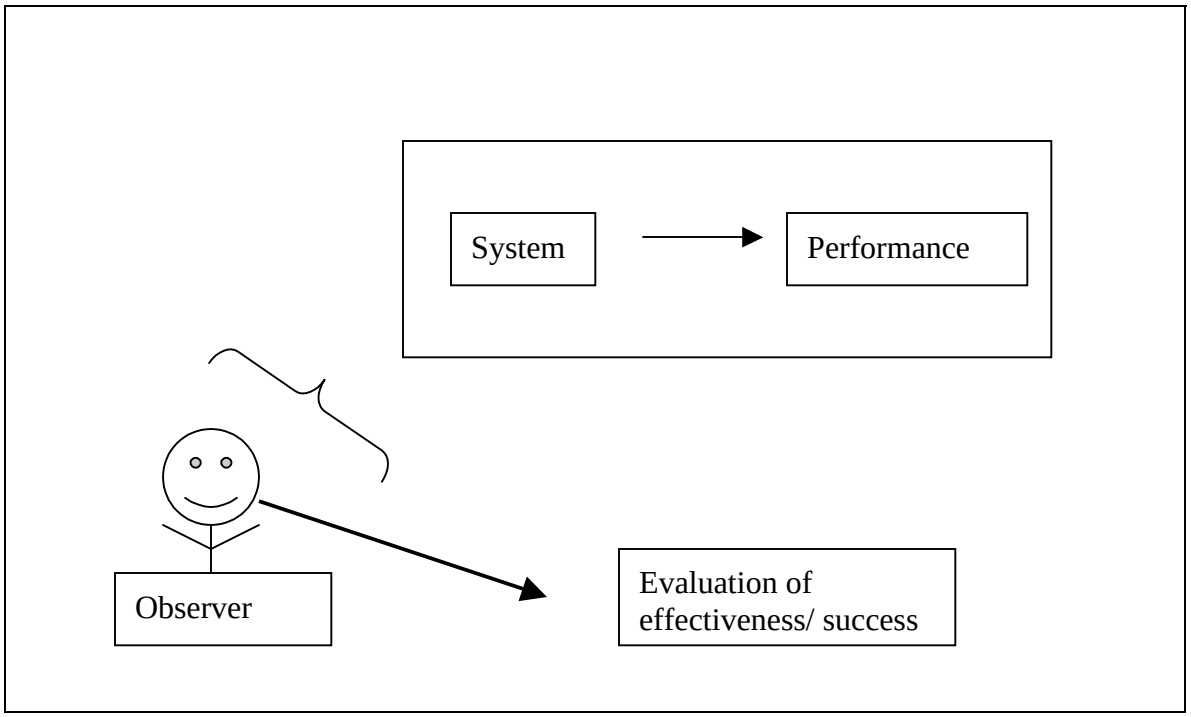


Figure 1. Role Of The Observer In Evaluating System Effectiveness Or Success

Observers with different criteria might disagree whether a particular level of system performance represents success or failure. Second, the evaluation of a system depends on the system's performance as interpreted by the observer. We are assuming that the observer is actually willing to look at measures of performance in order to evaluate success. Third, since system performance is different from the evaluation of success, the performance variables may or may not be expressed in the same terms the observer uses for defining system success.

INFORMATION SYSTEM AS A SPECIAL TYPE OF WORK SYSTEM

The system that is being observed is not just software or a computer or other technical artifact. It is not a theoretical method. Rather it is a system in operation. Using terminology from [Alter, 1999] the system is a work system. A work system is a system in which human participants and/or machines perform a business process using information, technology, and other resources to produce products and/or services for internal or external customers. By this definition,

software, computers, and other technical artifacts are the technology used by the work system, but they are NOT "the system" under consideration. Organizations typically contain multiple work systems and operate through them.

An information system is a particular type of work system whose internal functions are limited to processing information by performing six types of operations: capturing, transmitting, storing, retrieving, manipulating, and displaying information. An information system exists to produce information and/or to support or automate the work performed by other work systems. Information systems may serve other work systems through a variety of roles. (Note that the term work system applies to projects as well. A project, such as a system development project, is a time-limited work system designed to produce a particular product and then go out of existence.)

The definitions of work system and information system encompass many different types of information systems. The focus on systems in operation is different from the "type of system" dimension in Seddon *et al*. That dimension's six components include:

- an *aspect* of IT use (e.g., a single algorithm or form of user interface)
- a *single* IT application (e.g., a spreadsheet, a PC, or a library cataloging system)
- a *type* of IT or IT application (e.g., TCP/IP, a GDSS, a TPS, a data warehouse, etc.)
- *all* IT applications used by an organization or sub-organization
- an aspect of a system development *methodology*
- the *IT function* of an organization or sub-organization.

At first blush not one of the six components appears to conform to the definition of an information system as a special type of work system. The sixth is a department and the fifth is a theoretical approach that might be used in a project.

The first four "system types" initially seem be technologies rather than work systems, since a work system includes a business process, information, and human participants. If none of the six components actually describes an information system, it seems less convincing that the two dimensions should provide a powerful guide "for conceptualizing effectiveness measurement in IS research, and for choosing appropriate measures, both for research and practice."

Although not apparent from the "type of system" dimension, the terms GDSS, TPS, and data warehouse might actually denote either a technology or a work system in operation. For example, a vendor might present a data warehouse as a particular configuration of hardware and software, while a business professional might think of it as a work system in which human participants perform certain business processes using data warehouse technology in order to produce particular analytical products. The difference between these possibilities leads to research question that someone might want to investigate: Is the success rate of data warehouses (or DSS or GDSS or expert systems, etc.) higher when the organization and its management think of the data warehouse, DSS, etc. as a work system to be implemented in the organization rather than a technology to be installed as a computerized tool?

A major issue in evaluating information system effectiveness or success is the fact that information systems typically exist to support other work systems, which may be other information systems. In Figure 2 our observer is still trying to evaluate success by looking at the performance of the system, but the system includes a work system and an information system.

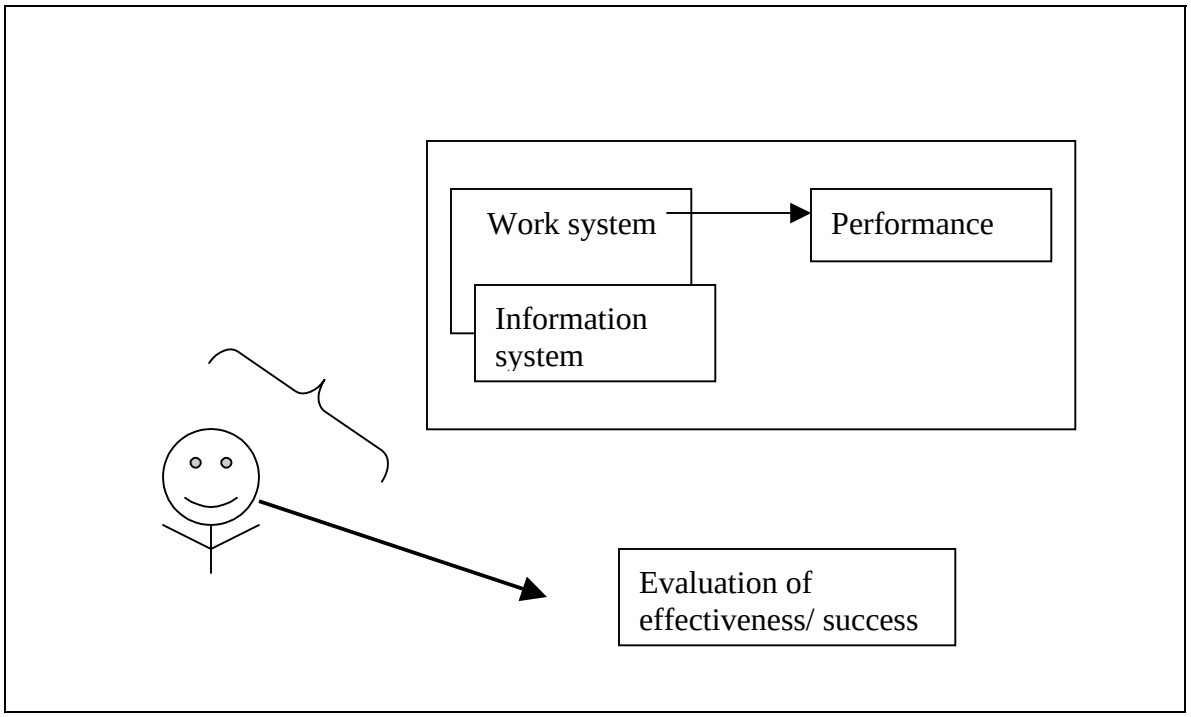


Figure 2: Evaluating an Information System that Supports a Work System

The work system and information system in Figure 2 overlap to some degree to indicate that some aspects of the work system are not included in the information system and some aspects of the information system are not included in the work system. For example, the work system may include communication, negotiations, decision making, and physical activities that are separate from the data processing activities in the information system. Similarly, the information system may contain components that are unrelated to this particular work system due to internal technical reasons or because the information system also supports other work systems that are separate from this work system.

The partial overlap between the work system and the information system causes a number of difficulties for the observer trying to assess the effectiveness of the information system. Assume that the observer is a business professional who cares more about the results of the work system than about the technical workings of the information system. The performance that is measured is the

performance of the work system since that is what really matters. The work system may perform well despite the poor design and unfriendly nature of the information system. Similarly, the work system may perform badly due to problems that have nothing to do with the information system.

TYPICAL MEASURES OF PERFORMANCE FOR WORK SYSTEMS, REGARDLESS OF WHETHER THEY ARE INFORMATION SYSTEMS

Regardless of whether a work system happens to be an information system, its performance can be divided into internal and external performance. Internal performance is how well the system operates internally whereas external performance is how well the system achieves its purpose. This distinction is sometimes summarized as the difference between efficiency and effectiveness, although discussions of IS effectiveness seem not to make this distinction. Internal performance is typically gauged in terms of business process measures such as productivity, cycle time, consistency (of the work that is done), and rate of output. External performance is measured in terms of the extent to which the system's product meets the needs and expectations of the system's customers, who should therefore evaluate external performance based on their perceptions of the system's product. Typical measures of external performance include cost, quality, reliability, responsiveness, and conformance to standards as viewed by the customer.

A variety of measures of performance apply for the other elements of the work system, namely, the technology, information, and human participants. Measures of performance for the technology are related to various aspects of its functional capabilities (capacity, speed, etc.), ease of use, compatibility, and maintainability. Measures of performance for information are related to information quality (accuracy, timeliness, etc.), accessibility, presentation, and security. Measures of performance focusing on participants include measures of the impact of the work system on them (related to stress, variety, social

connection, personal growth) and measures of their impact on the work system (related to skills, knowledge, commitment).

The two preceding paragraphs mentioned a variety of measures of performance related to the work system's product, business process, technology, information, and human participants, respectively. These measures of performance apply to information systems just as much as they apply to any work system. Many of them apply across many of the contexts identified by the Seddon *et al* dimensions of IS effectiveness.

Citing so many different measures of performance for different elements of a work system implies that the concept of "IS effectiveness" is multi-faceted. In any particular situation a variety of performance measures for each element may or may not weigh heavily on the evaluation of effectiveness from the viewpoint of any particular observer.

Overall, fundamentally different situations obviously call for different weightings of different measures of performance. It is not useful to sweep under the single heading "IS success" or "IS effectiveness" a hodge podge of fundamentally different topics that happen involve computers and *success* or one of its synonyms. In their earlier paper, DeLone and McLean [1992, p. 87] suggested that researchers should "systematically combine" measures from their six IS success categories. I disagree with them and come out closer to the conclusion by Seddon *et al* that the "diversity of IS effectiveness measures is to be encouraged, " At best, "IS effectiveness" seems to be an umbrella for a large number of measures that may or may not apply in any particular situation. A simple, singular concept of "IS effectiveness" would serve mainly to obscure information and would therefore be … ineffective.

THE SIAMESE TWIN PROBLEM: WHY EMPHASIZE THE EFFECTIVENESS OF THE LESS IMPORTANT SYSTEM?

A work system and an information system that supports it are somewhat like Siamese twins that are distinguishable but deeply connected. Even if they are inextricably attached, each has its own identity, needs, and possibilities for change. In some cases the attachment between the two systems is so complete that looking at them separately is meaningless. In others, it is possible to look at each system separately even though it is always necessary to look at both together at some points.

Unlike real Siamese twins, one of the system twins has natural precedence over the other. The work system is the more important twin and the information system exists to serve it. Also unlike real Siamese twins, the system twins often march to different drummers because someone other than the *work system*'s line manager may manage the information system.

The conceptual leap from systems to Siamese twins may seem exaggerated, but the analogy is useful for understanding a series of possible relationships between an information system and the work system(s) it supports. These are discussed in sections 6 and 7 of [Alter, 1999] and will not be repeated here. As an example of why the Siamese twins analogy is relevant, consider a meeting to improve a sales *work system* that includes generating leads, responding to contract inquiries, and closing sales contracts. Typically, the sales manager and representatives of the sales effort would focus on the *work system* while the IT manager and representatives of the IT staff would focus on the information system that stores and reports information generated by the sales *work system*. Several decades ago the two systems would have overlapped only minimally, with the information system providing or receiving information from the *work system* but not being an integral part of it. The information system and work system were like non-attached fraternal twins who needed to cooperate but

could easily stay separate.

The trend toward interactive computing over the last several decades makes the relationship more complicated because the overlap between the information system and *work system* expanded. For example, the sales people now use laptop computers to obtain information about customers, perform calculations that help in illustrating product options, and capture details about the contract. The information system is now integrated into the way they do their work. Despite this, the sales manager and others in the meeting may tend to discuss aspects of the *work system* without mentioning the information system, especially since the *work system* probably operated in some manner before the current information system existed. When they turn to the information system they may also discuss its features without mentioning the *work system* even though the *work system* gives those features their meaning. In the same meeting the IT representatives may tend to focus on the features and benefits of the information system even during the discussions of the *work system* issues that are not directly related to the information system. Throughout the meeting, some of the participants might keep one twin in the foreground while other participants are concentrating on the other twin. The total result will not make sense until each twin is considered separately and both are considered together.

Since the information system and the work system overlap to at least some extent there may be a question about which twin to emphasize. From a business viewpoint, the *work system* should be in the foreground because it is most directly linked to business results. Viewing the overlap this way recognizes that one twin is more important and asks how the other twin is helping.

In contrast, many software vendors and IT professionals understandably put the information system in the foreground and like to highlight its features and benefits. When analyzing the use of the information system they focus on business process steps that use the information in the information system. They

de-emphasize other parts of the *work system* because these seem outside the scope of the system that is being considered. Even if these parts of the *work system* are outside the scope of the information system, they are definitely pertinent, however, because the purpose of the exercise is the success of the *work system*, not the operation of the information system.

CONCLUSION

The increasing overlap between information systems and the work systems they support raises a number of difficult questions for practitioners and researchers concerned with IS effectiveness. For practitioners the question is about how to analyze systems efficiently and creatively without becoming overwhelmed in the combined details of the information system and the work system it supports.

For the researchers, the question involves the boundaries for defining and analyzing IS effectiveness. Looking at just the information system (or, worse yet, just the technology) without looking at the work system may be cleaner and may build more directly on past IS research, but it may not be the direction of maximum value. Looking at the work system without special attention to the information system might appear to be an incursion into the territory of organizational behavior or management studies. On balance, I think we should focus our efforts in the areas that have the greatest potential value. The real world we face is has fewer and fewer information systems whose effectiveness can be evaluated totally separate from the work systems they support. Research about IS effectiveness needs pay more attention to the overlaps.

AFTERTHOUGHT: LIMITATIONS OF EARLIER INFORMATION SYSTEM SUCCESS MODEL

Seddon *et al* introduce their paper by citing [DeLone and McLean, 1992], which classified IS effectiveness measures appearing in seven journals during 1981-1987. DeLone and McLean present their results in terms of an IS success

model that they summarize as follows: "SYSTEM QUALITY and INFORMATION QUALITY singularly and jointly affect both USE and USER SATISFACTION. Additionally, the amount of USE can affect the degree of USER SATISFACTION - positively or negatively - as well as the reverse being true. USE and USER SATISFACTION are direct antecedents of INDIVIDUAL IMPACT; and lastly, this IMPACT on individual performance should eventually have some ORGANIZATIONAL IMPACT." (p. 83)

This model has been used widely and is available in graphical form as the organizing principle for ISWorld's Information System Effectiveness home page (http://theweb.badm.sc.edu/grover/isworld/isoehom3.htm) (A sophisticated criticism and re-specification of that model appeared in [Seddon, 1997].)

The distinction between a work system and an information system that it supports does not appear in this widely used IS success model. This distinction provides a relatively simple way to see some of the difficulties in interpreting the meaning of the model's sequence of relationships involving system quality, information quality, information use, user satisfaction, individual impact, and organizational impact:

- *System quality*: Is this information system quality or work system quality? Is it possible to have a high quality information system and a low quality work system? Would the answer to the previous question different if the information system and work system overlap substantially, as happens in situations ranging from transaction processing through engineering design?

- *Information quality*: Is this measured in terms of the demands of the work system or in terms of the information per se regardless of whether the information is needed or used?

- *Information use*: Is this assumed to be voluntary use as part of an unstructured or semi-structured business process, or is it mandatory use as part of a highly structured business process that requires all participants to work in a similar manner? (Where usage is mandatory the tendency to use the information system or the information itself is much higher than it would be if usage were voluntary.)

- *User satisfaction*: Is this typically dominated by issues related to the information system or issues related to the work system? (Once again, is the answer different if the information system and work system overlap substantially?)

- *Individual impact*: Is this typically dominated by issues related to the information system or issues related to the work system and the surrounding context? (I would guess that the majority of the individual impact in most situations is from the work system as a whole rather than the information system. Why consciously choose to ignore the majority of the impacts?)

- *Organizational impact*: Many information systems are integral parts of work systems. Is it really meaningful to talk about the "organizational impact" of an integral part of a work system? Wouldn't this be like talking about the impact of your brain on your body? Is it more meaningful to talk about the organizational impact of the work system itself?

REFERENCES

Alter, S. (1999) "A General, yet Useful Theory of Information Systems," *Communications of AIS*, Vol. 1, Article 13, March 1999.
http://cais.isworld.org/articles/1-13/

DeLone, W.H. and E. R. McLean (1992) "Information systems success: the quest for the dependent variable", *Information Systems Research,* (3), pp. 60-95.

Seddon, P.B. (1997) "A respecification and extension of the DeLone and McLean model of IS Success", *Inforamtion Systems Research* (8)3, pp. 240-254.

Seddon, P.B., S. Staples, R. Patnayakuni, and M. Bowtell. (1999) "Dimensions of Information Systems Success", *Communications of AIS,* Vol. 2, Article 20, November 1999 http://cais.isworld.org/articles/2-20/

AUTHORS' RESPONSE TO ALTER

Peter B. Seddon
Department of Information Systems
The University of Melbourne
p.seddon@dis.unimelb.edu.au

D. Sandy Staples
Queen's School of Business
Queen's University
sstaples@business.queensu.ca

Alter's critique of our "Dimensions of IS Effectiveness" paper (henceforth the Dimensions paper, Seddon et al, 1999) advances two main propositions:

IT is so interwoven into the fabric of what organizations do that it is hard, and possibly meaningless, to try to measure the effectiveness of the IT component alone. Researchers might therefore be better advised to focus on measuring the effectiveness of what Alter calls "work systems", than just information systems.

Although Seddon et al. argue in their Dimensions paper that the 6*5=30 cell IS Effectiveness matrix is "a useful guide for conceptualizing effectiveness measurement", the model shown in Figure 1 and/or 2 of Alter's critique provides a sounder foundation for thinking about IS Effectiveness.

Alter calls Proposition One above the “Siamese twin” problem. He uses that term in the title and section 4 of the five main sections of his critique. The title of his critique says that Proposition One is a central issue ignored in our Dimensions paper.

Alter raises Proposition Two in the third paragraph of his critique: “it is possible to provide a better guide ‘for conceptualizing effectiveness measurement in IS research”. He then devotes the majority of the critique (sections 1, 2, and 3 of the five main sections) to explanation and support of Proposition Two.

We agree strongly with Alter’s philosophical position. In the two sections below we show, first, that Proposition Two is very much in accord with our own thinking, and second, that most measurement of IS effectiveness is consistent with Proposition One.

PROPOSITION ONE: THE SIAMESE TWIN PROBLEM

We agree with Alter that IT is often so inextricably associated with organizational work processes that it is hard to identify causal links between investments in IT and benefits flowing from those investments. We also agree with Alter that researchers attempting to measure IS effectiveness need to focus on improvements in work systems overall, not just IT systems. However, it is our experience that this sensible approach has been used by many researchers in the past. For example, the two example studies discussed below clearly involve IT systems deeply embedded in organizational settings. By using headings in our IS Effectiveness matrix such as “a single IT application *in an organization”* and **“**all IT applications *used by an organization or sub-organization*” (emphasis added) to describe systems, we hoped to signal to readers that our interests were in what Alter calls “work systems” and Davis et al (1992) calls information systems: “an information system is a social system that uses information technology” (p. 294). In our view, Alter's definition of an information system appears only to fit with our first column. Our next three columns represent applications of information systems in organizations (i.e., Alter's work systems). Webster's New Collegiate Dictionary defines application as "an act of putting to use" (p. 54, 1981). We meant to use the word

application in that sense (i.e., putting IT to use in an organization). Alter appears to have interpreted it a narrower sense, that of it referring to computer software.

People and organizations that invest in new technologies usually have to prepare some sort of business case where they argue that such investments will make them or their firm better off. After implementation, it is reasonable to ask if the investment (in both the technology and associated changes in work systems) was worthwhile. The following two examples from our IS Effectiveness matrix suggest that, despite the Siamese twin problem, it is feasible to identify the contribution made by IT:

1. Mukhopadhyay, Kekre and Kalathur (1995) were able to provide estimates of Reduced inventory holding costs and reduced premium freight costs at Chrysler following introduction of EDI. Clearly, all sorts of changes would have had to be made to the work systems at Chrysler to accommodate the new technology. But we believe Mukhopadhyay et al. did an excellent job in identifying the benefits attributable to introduction of EDI.
2. Weill (1992) used regression analysis based on data from 33 firms in one industry to explain variance in sales growth, ROA, and labor productivity due to different types of investment in IT. Again, he was trying to answer questions like: are firms' investments in transaction processing systems worthwhile?

Thus, while agreeing with Alter that the Siamese twin problem is real, and that researchers need to distinguish carefully between what he calls the "information system" and the "work system", we believe that researchers have done this successfully in the past, and will do so in future. As indicated by Alter's letter and our response, there is the potential for confusion when the meaning of terms can be interpreted different ways by different authors and readers. Alter (2000) effectively discusses how common this problem can be in the field of IS.

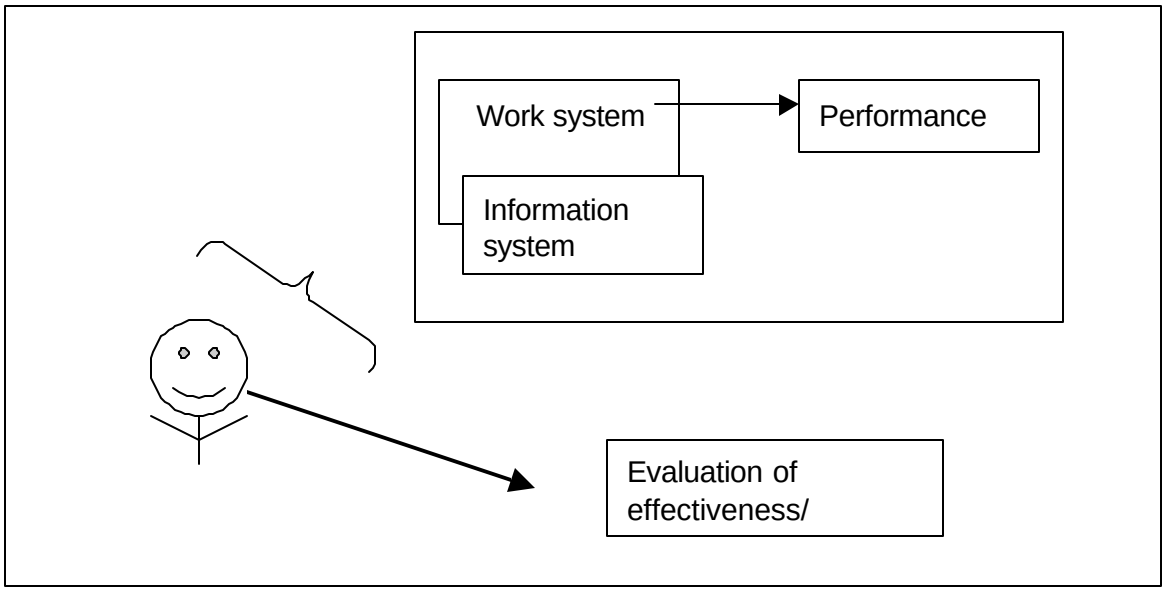
PROPOSITION TWO: A BETTER CONCEPTUAL MODEL?

Alter suggests that his Figure 2 (reproduced here as Figure 1a) is a better alternative to our IS Effectiveness matrix for guiding thinking about IS Effectiveness

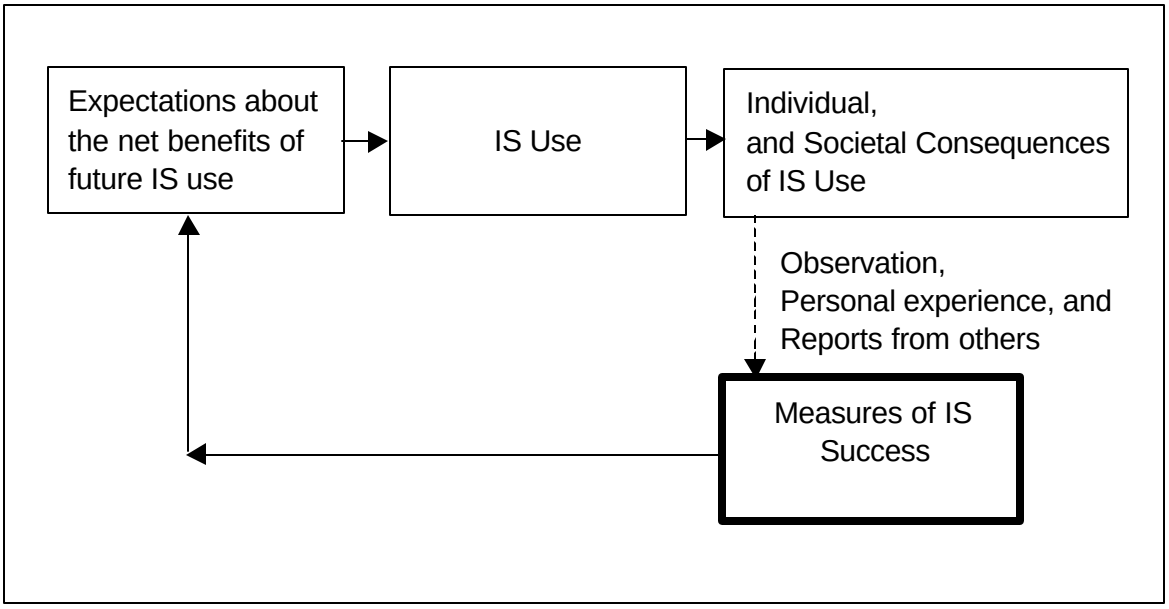
measurement. We agree that Alter's Figure 2 provides a good model for conceptualizing IS effectiveness. In fact, his model is almost identical to the conceptual model we used when preparing the Dimensions paper, i.e., Seddon's (1997) IS success model (Figure 5, p.245). The key elements of Seddon's model are shown in Figure 1b. Comparing Figures 1a and b, the combination of Alter's "Work system" and "Information system" in Figure 1a correspond to "IS Use" in Figure 1b. "Performance" in Figure 1a corresponds to "Individual, Organizational, and Societal Consequences of IS Use" in Figure 1b. And "Evaluation of effectiveness/success" in Figure 1a corresponds to "IS Success" in Figure 1b. The key point in both models is that the "Consequences of IS Use" are separated from judgments about IS Effectiveness/Success. This separation is necessary because,
as Alter and Seddon (1997, p.248) point out, such judgments are always stakeholder dependent.

Our goal in writing the Dimensions paper was to look inside the "Measures of IS Success" box shown in heavy lines in Figure 1b, and to try to make some stronger statements about the IS effectiveness measures appropriate when evaluations of IS effectiveness are made on behalf of different stakeholders. In particular, we argue that *different* IS effectiveness measures are required for different contexts. This point
is important because DeLone and McLean (1992), in their very influential paper on IS Success measurement, argue the opposite case.

We thank Alter for pointing out that the conceptual model underlying our thinking was not presented clearly in our Dimensions paper. As a further clarification, we must also point out that the definition of "Information System" in the top row of Seddon's (1997) Table 1, p.246, describes only the first four of the six columns of the IS Effectiveness matrix. The two right-hand columns, which go well beyond Seddon's definition of "information system", were added to the Effectiveness matrix because we wanted to try to be as inclusive as possible of research that could be classified under the heading IS Effectiveness. Our point in the Dimensions paper was that different measures of effectiveness should be used in different circumstances. Measures of effectiveness for IT projects (e.g.,enterprise resource planning system implementations)



(a) Alter's Figure 2: Evaluating an Information System that Supports a Work System.



(b) The Key Components Seddon's (1997, Figure 5, p.245) Respecified Model of IS Success

Figure 1: Comparison of Alter's and Seddon's Conceptualizations of IS Success

and IT departments are clearly different to those required for applications of IT, so it suited our purposes to include these two extra types of system. However, the systems

of interest in these two right-hand columns of the matrix are not what we would call information systems.

REFERENCES

Alter, S. (2000). “The Siamese twin problem: A central issue ignored by ‘Dimensions of Information System Effectiveness’”, Letter to the Editor, *Communications of the AIS* 2(20)

Alter, S. (2000). Same Words, Different Meanings: Are Basic IS/IT Concepts our Self-imposed Tower of Babel?” *Communications of the AIS,* 3(10).

Davis, G.B., A.S. Lee, K.R. Nickles, S. Chatterjee, R. Hartung, and Y. Wu (1992) "Diagnosis of an Information System Failure: A Framework and Interpretive Process." *Information and Management*, 23(5), pp. 293-318.

DeLone, W.H., and E.R. McLean (1992) "Information systems success: the quest for the dependent variable", *Information Systems Research,* (3), pp. 60-95.

Mukhopadhyay, T., S. Kekre, and S. Kalathur (1995) "Business Value of Information Technology: A Study of Electronic Data Interchange", *Management Information Systems Quarterly* (19)2, pp. 137-156.

Seddon, P.B. (1997) "A Respecification and Extension of the DeLone and McLean model of IS Success", *Information Systems Research* (8)3, pp. 240-253.

Seddon, P.B., D.S. Staples, R. Patnayakuni, R. and M.J. Bowtell (1999) "Dimensions of Information Systems Success", *Communications of the Association of Information Systems*, 2(20).

Weill, P. (1992) "The relationship between investment in information technology and firm performance: a study of the valve manufacturing sector", *Information Systems Research*, (3)4, pp. 307-333.