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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. This, in turn, means that the IS effectiveness matrix provides a useful guide for conceptualizing effectiveness measurement in IS research, and for choosing appropriate measures.

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

1. INTRODUCTION

> Researchers should systematically combine individual measures from the I/S success categories to create a comprehensive measurement instrument. [DeLone and McLean 1992, p. 87]

We have two objectives for this paper. The first is to disagree with both Keen (1980), who argued that IS researchers should try to identify "the" dependent variable for IS research, and DeLone and McLean (1992), who argued that researchers should systematically combine measures from their six IS success categories in measuring IS success. Instead, we argue that because of the range of different systems, stakeholders, and issues involved in different studies, a wide diversity of sharply-focused dependent variables is essential. The second objective is to argue that, in future research involving the measurement of IS effectiveness, researchers should always take care to identify, first, the stakeholder (in whose interest the evaluation of IS success is being performed) and, second, the specific system or class of system that is being evaluated.

To support our arguments, we draw on both the accounting and organizational effectiveness literatures to suggest that different *stakeholders* and different types of *system* require very different measures of IS effectiveness. The result of this thinking is our IS effectiveness matrix, illustrated below in Table 2. This provides a simple two-dimensional framework for conceptualizing IS effectiveness. To test the generality of the effectiveness matrix classifications, we examine and classify the measures used

in all 186 empirical studies of IS effectiveness that were published in *MIS Quarterly, Information Systems Research,* and the *Journal of MIS* during the nine years from 1988 to 1996. Assuming that the researchers who undertook these diverse studies chose their dependent variables with care, the fact that so many *different* measures were chosen is strong evidence to support our case for diversity in IS effectiveness measures. Finally, we argue that our matrix provides an excellent theoretical foundation for conceptualizing IS effectiveness and for choosing and reporting measures of IS effectiveness for future research.

2. THE IS EFFECTIVENESS MATRIX

The problems faced by IS researchers trying to measure IS effectiveness are similar to those faced by accountants in measuring income and management theorists in measuring organizational effectiveness. Accountants work with subjective estimates of value in an agency-theoretic world where self-interested human actors have been known to misrepresent their performance in order to improve their own personal self-esteem and wealth. Accountants recognize there can never be one "true" measure of wealth, so they have developed a range of different *partial* wealth measures that they use for different purposes. For example, Management Accountants use net present value for estimating the value of future investment projects when reporting to management, but Financial Accountants use "generally accepted accounting principles" (GAAP) when reporting income to the stock market. Very different measures of value are needed for different stakeholders.

In the organizational psychology literature, Cameron and Whetten (1983, pp. 270-274) argue that seven questions must be answered if a researcher is to place meaningful limits on the "construct space" of organizational effectiveness. Those seven questions, listed in the left-hand column of Table 1, seem just as relevant to IS researchers measuring IS effectiveness as they are to psychologists measuring organizational effectiveness. Building on the work of Cameron and Whetten, Grover, Jeong and Segars (1996) argue that the construct space for IS effectiveness measurement requires definition of the (1) evaluative referent, (2) unit of analysis, (3) evaluation type, (4) evaluation perspective, and (5) domain of study. The dimensions of Grover, Jeong and Segars' IS effectiveness construct space are similar to those of Cameron and Whetten; Table 1 shows mappings.

To test their classification scheme, Grover, Jeong and Segars examined papers from eight journals for 14 years and classified 107 measures used in approximately 85 studies. They conclude that their framework (a) "suggests that a clear understanding of target system(s), frame of reference, evaluation perspectives, and even the purpose of the evaluation is a prerequisite to determining the criteria" (p. 187) and (b) "provides a useful tool for IS effectiveness research because it attempts to delineate the boundaries of the construct as well as providing a common set of dimensions, albeit broad, for comparing and contrasting studies" (p. 187). We support their view.

Table 1. Defining the "Construct Space" of Organizational and IS Effectiveness

Cameron and Whetten (1983): Organizational Effectiveness		Grover, Jeong and Segars (1996): IS Effectiveness
1	From whose perspective is effectiveness being judged?	4. Evaluation perspective, e.g., users, top management, IS personnel, and external entities
2	What is the domain of activity? (depends on tasks emphasized in the organization, competencies of the organization, and demands from external forces)	5. Domain of study (data processing system [DPS], management information system [MIS], decision support system, office system, expert system, or telecommunications system).
3	What is the level of analysis? (individual, subunit, organization, population, societal)	2. Unit of analysis, individual or organizational
4	What is the purpose of evaluation?	
5	What is time frame is employed? (short, long)	
6	What type of data are to be used? (objective or perceptual)	3. Evaluation type? (the process of IS use, the user's or organization's response to IS use, and/or the impact of IS use)
7	Against which referent is effectiveness to be judged? (five alternative examples listed)	1. Evaluative referent (system A versus system B, comparison to theoretical ideal, or comparison of one system over time)

Independently of Grover, Jeong and Segars' work, we undertook a similar system/stakeholder analysis, but our approach differed from Grover, Jeong and Segars in a number of ways. First, like Grover, Jeong and Segars, we decided that most measurement of IS effectiveness involved a **system** of some kind. However, unlike Grover, Jeong and Segars, who classified their domains (systems) as DPS, MIS, etc., as shown in row 2 of Table 1, we decided to adopt a more general definition of "system." In our reading of the literature, the **system** of interest was generally one or more of the following:
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 suborganization
- an aspect of a system development **methodology**
- the **IT function** of an organization or sub-organization[1]

Second, like Cameron and Whetton (1983), Grover, Jeong and Segars (1996), Pouloudi and Whitley (1997), Seddon (1997), and others, we wanted to emphasize that, for whichever system is of interest, different **stakeholders** are likely to use different criteria for evaluating IS effectiveness. (Recall, a stakeholder is a person or group in whose interest the evaluation of IS success is being performed.) Cameron and Whetten 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, Jeong and Segars (p. 182) list four different classes of evaluation perspective: users, top management, IS personnel, and external entities. Our list of stakeholders differs slightly from both Cameron and Whetten and Grover et al.[2] According to our reading of the literature, evaluation of IS effectiveness was generally based on the points of view of one or more of the following five types of stakeholder:

- an **independent observer** (who has no personal stake in the measure)
- an **individual** user (who evaluates a system from his or her own point of view)
- a **group** of users, e.g., of a group decision support system (GDSS)
- the **management** or owners of the organization[3]
- a **country**, or mankind

Third, when the various combinations of *system* and *stakeholder* were arranged in a matrix[4] as shown in Table 2, so that the unit of analysis is "the system, evaluated from the point of view of some stakeholder," it was 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.

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

[2]We did not use Cameron and Whetten's "industry" group, nor Grover, Jeong and Segars' "IS personnel."

[3]This category may be too broad. Hirschheim and Lacity (1996) point out how the views of senior executives, business unit managers, and IT managers in a firm considering outsourcing can be very different.

[4]The categories used in defining the rows and columns of the matrix could easily be combined or split. It does not matter whether one views the matrix as 6 x 5, 12 x 10, or any other size. The key idea is that different measures are likely to be needed for different combinations of the system and the stakeholder.

Table 2. IS Effectiveness Measures used for Different Combinations of System and Stakeholder: 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) (three 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, et al. 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 Hirschheim 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

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.

As one looks at the range of measures in our Table 2, it seems obvious that very different measures of IS effectiveness are *necessary* for measuring IS effectiveness in different contexts, and that a single measure (Keen 1980), or a combination of six different types of measure (DeLone and McLean 1992, quoted earlier) is not going to work. Based on this observation, we propose that:

(a) *appropriate* diversity of IS effectiveness measures is to be encouraged, and

(b) the matrix in Table 2—which is based on a simple two-dimensional classification by system and stakeholder—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 through 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 six columns, or classes of system, in Table 2 seem to cover most of the systems discussed in the IS literature. The range of *systems* in Table 2 is broader than the *domains* in Grover, Jeong and Segars' Table 1. (Grover, Jeong and Segars' domains are all "types of system," column 3 in our matrix.) In some cases our range of systems seems to lead to more meaningful classification. For instance, Grover, Jeong and Segars (p. 186) classified the McKeen, Guimaraes and Wetherbe (1994) paper as an example of an end-user system, but the primary focus of that study was the benefits of user participation. In Table 2, the McKeen, Guimaraes and Wetherbe paper appears in column 5, where UIS has been used as an individual-stakeholder measure of the effectiveness of a development methodology. We believe that this development-methodology view provides a more meaningful classification of McKeen, Guimaraes and Wetherbe's use of this effectiveness measure.

The different rows of Table 2 describe the different stakeholders in whose interests IS effectiveness is measured. Row 1 is 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 nor Grover, Jeong and Segars 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 the individuals. Benefits individuals receive from use of information technology include such things as increased productivity, better decision-making, faster promotion (if the

[5]The one study not from the three journals is Lacity and Hirschheim's (1993) book on outsourcing. It is a useful example of a row 4, column 6 perspective on IS effectiveness.

system helps them perform more effectively than others), and possibly, political advantage (Markus 1983). In past research, individual benefits have been explored for all six types of system in Table 2, so there are no empty cells 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, percent change in labor, and market share. It is clear that Weill's measures are from 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.

Moving down again to 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, for example, 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 between the different types of stakeholder in Table 2 is because when one system is evaluated, by one person, on behalf of different stakeholders, you may get different responses. To illustrate, Table 3 shows a small sample of responses from data collected for a recent study of data warehousing success (Seddon and 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 shows that researchers must make it very clear (to the respondent, themselves, and the reader) on whose behalf the evaluation is performed.

The discussion so far has focused on measures of effectiveness of the different IT applications in columns 1 through 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, Guimaraes and Wetherbe measured satisfaction of *individual* users in their study of the effect of user participation on system effectiveness, so their effectiveness measure has been classified in row 2, column 5. By contrast, Caron, Jarvenpaa and Stoddard (1994) measured cost savings, quality improvement, and customer satisfaction in their study of reengineering at CIGNA insurance. The latter effectiveness measures reflect the (presumed) interests of *management*, not the individual employees, so their measures have been 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 IS discipline 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, Watson and Kavan'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, Watson and Kavan 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. So Lacity and Hirschheim's measures have been 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 financial-accounting profitability and return on investment.

Table 3. Transcript Responses from Interviewees about Data Warehousing Success

Respondent	"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.

3. TESTING THE IS EFFECTIVENESS MATRIX

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, Jeong and Segars (1996), and attempted to use the matrix to classify the IS effectiveness measures used in prior studies. DeLone and McLean reviewed the literature for the seven years from 1981 to 1988. We decided to review nine recent years from 1988 to 1996. The three journals we decided to review were all major U.S. journals: *MIS 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.

The first step in this review process was to identify empirical papers that used IS effectiveness measures as dependent variables (Step 1). The second was to classify the measures (Step 2). Both steps were harder than one might think. For both steps, two co-authors of this paper reviewed each article in each journal independently, then met to resolve disagreements. The following five cases illustrate some of the more difficult decisions we encountered in Step 1:

(a) Bretchneider and Wittmer (1993) use diffusion of innovation theory and data from 1,005 surveys to study organizational adoption of microcomputer technology. The dependent variable was organizational penetration of microcomputer technology, measured by *computers per employee*. One coauthor 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 we made in this case was to exclude this paper from further analysis.

(b) Compeau and Higgins (1995) use data from 1,020 mail surveys to explore determinants of self-efficacy. One classifier argued that self-efficacy is an attribute of a person, not an information system, so the paper should be excluded. The other argued that according to Compeau and Higgins (p. 191), "computer self-efficacy represents an individual's perceptions of his or her ability to use computers in the accomplishment of a task," which was surely a sign of IS effectiveness. We decided to retain this paper for further analysis.

(c) Davis (1989) develops two measures for predicting future IS use. 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.

(d) Lederer and Sethi (1996) report on the opinions of 105 senior IS managers about the factors that they believe are the keys to success in IS planning. 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, column 6.

(e) Barki and Hartwick (1994) explore the relationship between user participation, conflict, influence, and a dependent variable called *satisfactory conflict resolution*. 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.

The reason for presenting these five borderline classification examples is to give 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 these areas need effectiveness measures of some kind, and it is helpful to maintain awareness, first, that they exist, and second, that they are different from the effectiveness measures for the IT applications in columns 1 through 4.

Summarizing, not everyone will agree with our decisions about which papers contained IS effectiveness measures and which did not, but this difficulty also serves to emphasize our point. The range of topics investigated in IS research is so diverse that an equally wide range of dependent variables is required. Overall, 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*.

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 following five cases illustrate some of the more difficult decisions:

(a) Compeau and Higgins, in the study from example (b) above, measured performance expectations of individuals evaluating single packages, but no individual had any particular stake in the outcome. So we decided to classify their performance measure as stakeholder-independent (row 1) not individual effectiveness (row 2).

(b) Cronan and Douglas (1990) report on the effectiveness of end-user training on the value of systems built by end-users. 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.

(c) Alavi, Wheeler, and Valacich (1995) were 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 are clearly evaluations 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).

(d) Subramanian and Zarnich (1996) examined the effectiveness of two computer-aided software engineering tools in 40 projects. 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 the decision makers want to do with the information.

(e) Leidner and Elam (1993) looked at the impact of executive information systems (EIS) on executive decision making. 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, could these measures be classified as judgments about effectiveness from the point of view of the senior managers as individual stakeholders (row 2), or as judgements 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 above examples 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. 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. Some of these papers would have been stronger, i.e., both more precise in their measurement, and easier for the reader to understand, if they had identified the unit of analysis, i.e., the system and stakeholder, more clearly.

The result of our classification efforts is available as a 186-row table on the Web.[6] A summary of that table is presented in Table 4. Table 4 shows the frequency of occurrence of IS effectiveness measures for each different combination of system and stakeholder. The sum of entries in the cells in Table 4 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 4. Frequency of Occurrence of IS Effectiveness Measures for Each Different Combination of System and Stakeholder*

Stakeholder/ interest group	(1) An **aspect** of IT design or use	(2) a **single** IT application	(3) a **type** of IT or IT application	(4) **all** IT applications used by an organization	(5) An aspect of a system development **methodology**	(6) 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

*From our review of empirical measures in 186 studies in three journals (*MISQ*, *ISR*, and *JMIS*) for nine years: 1988-1996.

[6]http://www.dis.unimelb.edu.au/staff/peter/effetivenessmatrix.htm

4. CONCLUSIONS

DeLone and McLean (1992) analyzed 100 empirical papers containing IS effectiveness measures, from 1981 to 1988, found a multitude of different measures, and after arguing that a reduction in the number of measures was desirable, they classified those measures into six categories. In this paper, we analyzed 186 empirical papers from 1988 to 1996, and we too found a multitude of different measures. However, unlike DeLone and McLean, we do not believe that this diversity of measures is a problem. Rather, we believe that in a world of conflicting human interests and vastly different systems, *different* sharply-focused measures of IS effectiveness are needed for different purposes.

While we have 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 our 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. Table 2 may assist in identifying appropriate measures that should be combined in a study to assess effectiveness from different stakeholders' views, as well as assist in identifying units of analysis that previously have had little attention from researchers.

The first objective of this paper was to debunk the idea that there should ever be any single dependent variable (Keen 1980) or "comprehensive measurement instrument" (DeLone and McLean 1992, p. 88) that is appropriate for all IS research. IS research covers a multitude of topics, and in many, the notion of "IS effectiveness" is not an appropriate dependent variable. Even in studies where some sort of IS effectiveness measure is appropriate (30% of the papers we reviewed used empirical IS effectiveness measures), the IS effectiveness matrix demonstrates that a huge range of measures is required.

The second objective of this paper was to emphasize the importance of identifying the context in which IS effectiveness is being evaluated. Cameron and Whetten's (1983) questions in Table 1 provide a thorough definition of the construct space for IS effectiveness. The two key dimensions of this construct space, we argue, are the two dimensions of the IS effectiveness matrix: the stakeholder and the type of IT system. The example from the data warehousing study (Table 3 of this paper) shows how subtle differences in stakeholder perspective can produce significantly different evaluations of systems.

Combining the above two insights, we suggest that the two-dimensional IS effectiveness matrix presented in this paper (Tables 2 and 4) provides a useful way of framing most discussions about IS effectiveness measurement. It is simpler that the Grover, Jeong and Segars (1996) approach—simple enough to go in a textbook discussion on IS effectiveness—yet it captures the essence of IS effectiveness measurement. For the future, we recommend that researchers requiring an IS effectiveness measure should first define the unit of analysis by thinking very carefully about (a) the nature of the system(s) they wish to investigate, and (b) the stakeholder perspective(s) they wish to adopt. Measures should then be chosen accordingly. Reference to the papers in Table 2, the studies classified on our web site,[7] and to Grover, Jeong and Segars may assist with choice of measures, but researchers should not be reluctant to define their own measures. Use of standard instruments is good because it facilitates comparison between studies, but it is pointless to use a standard instrument that measures the wrong thing! Finally, we strongly recommend that when publishing results, researchers should always make clear what type of system they were studying, and on whose behalf the evaluation was conducted.

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[7]http://www.dis.unimelb.edu.au/staff/peter/effectiveness.matrix.htm

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