# Information Systems Success: The Quest for the Dependent Variable

**William H. DeLone**

*Department of Management*
*The American University*
*Washington, D.C. 20016*

**Ephraim R. McLean**

*Computer Information Systems*
*Georgia State University*
*Atlanta, Georgia 30302-4015*

A large number of studies have been conducted during the last decade and a half attempting to identify those factors that contribute to information systems success. However, the dependent variable in these studies—I/S success—has been an elusive one to define. Different researchers have addressed different aspects of success, making comparisons difficult and the prospect of building a cumulative tradition for I/S research similarly elusive. To organize this diverse research, as well as to present a more integrated view of the concept of I/S success, a comprehensive taxonomy is introduced. This taxonomy posits six major dimensions or categories of I/S success—SYSTEM QUALITY, INFORMATION QUALITY, USE, USER SATISFACTION, INDIVIDUAL IMPACT, and ORGANIZATIONAL IMPACT. Using these dimensions, both conceptual and empirical studies are then reviewed (a total of 180 articles are cited) and organized according to the dimensions of the taxonomy. Finally, the many aspects of I/S success are drawn together into a descriptive model and its implications for future I/S research are discussed.

**Information systems success—Information systems assessment—Measurement**

## Introduction

At the first meeting of the International Conference on Information System (ICIS) in 1980, Peter Keen identified five issues which he felt needed to be resolved in order for the field of management information systems to establish itself as a coherent research area. These issues were:

(1) What are the *reference disciplines* for MIS?
(2) What is the *dependent variable?*
(3) How does MIS establish a *cumulative tradition?*
(4) What is the *relationship* of MIS research to *computer technology* and to *MIS practice?*
(5) Where should MIS researchers *publish* their findings?

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Of the five, the second item, the dependent variable in MIS research, is a particularly important issue. If information systems research is to make a contribution to the world of practice, a well-defined outcome measure (or measures) is essential. It does little good to measure various independent or input variables, such as the extent of user participation or the level of I/S investment, if the dependent or output variable —I/S success or MIS effectiveness—cannot be measured with a similar degree of accuracy.

The importance of defining the I/S dependent variable cannot be overemphasized. The evaluation of I/S practice, policies, and procedures requires an I/S success measure against which various strategies can be tested. Without a well-defined dependent variable, much of I/S research is purely speculative.

In recognition of this importance, this paper explores the research that has been done involving MIS success since Keen first issued his challenge to the field and attempts to synthesize this research into a more coherent body of knowledge. It covers the formative period 1981–87 and reviews all those empirical studies that have attempted to measure some aspects of "MIS success" and which have appeared in one of the seven leading publications in the I/S field. In addition, a number of other articles are included, some dating back to 1949, that make a theoretical or conceptual contribution even though they may not contain any empirical data. Taken together, these 180 references provide a representative review of the work that has been done and provide the basis for formulating a more comprehensive model of I/S success than has been attempted in the past.

## A Taxonomy of Information Systems Success

Unfortunately, in searching for an I/S success measure, rather than finding none, there are nearly as many measures as there are studies. The reason for this is understandable when one considers that "information," as the output of an information system or the message in a communication system, can be measured at different levels, including the technical level, the semantic level, and the effectiveness level. In their pioneering work on communications, Shannon and Weaver (1949) defined the technical level as the accuracy and efficiency of the system which produces the information, the semantic level as the success of the information in conveying the intended meaning, and the effectiveness level as the effect of the information on the receiver.

Building on this, Mason (1978) relabeled "effectiveness" as "influence" and defined the influence level of information to be a "hierarchy of events which take place at the receiving end of an information system which may be used to identify the various approaches that might be used to measure output at the influence level" (Mason 1978, p. 227). This series of influence events includes the receipt of the information, an evaluation of the information, and the application of the information, leading to a change in recipient behavior and a change in system performance.

The concept of levels of output from communication theory demonstrates the serial nature of information (i.e., a form of communication). The information system creates information which is communicated to the recipient who is then influenced (or not!) by the information. In this sense, information flows through a series of stages from its production through its use or consumption to its influence on individual and/or organizational performance. Mason's adaptation of communication theory

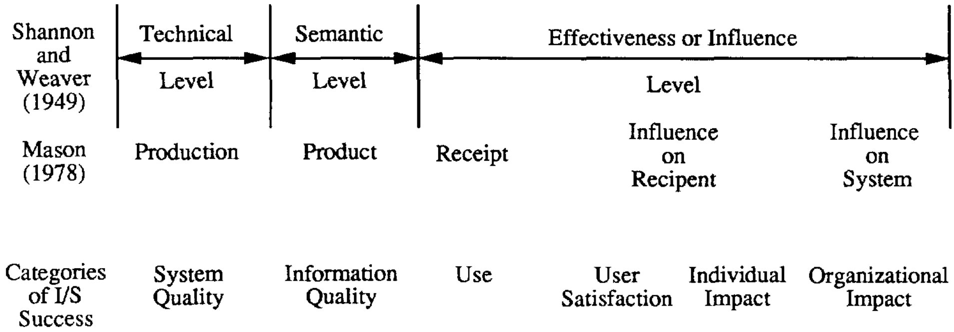


FIGURE 1. Categories of I/S Success.

to the measurement of information systems suggests therefore that there may need to be separate success measures for each of the levels of information.

In Figure 1, the three levels of information of Shannon and Weaver are shown, together with Mason's expansion of the effectiveness or influence level, to yield six distinct categories or aspects of information systems. They are SYSTEM QUALITY, INFORMATION QUALITY, USE, USER SATISFACTION, INDIVIDUAL IMPACT, and ORGANIZATIONAL IMPACT.

Looking at the first of these categories, some I/S researchers have chosen to focus on the desired characteristics of the information system itself which produces the information (SYSTEM QUALITY). Others have chosen to study the information product for desired characteristics such as accuracy, meaningfulness, and timeliness (INFORMATION QUALITY). In the influence level, some researchers have analyzed the interaction of the information product with its recipients, the users and/or decision makers, by measuring USE or USER SATISFACTION. Still other researchers have been interested in the influence which the information product has on management decisions (INDIVIDUAL IMPACT). Finally, some I/S researchers, and to a larger extent I/S practitioners, have been concerned with the effect of the information product on organizational performance (ORGANIZATIONAL IMPACT).

Once this expanded view of I/S success is recognized, it is not surprising to find that there are so many different measures of this success in the literature, depending upon which aspect of I/S the researcher has focused his or her attention. Some of these measures have been merely identified, but never used empirically. Others have been used, but have employed different measurement instruments, making comparisons among studies difficult.

Two previous articles have made extensive reviews of the research literature and have reported on the measurement of MIS success that had been used in empirical studies up until that time. In a review of studies of user involvement, Ives and Olson (1984) adopted two classes of MIS outcome variables: system quality and system acceptance. The system acceptance category was defined to include system usage, system impact on user behavior, and information satisfaction. Half a decade earlier, in a review of studies of individual differences, Zmud (1979) considered three categories of MIS success: user performance, MIS usage, and user satisfaction.

Both of these literature reviews made a valuable contribution to an understanding of MIS success, but both were more concerned with investigating independent variables (i.e., user involvement in the case of Ives and Olson and individual differences in the case of Zmud) than with the dependent variable (i.e., MIS success). In contrast, this paper has the measurement of the dependent variable as its primary focus. Also, over five years have passed since the Ives and Olson study was published and over ten years since Zmud's article appeared. Much work has been done since these two studies, justifying an update of their findings.

To review this recent work and to put the earlier research into perspective, the six categories of I/S success identified in Figure 1—SYSTEM QUALITY, INFORMATION QUALITY, INFORMATION USE, USER SATISFACTION, INDIVIDUAL IMPACT, AND ORGANIZATIONAL IMPACT—are used in the balance of this paper to organize the I/S research that has been done on I/S success.

In each of the six sections which follow, both conceptual and empirical studies are cited. While the conceptual citations are intended to be comprehensive, the empirical studies are intended to be representative, not exhaustive. Seven publications, from the period January 1981 to January 1988, were selected as reflecting the mainstream of I/S research during this formative period. Additional studies, from other publications, as well as studies from the last couple of years, could have been included; but after reviewing a number of them, it became apparent that they merely reinforced rather than modified the basic taxonomy of this paper.

In choosing the seven publications to be surveyed, five (*Management Science*, *MIS Quarterly*, *Communications of the ACM*, *Decision Sciences*, and *Information & Management*) were drawn from the top six journals cited by Hamilton and Ives (1983) in their study of the journals most respected by MIS researchers. (Their sixth journal, *Transactions on Database Systems*, was omitted from this study because of its specialized character.) To these five were added the *Journal of MIS*, a relatively new but important journal, and the *ICIS Proceedings*, which is not a journal *per se* but represents the published output of the central academic conference in the I/S field. A total of 100 empirical studies are included from these seven sources.

As with any attempt to organize past research, a certain degree of arbitrariness occurs. Some studies do not fit neatly into any one category and others fit into several. In the former case, every effort was made to make as close a match as possible in order to retain a fairly parsimonious framework. In the latter case, where several measures were used which span more than one category (e.g., measures of information quality *and* extent of use *and* user satisfaction), these studies are discussed in *each* of these categories. One consequence of this multiple listing is that there appear to be more studies involving I/S success than there actually are.

To decide which empirical studies should be included, and which measures fit in which categories, one of the authors of this paper and a doctoral student (at another university) reviewed each of the studies and made their judgments independently. The interrater agreement was over 90%. Conflicts over selection and measure assignment were resolved by the second author.

In each of the following sections, a table is included which summarizes the empirical studies which address the particular success variable in question. In reporting the success measures, the specific description or label for each dependent variable, as used by the author(s) of the study, is reported. In some cases the wording of these labels may make it appear that the study would be more appropriately listed in another table. However, as was pointed out earlier, all of these classification decisions are somewhat arbitrary, as is true of almost all attempts to organize an extensive body of research on a retrospective basis.

*System Quality: Measures of the Information Processing System Itself*

In evaluating the contribution of information systems to the organization, some I/S researchers have studied the processing system itself. Kriebel and Raviv (1980, 1982) created and tested a productivity model for computer systems, including such performance measures as resource utilization and investment utilization. Alloway (1980) developed 26 criteria for measuring the success of a data processing operation. The efficiency of hardware utilization was among Alloway's system success criteria.

Other authors have developed multiple measures of system quality. Swanson (1974) used several system quality items to measure MIS appreciation among user managers. His items included the reliability of the computer system, on-line response time, the ease of terminal use, and so forth. Emery (1971) also suggested measuring system characteristics, such as the content of the data base, aggregation of details, human factors, response time, and system accuracy. Hamilton and Chervany (1981) proposed data currency, response time, turnaround time, data accuracy, reliability, completeness, system flexibility, and ease of use among others as part of a "formative evaluation" scheme to measure system quality.

In Table 1 are shown the empirical studies which had explicit measures of system quality. Twelve studies were found within the referenced journals, with a number of distinct measures identified. Not surprisingly, most of these measures are fairly straightforward, reflecting the more engineering-oriented performance characteristics of the systems in question.

*Information Quality: Measures of Information System Output*

Rather than measure the quality of the system performance, other I/S researchers have preferred to focus on the quality of the information system output, namely, the quality of the information that the system produces, primarily in the form of reports. Larcker and Lessig (1980) developed six questionnaire items to measure the perceived importance and usableness of information presented in reports. Bailey and Pearson (1983) proposed 39 system-related items for measuring user satisfaction. Among their ten most important items, in descending order of importance, were information accuracy, output timeliness, reliability, completeness, relevance, precision, and currency.

In an early study, Ahituv (1980) incorporated five information characteristics into a multi-attribute utility measure of information value: accuracy, timeliness, relevance, aggregation, and formatting. Gallagher (1974) developed a semantic differential instrument to measure the value of a group of I/S reports. That instrument included measures of relevance, informativeness, usefulness, and importance. Munro and Davis (1977) used Gallagher's instrument to measure a decision maker's perceived value of information received from information systems which were created using different methods for determining information requirements. Additional information characteristics developed by Swanson (1974) to measure MIS appreciation among user managers included uniqueness, conciseness, clarity, and readability measures. Zmud (1978) included report format as an information quality measure in his empirical work. Olson and Lucas (1982) proposed report appearance and accuracy as measures of information quality in office automation information systems. Lastly, King and Epstein (1983) proposed multiple information attributes to yield a

TABLE 1
*Empirical Measures of System Quality*

| Authors | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Bailey and Pearson (1983) | Overall I/S, 8 organizations, 32 managers | Field | (1) Convenience of access<br>(2) Flexibility of system<br>(3) Integration of systems<br>(4) Response time |
| Barti and Huff (1985) | DSS; 9 organizations, 42 decision makers | Field | Realization of user expectations |
| Belardo, Karwan, and Wallace (1982) | Emergency management DSS, 10 emergency dispatchers | Lab | (1) Reliability<br>(2) Response time<br>(3) Ease of use<br>(4) Ease of learning |
| Conklin, Gotterer, and Rickman (1982) | Transaction processing; one organization | Lab | Response time |
| Franz and Robey (1986) | Specific I/S, 34 organizations, 118 user managers | Field | Perceived usefulness of I/S (12 items) |
| Goslar (1986) | Marketing DSS, 43 marketers | Lab | Usefulness of DSS features |
| Hiltz and Turoff (1981) | Electronic information exchange system, 102 users | Field | Usefulness of specific functions |
| Kriebel and Raviv (1982) | Academic information system; one university | Case | (1) Resource utilization<br>(2) Investment utilization |
| Lehman (1986) | Overall I/S, 200 I/S directors | Field | I/S sophistication (use of new technology) |
| Mahmood (1987) | Specific I/S, 61 I/S managers | Field | Flexibility of system |
| Morey (1982) | Manpower management system; one branch of the military | Case | Stored record error rate |
| Srinivasan (1985) | Computer-based modeling systems, 29 firms | Field | (1) Response time<br>(2) System reliability<br>(3) System accessibility |

composite measure of information value. The proposed information attributes included sufficiency, understandability, freedom from bias, reliability, decision relevance, comparability, and quantitativeness.

More recently, numerous information quality criteria have been included within the broad area of "User Information Satisfaction" (Iivari 1987; Iivari and Koskela 1987). The Iivari-Koskela satisfaction measure included three information quality constructs: "informativeness" which consists of relevance, comprehensiveness, recentness, accuracy, and credibility; "accessibility" which consists of convenience, timeliness, and interpretability; and "adaptability."

In Table 2, nine studies which included information quality measures are shown. Understandably, most measures of information quality are from the perspective of the user of this information and are thus fairly subjective in character. Also, these measures, while shown here as separate entities, are often included as part of the measurers of user satisfaction. The Bailey and Pearson (1983) study is a good example of this cross linkage.

### *Information Use: Recipient Consumption of the Output of an Information System*

The use of information system reports, or of management science/operations research models, is one of the most frequently reported measures of the success of an information system or an MS/OR model. Several researchers (Lucas 1973; Schultz and Slevin 1975; Ein-Dor and Segev 1978; Ives, Hamilton, and Davis 1980; Hamilton and Chervany 1981) have proposed I/S use as an MIS success measure in conceptual MIS articles. Ein-Dor and Segev claimed that different measures of computer success are mutually interdependent and so they chose system use as the primary criterion variable for their I/S research framework. "Use of system" was also an integral part of Lucas's descriptive model of information systems in the context of organizations. Schultz and Slevin incorporated an item on the probability of MS/OR model use into their five-item instrument for measuring model success.

In addition to these conceptual studies, the use of an information system has often been the MIS success measure of choice in MIS empirical research (Zmud 1979). The broad concept of use can be considered or measured from several perspectives. It is clear that actual use, as a measure of I/S success, only makes sense for voluntary or discretionary users as opposed to captive users (Lucas 1978; Welke and Konsynski 1980). Recognizing this, Maish (1979) chose voluntary use of computer terminals and voluntary requests for additional reports as his measures of I/S success. Similarly, Kim and Lee (1986) measured voluntariness of use as part of their measure of success.

Some studies have computed *actual* use (as opposed to reported use) by managers through hardware monitors which have recorded the number of computer inquiries (Swanson 1974; Lucas 1973, 1978; King and Rodriguez 1978, 1981), or recorded the amount of user connect time (Lucas 1978; Ginzberg 1981a). Other objective measures of use were the number of computer functions utilized (Ginzberg 1981a), the number of client records processed (Robey 1979), or the actual charges for computer use (Gremillion 1984). Still other studies adopted a subjective or *perceived* measure of use by questioning managers about their use of an information system (Lucas 1973, 1975, 1978; Maish 1979; Fuerst and Cheney 1982; Raymond 1985; DeLone 1988).

Another issue concerning use of an information system is "Use by whom?" (Huysmans 1970). In surveys of MIS success in small manufacturing firms, DeLone (1988) considered chief executive use of information systems while Raymond (1985) considered use by company controllers. In an earlier study, Culnan (1983a) considered both direct use and chauffeured use (i.e., use through others).

There are also different levels of use or adoption. Ginzberg (1978) discussed the following levels of use, based on the earlier work by Huysmans: (1) use that results in management action, (2) use that creates change, and (3) recurring use of the system. Earlier, Vanlommel and DeBrabander (1975) proposed four levels of use: use for getting instructions, use for recording data, use for control, and use for planning. Schewe (1976) introduced two forms of use: *general* use of "routinely generated computer reports" and *specific* use of "personally initiated requests for additional

TABLE 2
*Empirical Measures of Information Quality*

| Authors | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Bailey and Pearson (1983) | Overall I/S; 8 organizations, 32 managers | Field | Output<br>(1) Accuracy<br>(2) Precision<br>(3) Currency<br>(4) Timeliness<br>(5) Reliability<br>(6) Completeness<br>(7) Conciseness<br>(8) Format<br>(9) Relevance |
| Blaylock and Rees (1984) | Financial; one university, 16 MBA students | Lab | Perceived usefulness of specific report items |
| Jones and McLeod (1986) | Several information sources; 5 senior executives | Field | Perceived importance of each information item |
| King and Epstein (1983) | Overall I/S; 2 firms, 76 managers | Field | Information<br>(1) Currency<br>(2) Sufficiency<br>(3) Understandability<br>(4) Freedom from bias<br>(5) Timeliness<br>(6) Reliability<br>(7) Relevance to decisions<br>(8) Comparability<br>(9) Quantitativeness |
| Mahmood (1987) | Specific I/S; 61 I/S managers | Field | (1) Report accuracy<br>(2) Report timeliness |
| Mahmood and Medewitz (1985) | DSS, 48 graduate students | Lab | Report usefulness |
| Miller and Doyle (1987) | Overall I/S; 21 financial firms, 276 user managers | Field | (1) Completeness of information<br>(2) Accuracy of information<br>(3) Relevance of reports<br>(4) Timeliness of report |
| Rivard and Huff (1985) | User-developed I/S; 10 firms, 272 users | Field | Usefulness of information |
| Srinivasan (1985) | Computer-based modeling systems; 29 firms | Field | (1) Report accuracy<br>(2) Report relevance<br>(3) Understandability<br>(4) Report timeliness |

information not ordinarily provided in routine reports." By this definition, specific use reflects a higher level of system utilization. Fuerst and Cheney (1982) adopted Schewe's classification of general use and specific use in their study of decision support in the oil industry.

Bean et al. (1975); King and Rodriguez (1978, 1981), and DeBrabander and Thiers (1984) attempted to measure the nature of system use by comparing this use to the decision-making purpose for which the system was designed. Similarly, Iivari (1985) suggested appropriate use or acceptable use as a measure of MIS success. In a study by Robey and Zeller (1978), I/S success was equated to the adoption and extensive use of an information system.

After reviewing a number of empirical studies involving use, Trice and Treacy (1986) recommend three classes of utilization measures based on theories from reference disciplines: degree of MIS institutionalization, a binary measure of use vs. non-use, and unobtrusive utilization measures such as connect time and frequency of computer access. The degree of institutionalization is to be determined by user dependence on the MIS, user feelings of system ownership, and the degree to which MIS is routinized into standard operating procedures.

Table 3 shows the 27 empirical studies which were found to employ system use as at least one of their measures of success. Of all the measures identified, the system use variable is probably the most objective and the easiest to quantify, at least conceptually. Assuming that the organization being studied is (1) regularly monitoring such usage patterns, and (2) willing to share these data with researchers, then usage is a fairly accessible measure of I/S success. However, as pointed out earlier, usage, either actual or perceived, is only pertinent when such use is voluntary.

*User Satisfaction: Recipient Response to the Use of the Output of an Information System*

When the use of an information system is required, the preceding measures become less useful; and successful interaction by management with the information system can be measured in terms of user satisfaction. Several I/S researchers have suggested user satisfaction as a success measure for their empirical I/S research (Ein-Dor and Segev 1978; Hamilton and Chervany 1981). These researchers have found user satisfaction as especially appropriate when a *specific* information system was involved. Once again a key issue is *whose* satisfaction should be measured. In attempting to determine the success of the overall MIS effort, McKinsey & Company (1968) measured chief executives' satisfaction.

In two empirical studies on implementation success, Ginzberg (1981a, b) chose user satisfaction as his dependent variable. In one of those studies (1981a), he adopted both use and user satisfaction measures. In a study by Lucas (1978), sales representatives rated their satisfaction with a new computer system. Later, in a different study, executives were asked in a laboratory setting to rate their enjoyment and satisfaction with an information system which aided decisions relating to an inventory ordering problem (Lucas 1981).

In the Powers and Dickson study on MIS project success (1973), managers were asked how well their information needs were being satisfied. Then, in a study by King and Epstein (1983), I/S value was imputed based on managers' satisfaction ratings. User satisfaction is also recommended as an appropriate success measure in experimental I/S research (Jarvenpaa, Dickson, and DeSanctis 1985) and for researching the effectiveness of group decision support systems (DeSanctis and Gallupe 1987).

Other researchers have developed multi-attribute satisfaction measures rather than relying on a single overall satisfaction rating. Swanson (1974) used 16 items to measure I/S appreciation, items which related to the characteristics of reports and of the underlying information system itself. Pearson developed a 39-item instrument for measuring user satisfaction. The full instrument is presented in Bailey and Pearson

(1983), with an earlier version reviewed and evaluated by Kriebel (1979) and by Ives, Olson, and Baroudi (1983). Raymond (1985) used a subset of 13 items from Pearson's questionnaire to measure manager satisfaction with MIS in small manufacturing firms. More recently, Sanders (1984) developed a questionnaire and used it (Sanders and Courtney 1985) to measure decision support systems (DSS) success. Sanders' overall success measure involves a number of measures of user and decision-making satisfaction.

Finally, studies have found that user satisfaction is associated with user *attitudes* toward computer systems (Igerhseim 1976; Lucas 1978) so that user-satisfaction measures may be biased by user computer attitudes. Therefore, studies which include user satisfaction as a success measure should ideally also include measures of user attitudes so that the potentially biasing effects of those attitudes can be controlled for in the analysis. Goodhue (1986) further suggests "information satisfactoriness" as an antecedent to and surrogate for user satisfaction. Information satisfactoriness is defined as the degree of match between task characteristics and I/S functionality.

As the numerous entries in Table 4 make clear, user satisfaction or user information satisfaction is probably the most widely used single measure of I/S success. The reasons for this are at least threefold. First, "satisfaction" has a high degree of face validity. It is hard to deny the success of a system which its users say that they like. Second, the development of the Bailey and Pearson instrument and its derivatives has provided a reliable tool for measuring satisfaction and for making comparisons among studies. The third reason for the appeal of satisfaction as a success measure is that most of the other measures are so poor; they are either conceptually weak or empirically difficult to obtain.

*Individual Impact: The Effect of Information on the Behavior of the Recipient*

Of all the measures of I/S success, "impact" is probably the most difficult to define in a nonambiguous fashion. It is closely related to performance, and so "improving my—or my department's—performance" is certainly evidence that the information system has had a positive impact. However, "impact" could also be an indication that an information system has given the user a better understanding of the decision context, has improved his or her decision-making productivity, has produced a change in user activity, or has changed the decision maker's perception of the importance or usefulness of the information system. As discussed earlier, Mason (1978) proposed a hierarchy of impact (influence) levels from the receipt of the information, through the understanding of the information, the application of the information to a specific problem, and the change in decision behavior, to a resultant change in organizational performance. As Emery (1971, p. 1) states: "Information has no intrinsic value; any value comes only through the influence it may have on physical events. Such influence is typically exerted through human decision makers."

In an extension of the traditional statistical theory of information value, Mock (1971) argued for the importance of the "learning value of information." In a laboratory study of the impact of the mode of information presentation, Lucas and Nielsen (1980) used learning, or rate of performance improvement, as a dependent variable. In another laboratory setting, Lucas (1981) tested participant understanding of the inventory problem and used the test scores as a measure of I/S success. Watson and Driver (1983) studied the impact of graphical presentation on information recall. Meador, Guyote, and Keen (1984) measured the impact of a DSS design

TABLE 3
*Empirical Measures of Information System Use*

| Authors | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Alavi and Henderson (1981) | Work force and production scheduling DSS; one university, 45 graduates | Lab | Use or nonuse of computer-based decision aids |
| Baroudi, Olson, and Ives (1986) | Overall I/S, 200 firms, 200 production managers | Field | Use of I/S to support production |
| Barti and Huff (1985) | DSS; 9 organizations, 42 decision makers | Field | Percentage of time DSS is used in decision making situations |
| Bell (1984) | Financial; 30 financial | Lab | Use of numerical vs. nonnumerical information |
| Benbasat, Dexter, and Masulis (1981) | Pricing; one university, 50 students and faculty | Lab | Frequency of requests for specific reports |
| Bergeron (1986b) | Overall I/S; 54 organizations, 471 user managers | Field | Use of chargeback information |
| Chandrasekaran and Kirs (1986) | Reporting systems; MBA students | Field | Acceptance of report |
| Culnan (1983a) | Overall I/S: one organization, 184 professionals | Field | (1) Direct use of I/S vs. chauffeured use<br>(2) Number of requests for information |
| Culnan (1983b) | Overall I/S, 2 organizations, 362 professionals | Field | Frequency of use |
| DeBrabander and Thiers (1984) | Specialized DSS; one university, 91 two-person teams | Lab | Use vs. nonuse of data sets |
| DeSanctis (1982) | DSS; 88 senior level students | Lab | Motivation to use |
| Ein-Dor, Segev, and Steinfeld (1981) | PERT; one R & D organization, 24 managers | Field | (1) Frequency of past use<br>(2) Frequency of intended use |
| Green and Hughes (1986) | DSS; 63 city managers | Lab | Number of DSS features used |
| Fuerst and Cheney (1982) | DSS; 8 oil companies, 64 users | Field | (1) Frequency of general use<br>(2) Frequency of specific use |
| Ginzberg (1981a) | On-line portfolio management system, U.S. bank, 29 portfolio managers | Field | (1) Number of minutes<br>(2) Number of sessions<br>(3) Number of functions used |
| Hogue (1987) | DSS; 18 organizations | Field | Frequency of voluntary use |
| Gremillion (1984) | Overall I/S; 66 units of the National Forest system | Field | Expenditures/charges for computing use |

TABLE 3 (*cont'd*)

| Authors | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Kim and Lee (1986) | Overall I/S; 32 organizations, 132 users | Field | (1) Frequency of use<br>(2) Voluntariness of use |
| King and Rodriguez (1981) | Strategic system; one university, 45 managers | Lab | (1) Number of queries<br>(2) Nature of queries |
| Mahmood and Medewitz (1985) | DSS; 48 graduate students | Lab | Extent of use |
| Nelson and Cheney (1987) | Overall I/S; 100 top/middle managers | Field | Extent of use |
| Perry (1983) | Office I/S; 53 firms | Field | Use at anticipated level |
| Raymond (1985) | Overall I/S; 464 small manufacturing firms | Field | (1) Frequency of use<br>(2) Regularity of use |
| Snitkin and King (1986) | Personal DSS; 31 users | Field | Hours per week |
| Srinivasan (1985) | Computer-based modeling systems; 29 firms | Field | (1) Frequency of use<br>(2) Time per computer session<br>(3) Number of reports generated |
| Swanson (1987) | Overall I/S; 4 organizations, 182 users | Field | Average frequency with which user discussed report information |
| Zmud, Boynton, and Jacobs (1987) | Overall I/S; Sample A: 132 firms<br>Sample B: one firm | Field | Use in support of<br>(a) Cost reduction<br>(b) Management<br>(c) Strategy planning<br>(d) Competitive thrust |

methodology using questionnaire items relating to resulting decision effectiveness. For example, one questionnaire item referred specifically to the subject's perception of the improvement in his or her decisions.

In the information system framework proposed by Chervany, Dickson, and Kozar (1972), which served as the model for the Minnesota Experiments (Dickson, Chervany, and Senn 1977), the dependent success variable was generally defined to be decision effectiveness. Within the context of laboratory experiments, decision effectiveness can take on numerous dimensions. Some of these dimensions which have been reported in laboratory studies include the average time to make a decision (Benbasat and Dexter 1979, 1985; Benbasat and Schroeder 1977; Chervany and Dickson 1974; Taylor 1975), the confidence in the decision made (Chervany and Dickson 1974; Taylor 1975), and the number of reports requested (Benbasat and Dexter 1979; Benbasat and Schroeder 1977). DeSanctis and Gallupe (1987) suggested member participation in decision making as a measure of decision effectiveness in group decision making.

In a study which sought to measure the success of user-developed applications, Rivard and Huff (1984) included increased user productivity in their measure of success. DeBrabander and Thiers (1984) used efficiency of task accomplishment (time required to find a correct answer) as the dependent variable in their laboratory

TABLE 4
*Empirical Measures of User Satisfaction*

| Author(s) | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Alavi and Henderson (1981) | Work force and production scheduling DSS; one university; 45 graduate students | Lab | Overall satisfaction with DSS |
| Bailey and Pearson (1983) | Overall I/S, 8 organizations, 32 managers | Field | User satisfaction (39-item instrument) |
| Baroudi, Olson, and Ives (1986) | Overall I/S; 200 firms, 200 production managers | Field | User information satisfaction |
| Barti and Huff (1985) | DSS; 9 organizations, 42 decision makers | Field | User information satisfaction (modified Bailey & Pearson instrument) |
| Bruwer (1984) | Overall I/S; one organization, 114 managers | Field | User satisfaction |
| Cats-Baril and Huber (1987) | DSS; one university, 101 students | Lab | Satisfaction with a DSS (multi-item scale) |
| DeSanctis (1986) | Human resources I/S; 171 human resource system professionals | Field | (1) Top management satisfaction<br>(2) Personal management satisfaction |
| Doll and Ahmed (1985) | Specific I/S; 55 firms, 154 managers | Field | User satisfaction (11-item scale) |
| Edmundson and Jeffery (1984) | Accounting software package; 12 organizations | Field | User satisfaction (1 question) |
| Ginzberg (1981a) | On-line portfolio management system; U.S. bank, 29 portfolio managers | Field | Overall satisfaction |
| Ginzberg (1981b) | Overall I/S; 35 I/S users | Field | Overall satisfaction |
| Hogue (1987) | DSS; 18 organizations | Field | User satisfaction (1 question) |
| Ives, Olson, and Baroudi (1983) | Overall I/S; 200 firms, 200 production managers | Field | User satisfaction (Bailey & Pearson instrument) |
| Jenkins, Naumann, and Wetherbe (1984) | A specific I/S; 23 corporations, 72 systems development managers | Field | User satisfaction (25-item instrument) |
| King and Epstein (1983) | Overall I/S; 2 firms, 76 managers | Field | User satisfaction (1 item: scale 0 to 100) |
| Langle, Leitheiser, and Naumann (1984) | Overall I/S; 78 organizations, I/S development managers | Field | User satisfaction (1 question) |
| Lehman, Van Wetering, and Vogel (1986) | Business graphics; 200 organizations, DP managers | Field | (1) Software satisfaction<br>(2) Hardware satisfaction |
| Lucas (1981) | Inventory ordering system; one university, 100 executives | Lab | (1) Enjoyment<br>(2) Satisfaction |

TABLE 4 (*cont'd*)

| Author(s) | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Mahmood (1987) | Specific I/S; 61 I/S managers | Field | Overall satisfaction |
| Mahmood and Becker (1985–1986) | Overall I/S, 59 firms, 118 managers | Field | User satisfaction |
| Mahmood and Medewitz (1985) | DSS; 48 graduate students | Lab | User satisfaction (multi-item scale) |
| McKeen (1983) | Application systems; 5 organizations | Field | Satisfaction with the development project (Powers and Dickson instrument) |
| Nelson and Cheney (1987) | Overall I/S: 100 top/middle managers | Field | User satisfaction (Bailey & Pearson instrument) |
| Olson and Ives (1981) | Overall I/S; 23 manufacturing firms, 83 users | Field | Information dissatisfaction difference between information needed and amount of information received |
| Olson and Ives (1982) | Overall I/S: 23 manufacturing firms, 83 users | Field | Information satisfaction, difference between information needed and information received |
| Raymond (1985) | Overall I/S: 464 small manufacturing firms | Field | Controller satisfaction (modified Bailey & Pearson instrument) |
| Raymond (1987) | Overall I/S: 464 small-firm finance managers | Field | User satisfaction (modified Bailey & Pearson instrument) |
| Rivard and Huff (1984) | User-developed applications; 10 large companies | Field | User complaints regarding Information Center services |
| Rushinek and Rushinek (1985) | Accounting and billing system: 4448 users | Field | Overall user satisfaction |
| Rushinek and Rushinek (1986) | Overall I/S: 4448 users | Field | Overall user satisfaction |
| Sanders and Courtney (1985) | Financial DSS; 124 organizations | Field | (1) Overall satisfaction<br>(2) Decision-making satisfaction |
| Sanders, Courtney, and Loy (1984) | Interactive Financial Planning System (IFPS): 124 organizations, 373 users | Field | (1) Decision-making satisfaction<br>(2) Overall satisfaction |
| Taylor and Wang (1987) | DBMS with multiple dialogue modes; one university, 93 students | Lab | User satisfaction with interface |

experiment. Finally, Sanders and Courtney (1985) adopted the speed of decision analysis resulting from DSS as one item in their DSS success measurement instrument.

Mason (1978) has suggested that one method of measuring I/S impact is to determine whether the output of the system causes the receiver (i.e., the decision maker) to change his or her behavior. Ein-Dor, Segev, and Steinfeld (1981) asked decision makers: "Did use of PERT [a specific information system] ever lead to a change in a decision or to a new decision?" Judd, Paddock, and Wetherbe (1981) measured whether a budget exception reporting system resulted in managers' taking investigative action.

Another approach to the measurement of the impact of an information system is to ask user managers to estimate the value of the information system. Cerullo (1980) asked managers to rank the value of their computer-based MIS on a scale of one to ten. Ronen and Falk (1973) asked participants to rank the value of information received in an experimental decision context. Using success items developed by Schultz and Slevin (1975), King and Rodriguez (1978, 1981) asked users of their "Strategic Issue Competitive Information System" to rate the worth of that I/S.

Other researchers have gone a step further by asking respondents to place a dollar value on the information received. Gallagher (1974) asked managers about the maximum amount they would be willing to pay for a particular report. Lucas (1978) reported using willingness to pay for an information system as one of his success measures. Keen (1981) incorporated willingness to pay development costs for improved DSS capability in his proposed "Value Analysis" for justification of a DSS. In an experiment involving MBA students, Hilton and Swieringa (1982) measured what participants were willing to pay for specific information which they felt would lead to higher decision payoffs. Earlier, Garrity (1963) used MIS expenditures as a percentage of annual capital expenditures to estimate the value of the MIS effort.

Table 5, with 39 entries, contains the largest number of empirical studies. This in itself is a healthy sign, for it represents an attempt to move beyond the earlier inward-looking measures to those which offer the potential to gauge the contribution of information systems to the success of the enterprise. Also worth noting is the predominance of laboratory studies. Whereas most of the entries in the preceding tables have been field experiments, 24 of the 39 studies reported here have used controlled laboratory experiments as a setting for measuring the impact of information on individuals. The increased experimental rigor which laboratory studies offer, and the extent to which they have been utilized at least in this success category, is an encouraging sign for the maturing of the field.

### *Organizational Impact: The Effect of Information on Organizational Performance*

In a survey by Dickson, Leitheiser, Wetherbe, and Nechis (1984), 54 information systems professionals ranked the measurement of information system effectiveness as the fifth most important I/S issue for the 1980s. In a recent update of that study by Brancheau and Wetherbe (1987), I/S professionals ranked measurement of information system effectiveness as the ninth most important I/S issue. Measures of individual performance and, to a greater extent, organization performance are of considerable importance to I/S practitioners. On the other hand, MIS academic researchers have tended to avoid performance measures (except in laboratory studies) because of the difficulty of isolating the effect of the I/S effort from other effects which influence organizational performance.

As discussed in the previous section, the effect of an information system on individual decision performance has been studied primarily in laboratory experiments using students and computer simulations. Many of these experiments were conducted at the University of Minnesota (Dickson, Chervany, and Senn 1977). Among these "Minnesota Experiments" were some that studied the effects of different information formats and presentation modes on decision performance as measured in terms of lower production, inventory, or purchasing costs. King and Rodriguez (1978, 1981) measured decision performance by evaluating participant tests responses to various hypothesized strategic problems.

In another laboratory study, Lucas and Nielsen (1980) measured participant performance (and thus, indirectly, organizational performance) in terms of profits in a logistics management game. In a later experiment, Lucas (1981) investigated the effect of computer graphics on decisions involving inventory ordering. Finally, Remus (1984) used the costs of various scheduling decisions to evaluate the effects of graphical versus tabular displays.

Field studies and case studies which have dealt with the influence of information systems have chosen various organizational performance measures for their dependent variable. In their study, Chervany, Dickson, and Kozar (1972) chose cost reductions as their dependent variable. Emery (1971, p. 6) has observed that: "Benefits from an information system can come from a variety of sources. An important one is the reduction in operating costs of activities external to the information processing system."

Several researchers have suggested that the success of the MIS department is reflected in the extent to which the computer is applied to critical or major problem areas of the firm (Garrity 1963; Couger and Wergin 1974; Ein-Dor and Segev 1978; Rockart 1979; Senn and Gibson 1981). In Garrity's early article (1963), company I/S operations were ranked partly on the basis of the range and scope of its computer applications. In a later McKinsey study (1968), the authors used the range of "meaningful, functional computer applications" to distinguish between more or less successful MIS departments. In a similar vein, Vanlommel and DeBrabander (1975) used a weighted summation of the number of computer applications as a measure of MIS success in small firms. Finally, Cerullo (1980) ranked MIS success on the basis of a firms's ability to computerize high complexity applications.

In a survey of several large companies, Rivard and Huff (1984) interviewed data processing executives and asked them to assess the cost reductions and company profits realized from specific user-developed application programs. Lucas (1973) and Hamilton and Chervany (1981) suggested that company revenues can also be improved by computer-based information systems. In a study of a clothing manufacturer, Lucas (1975) used total dollar bookings as his measure of organizational performance. Chismar and Kriebel (1985) proposed measuring the relative efficiency of the information systems effort by applying Data Envelopment Analysis to measure the relationship of corporate outcomes such as total sales and return on investment to I/S inputs.

More comprehensive studies of the effect of computers on an organization include both revenue and cost issues, within a cost/benefit analysis (Emery 1971). McFadden (1977) developed and demonstrated a detailed computer cost/benefit analysis using a mail order business as an example. In a paper entitled "What is the Value of Investment in Information Systems?," Matlin (1979) presented a detailed reporting system for the measurement of the value and costs associated with an information system. Cost/benefit analyses are often found lacking due to the difficulty of quantifying "intangible benefits." Building on Keen's Value Analysis approach (1981), Money, Tromp, and Wegner (1988) proposed a methodology for identifying and quantifying

TABLE 5
*Empirical Measures of Individual Impact*

| Author(s) | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Aldag and Power (1986) | DSS; 88 business students | Lab | (1) User confidence (2) Quality of decision analysis |
| Belardo, Karwan, and Wallace (1982) | Emergency management DSS, 10 emergency dispatchers | Lab | (1) Efficient decisions (2) Time to arrive at a decision |
| Benbasat and Dexter (1985) | Financial; 65 business students | Lab | Time taken to complete a task |
| Benbasat and Dexter (1986) | Financial; 65 business students | Lab | Time taken to complete a task |
| Benbasat, Dexter, and Masulis (1981) | Pricing; one university, 50 students and factuly | Lab | Time to make pricing decisions |
| Bergeron (1986a) | DP chargeback system; 54 organizations, 263 user managers | Field | Extent to which users analyze charges and investigate budget variances |
| Cats-Baril and Huber (1987) | DSS; one university, 101 students | Lab | (1) Quality of career plans (2) Number of objectives and alternatives generated |
| Crawford (1982) | Electronic mail; computer vendor organization | Case | Improved personal productivity, hrs/wk/manager |
| DeBrabander and Thiers (1984) | Specialized DSS; one university, 91 two-person teams | Lab | (1) Time efficiency of task accomplishment (2) User adherence to plan |
| DeSanctis and Jarvenpaa (1985) | Tables vs. graphs; 75 MBA students | Lab | Decision quality, forecast accuracy |
| Dickson, DeSanctis, and McBride (1986) | Graphics system; 840 undergraduate students | Lab | (1) Interpretation accuracy (2) Decision quality |
| Drury (1982) | Chargeback system; 173 organizations, senior DP managers | Field | (1) Computer awareness (2) Cost awareness |
| Ein-Dor, Segev, and Steinfeld (1981) | PERT; one R & D organization, 24 managers | Field | Change in decision behavior |

TABLE 5 (*cont'd*)

| Author(s) | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Fuerst and Cheney (1982) | DSS; 8 oil companies, 64 users | Field | Value in assisting decision making |
| Goslar, Green and Hughes (1986) | DSS; 19 organizations, 43 sales and marketing personnel | Lab | (1) Number of alternatives considered<br>(2) Time to decision<br>(3) Confidence in decision<br>(4) Ability to identify solutions |
| Goul, Shane, and Tonge (1986) | Knowledge-based DSS; one university, 52 students | Lab | Ability to identify strategic opoortunities or problems |
| Green and Hughes (1986) | DSS; 63 city managers | Lab | (1) Time to decision<br>(2) Number of alternatives considered<br>(3) Amount of data considered |
| Grudnitski (1981) | Planning and control system; 65 business students | Lab | Precision of decision maker's forecast |
| Gueutal, Surprenant, and Bubeck (1984) | Computer-aided design system; 69 students | Lab | (1) Task performance<br>(2) Confidence in performance |
| Hilton and Swieringa (1982) | General I/S; one university, 56 MBA students | Lab | Dollar value of information |
| Hughes (1987) | DSS generator; 63 managers | Field | (1) Time to reach decision<br>(2) Number of alternatives considered |
| Judd, Paddock, and Wetherbe (1981) | Budget exception reporting system, 116 MBA students | Lab | Management takes investigative action |
| Kaspar (1985) | DSS; 40 graduate students | Lab | Ability to forecast firm performance |
| King and Rodriguez (1981) | Strategic system; one university, 45 managers | Lab | (1) Worth of information system<br>(2) Quality of policy decisions |
| Lee, MacLachlan, and Wallace (1986) | Performance I/S; 45 marketing students | Lab | (1) Accuracy of information interpretation<br>(2) Time to solve problem |
| Lucas (1981) | Inventory ordering system; one university, 100 executives | Lab | User understanding of inventory problem |

TABLE 5 (*cont'd*)

| Author(s) | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Lucas and Palley (1987) | Overall I/S; 3 manufacturing firms, 87 plant managers | Field | (1) Power of I/S department<br>(2) Influence of I/S department |
| Luzi and Mackenzie (1982) | Performance information system; one university, 200 business students | Lab | (1) Time to solve problem<br>(2) Accuracy of problem solution<br>(3) Efficiency of effort |
| Meador, Guyote, and Keen (1984) | DSS; 18 firms, 73 users | Field | (1) Effectiveness in supporting decisions<br>(2) Time savings |
| Millman and Hartwick (1987) | Office I/S; 75 middle managers | Field | Personal effectiveness |
| Rivard and Huff (1984) | User-developed applications; 10 large companies | Field | User productivity |
| Rivard and Huff (1985) | User-developed I/S; 10 firms 272 users | Field | Productivity improvement |
| Sanders and Courtney (1985) | Financial DSS; 124 organizations | Field | Decision-making efficiency and effectiveness |
| Snitkin and King (1986) | Personal DSS; 31 users | Field | Effectiveness of personal DSS |
| Srinivasan (1985) | Computer-based modeling systems, 29 firms | Field | (1) Problem identification<br>(2) Generation of alternatives |
| Vogel, Lehman, and Dickson (1986) | Graphical Presentation System; 174 undergraduate students | Lab | Change in commitment of time and money |
| Watson and Driver (1983) | Graphical presentation of information; 29 undergraduate business students | Lab | (1) Immediate recall of information<br>(2) Delayed recall of information |
| Zmud (1983) | External information channels: 49 software development managers | Field | Recognition and use of modern software practices |
| Zmud, Blocher, and Moffie (1983) | Invoicing system; 51 internal auditors | Lab | (1) Decision accuracy<br>(2) Decision confidence |

intangible benefits. The proposed methodology then applied a statistical test to determine whether "significant" value can be attached to a decision support system.

With the corporate "bottom line" in mind, several MIS frameworks have proposed that MIS effectiveness be determined by its contribution to company profits (Chervany, Dickson, and Kozar 1972; Lucas 1973; Hamilton and Chervany 1981), but few empirical studies have attempted to measure actual profit contribution. Ferguson and Jones (1969) based their evaluation of success on more profitable job schedules which resulted from decision-maker use of the information system. Ein-Dor, Segev, and Steinfeld (1981) attempted to measure contribution to profit by asking users of a PERT system what savings were realized from use of PERT and what costs were incurred by using PERT.

Another measure of organizational performance which might be appropriate for measuring the contribution of MIS is return on investment. Both Garrity (1963) and the McKinsey study (1968) reported using return on investment calculations to assess the success of corporate MIS efforts. Jenster (1987) included nonfinancial measures of organizational impact in a field study of 124 organizations. He included productivity, innovations, and product quality among his measures of I/S success. In a study of 53 firms, Perry (1983) measured the extent to which an office information system contributed to meeting organizational goals.

Strassmann, in his book *Information Payoff* (1985), presented a particularly comprehensive view of the role of information systems with regards to performance, looking at it from the perspective of the individual, the organization, the top executive, and society. His measure of performance was a specially constructed "Return on Management" (ROM) metric.

In nonprofit organizations, specifically government agencies, Danziger (1977) proposed using productivity gains as the measure of information systems impact on the organization. He explained that productivity gains occur when the "functional output of the government is increased at the same or increased quality with the same or reduced resources inputs" (p. 213). In a presentation of several empirical studies conducted by the University of California, Irvine, Danziger included five productivity measures: staff reduction, cost reduction, increased work volume, new information, and increased effectiveness in serving the public.

The success of information systems in creating competitive advantage has prompted researchers to study I/S impacts not only on firm performance but also on industry structure (Clemons and Kimbrough 1986). Bakos (1987) reviewed the literature on the impacts of information technology on firm and industry-level performance from the perspective of organization theory and industrial economics. At the firm level, he suggested measures of changes in organizational structure and of improvements in process efficiency using Data Envelopment Analysis (Chismar and Kriebel 1985) as well as other financial measures. At the industry level, he found impact measures (e.g., economies of scale, scope, and market concentration) harder to identify in any readily quantifiable fashion and suggested that further work is needed.

Johnston and Vitale (1988) have proposed a modified cost/benefit analysis approach to measure the effects of interorganizational systems. Traditional cost/benefit analysis is applied to identify quantifiable benefits such as cost reductions, fee revenues, and increased product sales. Once the quantifiable costs and benefits have been identified and compared, Johnston and Vitale suggest that top management use judgment to assess the value of the benefits which are more difficult to quantify such as reduction of overhead, increases in customer switching costs, barriers to new firm entry, and product differentiation.

Table 6 is the last of the six tables summarizing the I/S success measures identified in this paper. Somewhat surprisingly, 20 empirical studies were found, with 13 using field-based measures (as opposed to the laboratory experiments characterizing the individual impacts) to get at the real-world effects of the impact of information systems on organizational performance. However, this is only a beginning; and it is in this area, "assessing the business value of information systems," where much work needs to be done.

## Discussion

In reviewing the various approaches that I/S researchers have taken in measuring MIS success, the following observations emerge.

1. *As these research studies show, the I/S researcher has a broad list of individual dependent variables from which to choose.*

It is apparent that there is no consensus on *the* measure of information systems success. Just as there are many steps in the production and dissemination of information, so too are there many variables which can be used as measures of "I/S success." In Table 7, all of the variables identified in each of the six success categories discussed in the preceding sections are listed. These include success variables which have been suggested but never used empirically as well as those that have actually been used in experiments.

In reviewing these variables, no single measure is intrinsically better than another; so the choice of a success variable is often a function of the objective of the study, the organizational context, the aspect of the information system which is addressed by the study, the independent variables under investigation, the research method, and the level of analysis, i.e., individual, organization, or society (Markus and Robey 1988). However, this proliferation of measures has been overdone. Some consolidation is needed.

2. *Progress toward an MIS cumulative tradition dictates a significant reduction in the number of different dependent variable measures so that research results can be compared.*

One of the major purposes of this paper is the attempt to reduce the myriad of variables shown in Table 7 to a more manageable taxomony. However, within each of these major success categories, a number of variables still exist. The existence of so many different success measures makes it difficult to compare the results of similar studies and to build a cumulative body of empirical knowledge. There are, however, examples of researchers who have adopted measurement instruments developed in earlier studies.

Ives, Olson, and Baroudi (1983) have tested the validity and reliability of the user-satisfaction questionnaire developed by Bailey and Pearson (1983) and used that instrument in an empirical study of user involvement (Baroudi, Olson and Ives 1986). Raymond (1985, 1987) used a subset of the Bailey and Pearson user-satisfaction instrument to study MIS success in small manufacturing firms. Similarly, Mahmood and Becker (1986) and Nelson and Cheney (1987) have used the Bailey and Pearson instrument in empirical studies. In another vein, McKeen (1983) adopted the Powers and Dickson (1973) satisfaction scale to measure the success of I/S development strategies.

King and Rodriguez (1978, 1981), Robey (1979), Sanders (1984), and Sanders and Courtney (1985) have adopted parts of a measurement instrument which Schultz and Slevin (1975) developed to measure user attitudes and perceptions about the value of operations research models. Munro and Davis (1977) and Zmud (1978) utilized Gallagher's questionnaire items (1974) to measure the perceived value of an information system. Finally, Blaylock and Rees (1984) used Larcker and Lessig's 40 information items (1980) to measure perceived information usefulness.

These are encouraging trends. More MIS researchers should seek out success measures that have been developed, validated, and applied in previous empirical research.

3. *Not enough MIS field study research attempts to measure the influence of the MIS effort on organizational performance.*

Attempts to measure MIS impact on overall organizational performance are not often undertaken because of the difficulty of isolating the contribution of the information systems function from other contributors to organizational performance. Nevertheless, this connection is of great interest to information system practitioners and to top corporate management. MIS organizational performance measurement deserves further development and testing.

Cost/benefit schemes such as those presented by Emery (1971), McFadden (1977), and Matlin (1979) offer promising avenues for further study. The University of California, Irvine, research on the impact of information systems on government activity (Danziger 1987) suggests useful impact measures for public as well as private organizations. Lucas (1975) included organizational performance in his descriptive model and then operationalized this variable by including changes in sale revenues as an explicit variable in his field study of a clothing manufacturer. Garrity (1963) and the McKinsey & Company study (1968) reported on early attempts to identify MIS returns on investment. McLean (1989), however, pointed out the difficulties with these approaches, while at the same time attempting to define a framework for such analyses. Strassmann (1985) has developed his "Return on Management" metric as a way to assess the overall impact of information systems on companies.

These research efforts represent promising beginnings in measuring MIS impact on performance.

4. *The six success categories and the many specific I/S measures within each of these categories clearly indicate that MIS success is a multidimensional construct and that it should be measured as such.*

Vanlommel and DeBrabander (1975) early pointed out that the success of a computer-based information system is not a homogeneous concept and therefore the attempt should not be made to capture it by a simple measure. Ein-Dor and Segev (1978) admitted that their selection of MIS use as their dependent variable may not be ideal. They stated that "A better measure of MIS success would probably be some weighted average for the criteria mentioned above" (i.e., use, profitability, application to major problems, performance, resulting quality decision, and user satisfaction).

In reviewing the empirical studies cited in Tables 1 through 6, it is clear that most of them have attempted to measure I/S success in only one or possibly two success

TABLE 6
*Measures of Organizational Impact*

| Author(s) | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Benbasat and Dexter (1985) | Financial; 65 business students | Lab | Profit performance |
| Benbasat and Dexter (1986) | Financial; 65 business students | Lab | Profit performance |
| Benbasat, Dexter, and Masulis (1981) | Pricing; one university, 50 students and faculty | Lab | Profit |
| Bender (1986) | Overall I/S; 132 life insurance companies | Field | Ratio of total general expense to total premium income |
| Cron and Sobol (1983) | Overall I/S; 138 small to medium-sized wholesalers | Field | (1) Pretax return on assets<br>(2) Return on net worth<br>(3) Pretax profits (% of sales)<br>(4) Average 5-year sales growth |
| Edelman (1981) | Industrial relations; one firm, 14 operating units | Field | Overall manager productivity (cost of information per employee) |
| Ein-Dor, Segev, and Steinfeld (1981) | PERT, one R & D organization 24 managers | Field | Profitability |
| Griese and Kurpicz (1985) | Overall I/S; 69 firms | Field | Number of computer applications |
| Jenster (1987) | I/S which monitors critical success factors; 124 organizations | Field | (1) Economic performance<br>(2) Marketing achievements<br>(3) Productivity in production<br>(4) Innovations<br>(5) Product and management quality |
| Kaspar and Cerveny (1985) | End user systems; 96 MBA students | Lab | (1) Return on assets<br>(2) Market share<br>(3) Stock price |
| Lincoln (1986) | Specific I/S applications; 20 organizations, 167 applications | Field | (1) Internal rate of return<br>(2) Cost-benefit ratio |
| Lucas (1981) | Inventory ordering system; one university, 100 executives | Lab | Inventory ordering costs |
| Miller and Doyle (1987) | Overall I/S; 21 financial firms, 276 user managers | Field | Overall cost-effectiveness of I/S |
| Millman and Hartwick (1987) | Office I/S; 75 middle managers | Field | Organizational effectiveness |
| Perry (1983) | Office I/S; 53 firms | Field | I/S contribution to meeting goals |
| Remus (1984) | Production scheduling system; one university, 53 junior business students | Lab | Production scheduling costs |

TABLE 6 (*cont'd*)

| Author(s) | Description of Study | Type | Description of Measure(s) |
|---|---|---|---|
| Rivard and Huff (1984) | User developed applications; 10 large companies | Field | (1) Cost reductions (2) Profit contribution |
| Turner (1982) | Overall I/S, 38 mutual savings banks | Field | Net income relative to total operating expenses |
| Vasarhelyi (1981) | Personal information system on stock market, 204 MBA students | Lab | Return on investment of stock portfolio |
| Yap and Walsham (1986) | Overall I/S; Managing directors, 695 organizations | Field | Profits per net assets |

categories. Of the 100 studies identified, only 28 attempted measures in multiple categories. These are shown in Table 8. Nineteen used measures in two categories, eight used three, and only one attempted to measure success variables in four of the six categories. These attempts to combine measures, or at least to use multiple measures, are a promising beginning. It is unlikely that any single, overarching measure of I/S success will emerge; and so multiple measures will be necessary, at least in the foreseeable future.

However, shopping lists of desirable features or outcomes do not constitute a coherent basis for success measurement. The next step must be to incorporate these several individual dimensions of success into an overall model of I/S success.

Some of the researchers studying organizational effectiveness measures offer some insights which might enrich our understanding of I/S success (Lewin and Minton 1986). Steers (1976) describes organizational effectiveness as a contingent, continuous *process* rather than an end-state or static outcome. Miles (1980) describes an "ecology model" of organizational effectiveness which integrates the goals-attainment perspective and the systems perspective of effectiveness. Miles's ecology model recognizes the pattern of "dependency relationships" among elements of the organizational effectiveness process. In the I/S effectiveness process, the dependency of user satisfaction on the use of the product is an example of such a dependency relationship. So while there is a temporal dimension to I/S success measurement, so too is there an interdependency dimension.

The process and ecology concepts from the organizational effectiveness literature provide a theoretical base for developing a richer model of I/S success measurement. Figure 2 presents an I/S success model which recognizes success as a *process* construct which must include both temporal and causal influences in determining I/S success. In Figure 2, the six I/S success categories first presented in Figure 1 are rearranged to suggest an *inter*dependent success construct while maintaining the serial, temporal dimension of information flow and impact.

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

TABLE 7

*Summary of MIS Success Measures by Category*

| System Quality | Information Quality | Information Use | User Satisfaction | Individual Impact | Organization Impact |
|---|---|---|---|---|---|
| Data accuracy | Importance | Amount of use/duration of use: | Satisfaction with specifics | Information understanding | Application portfolio: |
| Data currency | Relevance | Number of inquiries | Overall satisfaction | Learning | Range and scope of application |
| Database contents | Usefulness | Amount of connect time | Single-item measure | Accurate interpretation | Number of critical applications |
| Ease of use | Informativeness | Number of functions used | Multi-item measure | Information awareness | Operating cost reductions |
| Ease of learning | Usableness | Number of records accessed | Information satisfaction: | Information recall | Staff reduction |
| Convenience of access | Understandability | Frequency of access | Difference between information needed and received | Problem identification | Overall productivity gains |
| Human factors | Readability | Frequency of report requests | Enjoyment | Decision effectiveness: | Increased revenues |
| Realization of user requirements | Clarity | Number of reports generated | Software satisfaction | Decision quality | Increased sales |
| Usefulness of system features and functions | Format | Charges for system use | Decision-making satisfaction | Improved decision analysis | Increased market share |
| System accuracy | Appearance | Regularity of use | | Correctness of decision | Increased profits |
| System flexibility | Content | Use by whom? | | Time to make decision | Return on investment |
| System reliability | Accuracy | Direct vs. chauffeured use | | Confidence in decision | Return on assets |
| System sophistication | Precision | | | Decision-making participation | Ratio of net income to operating expenses |
| Integration of | Conciseness | | | | |
| | Sufficiency | | | | |
| | Completeness | | | | |
| | Reliability | | | | |
| | Currency | | | | |
| | Timeliness | | | | |
| | Uniqueness | | | | |
| | Comparability | | | | |
| | Quantitativeness | | | | |
| | Freedom from bias | | | | |

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|---|---|---|---|---|---|
| systems<br>System efficiency<br>Resource utilization<br>Response time<br>Turnaround time | | | Binary use:<br>Use vs. nonuse<br>Actual vs. reported use<br>Nature of use:<br>Use for intended purpose<br>Appropriate use<br>Type of information used<br>Purpose of use<br>Levels of use:<br>General vs. specific<br>Recurring use<br>*Institutionalization/ routinization of use*<br>Report acceptance<br>Percentage used vs. opportunity for use<br>Voluntariness of use<br>Motivation to use | Improved individual productivity<br>Change in decision<br>Causes management action<br>Task performance<br>Quality of plans<br>Individual power or influence<br>Personal valuation of I/S<br>Willingness to pay for information | Cost/benefit ratio<br>Stock price<br>Increased work volume<br>*Product quality*<br>Contribution to achieving goals<br>Increased work volume<br>Service effectiveness |

TABLE 8
*Empirical Studies with Multiple Success Categories (1981–1987)*

| Study | System Quality | Information Quality | Use | User Satisfaction | Individual Impact | Organizational Impact |
|---|---|---|---|---|---|---|
| Srinivasan (1985) | X | X | X | | X | |
| Bailey and Pearson (1983) | X | X | | X | | |
| Barti and Huff (1985) | X | | X | X | | |
| Benbasat, Dexter, and Masulis (1981) | | | X | | X | X |
| Ein-Dor, Segev, and Steinfeld (1981) | | | X | | X | X |
| Lucas (1981) | | | | X | X | X |
| Mahmood (1987) | X | X | | X | | |
| Mahmood and Medewitz (1985) | | X | X | X | | |
| Rivard and Huff (1984) | | | | X | X | X |
| Alavi and Henderson (1981) | | | X | X | | |
| Baroudi, Olson, and Ives (1986) | | | X | X | | |
| Belardo, Karwan, and Wallace (1982) | X | | | | X | |
| Benbasat and Dexter (1986) | | | | | X | X |
| Cats-Baril and Huber (1987) | | | | X | X | |
| DeBrabander and Thiers (1984) | | | X | | X | |
| Fuerst and Cheney (1982) | | | X | | X | |
| Ginzberg (1981a) | | | X | X | | |
| Hogue (1987) | | | X | X | | |
| King and Epstein (1983) | X | X | | | | |
| King and Rodriguez (1981) | | | X | | X | |
| Miller and Doyle (1987) | X | | | | | X |
| Millman and Hartwick (1987) | | | | | X | X |
| Nelson and Cheney (1987) | | | X | X | | |
| Perry (1983) | | | X | | | X |
| Raymond (1985) | | | X | X | | |
| Rivard and Huff (1985) | | X | | | X | |
| Sanders and Courtney (1985) | | | | X | X | |
| Snitkin and King (1986) | | | X | | X | |

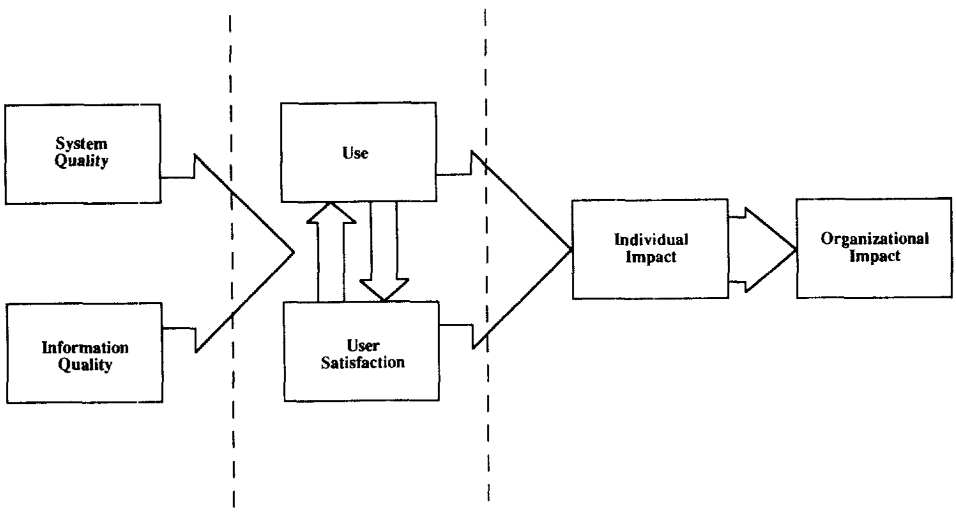


FIGURE 2. I/S Success Model.

INDIVIDUAL IMPACT; and, lastly, this IMPACT on individual performance should eventually have some ORGANIZATIONAL IMPACT.

To be useful, a model must be both complete and parsimonious. It must incorporate and organize all of the previous research in the field, while, at the same time be sufficiently simple so that it does not get caught up in the complexity of the real-world situation and thus lose its explanatory value. As Tables 1 through 8 show, the six categories of the taxonomy and the structure of the model allow a reasonably coherent organization of at least a large sample of the previous literature, while, at the same time, providing a logic as to how these categories interact. In addition to its explanatory value, a model should also have some predictive value. In fact, the whole reason for attempting to define the dependent variable in MIS success studies is so that the operative independent variables can be identified and thus used to predict future MIS success.

At present, the results of the attempts to answer the question "What causes MIS success?" have been decidedly mixed. Researchers attempting to measure, say, the effects of user participation on the subsequent success of different information systems may use user satisfaction as their primary measure, without recognizing that system and information quality may be highly variable among the systems being studied. In other words, the variability of the satisfaction measures may be caused, not by the variability of the extent or quality of participation, but by the differing quality of the systems themselves, i.e., users are unhappy with "bad" systems even when they have played a role in their creation. These confounding results are likely to occur unless all the components identified in the I/S success model are measured or at least controlled. Researchers who neglect to take these factors into account do so at their peril.

An I/S success model, consisting of six interdependent constructs, implies that a measurement instrument of "overall success," based on items arbitrarily selected from the six I/S success categories, is likely to be problematic. Researchers should systematically combine individual measures from the I/S success categories to create a comprehensive measurement instrument. The selection of success measures should also consider the contingency variables, such as the independent variables being researched; the organizational strategy, structure, size, and environment of the organization being studied; the technology being employed; and the task and individual characteristics of the system under investigation (Weill and Olson 1989).

The I/S success model proposed in Figure 2 is an attempt to reflect the interdependent, process nature of I/S success. Rather than six independent success categories, there are six *inter*dependent dimensions to I/S success. This success model clearly needs further development and validation before it could serve as a basis for the selection of appropriate I/S measures. In the meantime, it suggests that careful attention must be given to the development of I/S success instruments.

## Conclusion

As an examination of the literature on I/S success makes clear, there is not one success measure but many. However, on more careful examination, these many measures fall into six major categories—SYSTEM QUALITY, INFORMATION QUALITY, USE, USER SATISFACTION, INDIVIDUAL IMPACT, and ORGANIZATIONAL IMPACT. Moreover, these categories or components are interrelated and interdependent, forming an I/S success model. By studying the interactions along these components of the model, as well as the components themselves, a clearer picture emerges as to what constitutes information systems success.

The taxonomy introduced in this paper and the model which flows from it should be useful in guiding future research efforts for a number of reasons. First, they provide a more comprehensive view of I/S success than previous approaches. Second, they organize a rich but confusing body of research into a more understandable and coherent whole. Third, they help explain the often conflicting results of much recent I/S research by providing alternative explanations for these seemingly inconsistent findings. Fourth, when combined with a literature review, they point out areas where significant work has already been accomplished so that new studies can build upon this work, thus creating the long-awaited "cumulative tradition" in I/S. And fifth, they point out where much work is still needed, particularly in assessing the impact of information systems on organizational performance.*

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