

# Exploring the Measurement of End User Computing Success

Conrad Shayo

California State University of San Bernardino

Ruth Guthrie

California Polytechnic University of Pomona

Magid Igbaria

Claremont Graduate University

*As end user computing (EUC) becomes more pervasive in organizations, a need arises to measure and understand the factors that make EUC successful. EUC success is viewed as a subclass of organizational information system (IS) success, having distinct characteristics that distinguish it from other sources of organizational computing success. Namely, the success of applications developed by the information systems department (ISD), software vendors, or outsourcing companies. The literature shows that despite the volitional nature of end user computing, end user satisfaction is the most popular measure EUC success. Moreover, despite known limitations reported in the literature, self-reported scales are the instruments of choice by most researchers. This paper explores the literature on EUC success measurement and discusses the main issues and concerns researchers face. While alluding to the difficulty of devising economic and quantitative measures of EUC success, recommendations are made including the use of unobtrusive measures of success, take into account contextual factors, use well-defined concepts and measures and seek a comprehensive integrated model that incorporates a global view.*

End user computing, defined as the optional development of computer applications and models by personnel outside the MIS department (Brancheau and Brown, 1991), is an important issue for IS executives (Niederman et. al., 1991; Watson and Brancheau, 1991). The emergence of EUC can be traced to the proliferation of microcomputers, increased organizational computing needs, more sophisticated user application development tools and higher computer and information literacy among staff and professional workers. Actual and invisible backlogs that could not be satisfied by the information systems department served as a catalyst to this trend. But, has IT investment in EUC been successful? Has the proliferation of microcomputers in organizations truly enhanced productivity, effectiveness and competitive advantage?

The answer to these questions should be seen in the context of overall computing success within the organization.

A model showing subsets of organizational computing success and characteristics of application development within divisions or organizational computing is shown in Figure 1. The figure shows that overall organizational IS success is a conglomerate of end user developed applications (EUC success), information systems department (ISD) developed applications (ISD success), vendor off-the-shelf applications (vendor success), and applications developed by outsource companies (outsource success).

End user computing applications are usually developed with a great deal of freedom, using less standardization and control than ISD and vendor supplied applications. They often solve individual or departmental problems and are low risk but lack integration with other organizational systems. An organization's IS application's portfolio will be characterized by one or many intensities of each source of application

development depending on the organization's IS acquisition strategy. The role of general management is to optimize the success of the application development mix by attempting to maximize the success of each component within the constraints of the organizational environment.

### Measurement

Centuries ago, sailors would measure their speed and progress on the sea without the aide of a global positioning system. With a rope of evenly tied knots, the slow release of the rope into the water would give a measure of speed. It was a satisfactory measure of their progress toward their goal at the time. A captain, assuming he knew how to navigate, could judge progress by simply calculating the distance traveled. In the very early days of computing and computer programming, measures such as lines of code, number of cards punched or graveyard hours at the lab were indicators of progress. Quantifying effectiveness — doing the right thing, and efficiency — doing something right was, and still remains, a more complex task.

This is true to the extent that the payoff from IT investment is continually under investigation (Panko, 1991; Markus, 1992; Brynjolfsson, 1993). Between the 1950s and early 1970s when mainframe computers were dominant, measurement of payoff from IT investment focused on number of jobs eliminated, costs avoided, or cost reduced and CPU hours used. General management was more concerned about efficiency at this time. With the introduction of mini and micro-

computers between the mid-1970s and early 1980s, measurement focused on individual and work group effectiveness. General management was concerned that the rapid proliferation and investment in microcomputers was not paying off (Applegate, McFarlan, McKinney, 1996). The emergence of client/server computing and the Internet in the mid-1980s and early to mid-1990s, caused organizations to realize that IT could enhance or support organizational effectiveness and competitiveness.

This paper presents the findings and critique of recent literature on the measurement of EUC success. We explore EUC measurement issues related to individual, group, and organizational efficiency and effectiveness as well as organizational competitiveness. Note that EUC is the optional development of computer applications and models by personnel outside the MIS department. As shown in Figure 1, EUC success is just one contribution to the overall organizational computing success. The context of EUC also include the other sources of IS applications which include systems developed by the ISD and vendors. For the purposes of this paper, we define EUC success as the degree to which EUC contributes to individual, group, and organizational effectiveness and competitiveness in an environment that includes ISD and vendor developed applications.

The rest of the paper is organized as follows: first is a background review of the literature on IS success measurement in general and EUC measurement in particular. Second is a discussion of the problems of measuring EUC success.

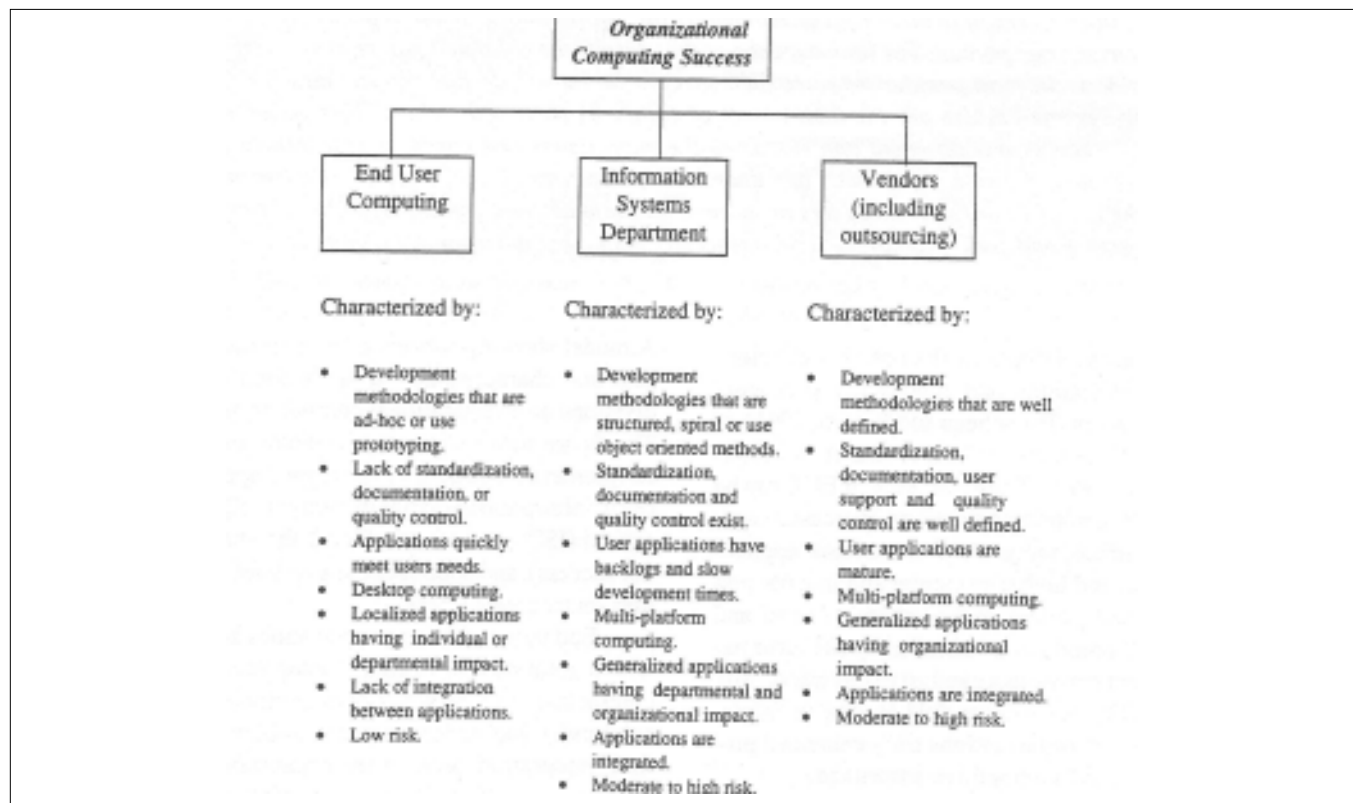


Figure 1: Organizational Computing Success

Third are conclusions and recommendations on how to improve the measurement of EUC success.

## Background Literature on Information Systems Success and EUC Success

As indicated in Figure 1, a distinction is made between IS success and EUC success measures. IS success is an organizational computing success measure whereas EUC success is a more specialized individual computing success measure.

Several articles discuss components of IS success (Zmud, 1979; Ives and Olson, 1984; DeLone and McLean, 1992; Seddon, 1997), though its economic and quantitative measurement is often elusive. Consensus on specific measures of IS success seem to center around organizational impacts, system use and user satisfaction. DeLone and McLean (1992) identified six main categories of IS success: system quality, information quality, system use, user satisfaction, individual impact, and organizational impact. Figure 2 provides the temporal and causal interdependencies among

the six variables. DeLone and McLean conclude that the six categories of success measures clearly indicate that IS success is a multidimensional construct and that IS success should be measured as such. As shown in Figure 2, “organizational impact” is seen as the ultimate measure of IS success. DeLone and McLean also suggest that user satisfaction should always be used when “IS use” is mandatory. Seddon creates an extension of the DeLone and McLean model in which behavioral aspects of IS use are separated from perceptual measures of IS success, Figure 3.

Seddon separates behavioral IS use from the DeLone and McLean model of IS success and divides it into expectations about net benefits of an introduced system and its actual use. He contends that actual use is a behavior, not necessarily a success measurement. The behavioral use creates individual, organizational or societal consequences that influence the IS success measures.

Seddon’s motivation for expanding DeLone and McLean is to clarify variance and process measures in the model by elaborating the different meanings of ‘use’. Use can refer to benefits that the system provides (perceived useful-

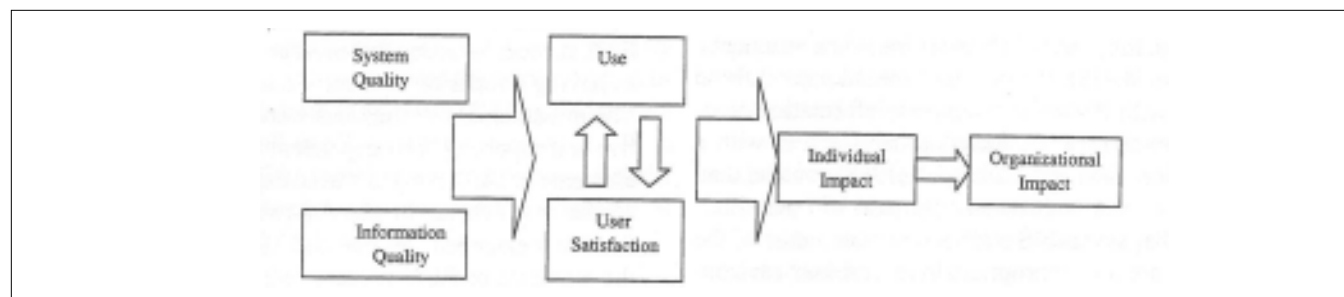


Figure 2: DeLone and McLean’s Model of IS Success

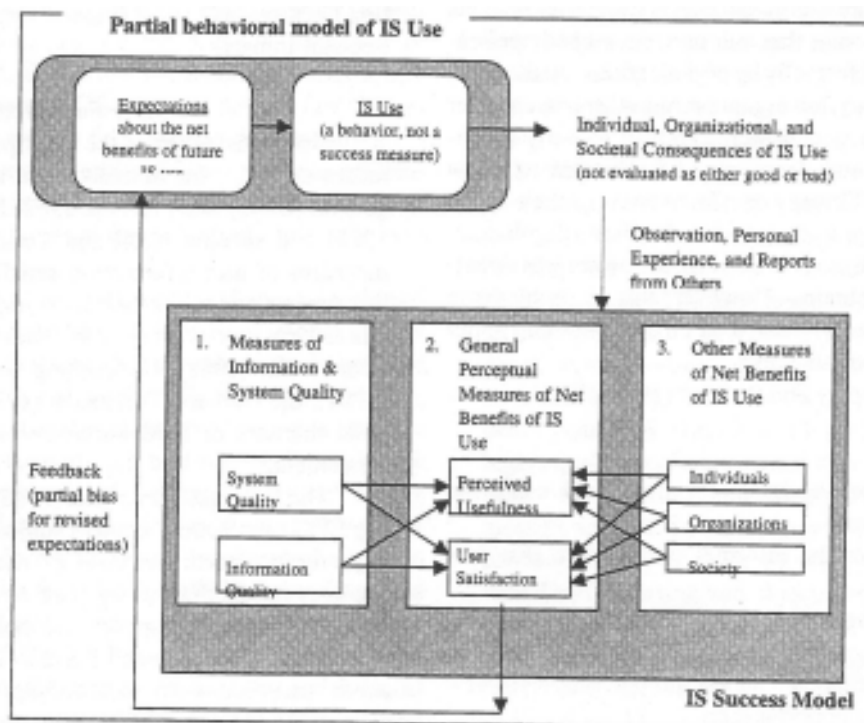


Figure 3: Seddon’s Respecified Model of IS Success

ness), anticipated benefits from future use (i.e. self efficacy, motivation), and use as part of organizational process (satisfaction, individual and organizational impacts). Moreover, Seddon argues that user satisfaction is paramount to measurement of information systems success. Application of Seddon's research model to EUC would suggest that the dependent variable should be "expectations about the net benefits of future use" of a specific end user developed application. End user computing satisfaction is used as the most important surrogate measure of EUC success.

Doll and Torkzadeh (1988) contend that general measures of end user satisfaction developed for traditional IS environments may no longer be appropriate for an end user environment where users directly interact with specific application software. The authors refer to such general traditional measures as "measures of user information satisfaction" (UIS). They propose that the term "end user satisfaction" be reserved for an end user's satisfaction with a specific application. According to Doll and Torkzadeh, EUC satisfaction is defined as the attitude toward a specific computer application by someone who interacts with the application directly. They argue that the UIS instruments omit aspects important to EUC such as ease of use. In contrast, UIS measurement instruments, such as the Ives, et. al. (1983) instrument, measure general end user satisfaction with IS staff and services, information products, and user involvement rather than satisfaction with a specific application. Doll and Torkzadeh (1988) contend that, most end users can not evaluate such general UIS activities. They conclude that several IS staff and service items of the UIS instruments are less appropriate in an end user environment.

While research continues to grow on IS success, it remains scanty on the measurement of end user success. This is no surprise, considering that end user developed applications are rarely tracked formally by organizations. At the same time, it is not difficult to find organizations where an end user developed application is considered critical to daily operations. Furthermore, end users may be reluctant to allow measurement of the efficiency or effectiveness of their applications, especially from an outsider, for fear of job loss. Benign measures, such as end user satisfaction are less threatening and easier to obtain. However, this is problematic because users are asked to place a value on something about which they are far from objective.

According to Gerrity and Rockart (1986), EUC success will occur if there is:

- an increase of effectiveness in the individual using the developed application.
- a move to formalize the informal user system that was developed.
- an increase in learning on the part of the user in the ability to accomplish work.
- an increase in competitive advantage through support of new products, markets or opportunities.

- an improvement in organizational effectiveness as users access necessary data to improve decisions they make.

In 1990, Scott Morton added a sixth item to this list: EUC success is observed if an overall increase in national wealth due to increased knowledge of workers and information handlers exists.

## Measuring Elements of EUC Success

At the advent of EUC in the late 1970s and early 1980s, metrics about end users kept by the IT department typically consisted of tallies of help desk requests sorted by hardware failures, packaged software assistance, laser printer maintenance and network connections for end user PCs. While these may be adequate measures of EUC operations and mean time between failure for hardware, they fall short in measuring end user computing success. The goals of end user computing are often hidden in a company and the speed and quality with which the goals are reached is hidden because end users often develop applications without organizational knowledge.

In our review of the literature on the measurement of EUC success we found that most articles could be categorized as having a focus on user satisfaction, use and productivity. The measurement instruments were largely based on subjective self reporting. The dependent and independent variable elements of EUC success varied depending on the objectives of the researchers. In the following section, we will use Seddon's extended DeLone and McLean's model to discuss the elements of EUC success. We focus on the IS Success Model components shown in Figure 3 which include: User Satisfaction, Perceived Usefulness, System Quality, Information Quality, Individual Impact, Organizational Impact, and Societal Impact.

### User Satisfaction

User satisfaction is the most popular measure taken in recent studies. Instruments have been validated for both general (Bailey and Pearson, 1983; Ives, Olson and Baroudi, 1983) and specific (Doll and Torkzadeh, 1988) perceived measures of user information satisfaction. Other validated instruments end user satisfaction instruments include Doll & Xia (1996), Ives, Olson and Baroudi (1983), and Baroudi and Orlikowski, (1988). According to Amoroso and Cheney (1991), the Doll and Torkzadeh (1988) instrument is a more valid measure of EUC success than the Ives et al. (1983) instrument.

The Doll and Torkzadeh (1988) instrument for measuring EUC satisfaction requires subjective self-reports of content, format, accuracy, ease of use, and timeliness of an application. Studies using user satisfaction as a measure indicate that EUC support and policy are correlated with satisfaction (Berferon and Berube, 1988), and that users are more satisfied with microcomputers than mainframes (Glorfeld and Cronan, 1992). Evidence also links satisfaction



to user skill (Glorfeld and Cronan, 1992; Harrison and Rainer, 1992, Barker, 1994), information quality (Doll and Torkzadeh, 1988) and motivation (Barker 1994; Igbaria, Parasuraman and Baroudi, 1996).

Several articles discuss the merits and problems with measurement of user satisfaction as an indicator of EUC success (Galletta and Lederer, 1989; Torkzadeh and Doll, 1991; Etezadi-Amoli and Farhoomand, 1991; DeLone and McLean, 1992, Doll et al., 1994). Seddon (1997) would argue that for lack of a better measure, user satisfaction is the most desirable measure of net benefits or success. However, this is problematic in that equating user satisfaction with EUC success does not tell us whether the system is productive or whether its use gives the concerned organization some economic gain. Consider a user-developed program that produces reports that are redundant to those produced by another organizational computing system. While the user may be highly satisfied, the overall impact could be described as a failure. There is, therefore, need to measure correlates of individual end user satisfaction with organizational context variables.

Bergeron and Berube (1988) correlated perceptions of IS support features with satisfaction. They found a negative correlation between user satisfaction and the number of micro-computing policies. Glorfeld and Cronan (1992) used both the Ives, et. al. and the Doll and Torkzadeh measures of UIS to study the success of EUC management techniques. Results indicated a positive relationship for the impact of management technique on satisfaction.

### Information Systems Use

Measures of information system use are blurred in the literature because it is difficult to sort objective from subjective measures and to distinguish when use is mandatory or voluntary. Obviously, if the use is mandatory, satisfaction might be a better measure of IS success. Seddon (1997) tries to clarify the many types of IS use by distinguishing (a) expectations about the net benefits of future use of an application developed by an end user, i.e., perceived usefulness of future use, and (b) actual use of the individual application. See Figure 3.

Expectations of future net benefit is distinguished from perceived usefulness and user satisfaction in that it is a measure of an individual's expectation about the benefits of future use of the information system. For example, end users will be asked to evaluate the statement: "Using [a specific application] will improve my job performance", where 1 = strongly disagree, 3 = uncertain, 5 = strongly agree." This is related to an individual's goals, self-efficacy and level of experience or skill. In the literature, measures of expected benefit follow a model from Davis (1989) and indicate the relationship between perceived usefulness and actual use (Segars and Grover, 1993; Taylor and Todd, 1995).

Actual use of an information system is one of the most frequently reported measures of IS success (DeLone and

McLean, 1992). Measures include: observing microcomputer monitors and self-reported actual use. According to DeLone and McLean, usage, whether actual or perceived, is a useful measure of IS success only when such use is voluntary. Cheney, et. al. (1986) agree by proposing that unless use is mandatory, an end user will utilize EUC facilities only when they are perceived to be of value to the user. Thus, the authors recommend application utilization as a surrogate measure of EUC success when use is voluntary. The measurement of perceived usefulness in the Seddon's (1997) extended model refers to a user's reaction to a system that has already been introduced and used. End users are asked to evaluate the statement: "Using [a specific application] has improved my job performance", where 1 = strongly disagree, 3 = uncertain, 5 = strongly agree."

In a study of motivation on microcomputer usage, Igbaria, Parasuraman and Baroudi (1996) found that perceived usefulness was the strongest motivator for system acceptance. Evidence also showed that skill played a major role in microcomputer acceptance. In a study of system effectiveness and use (Snitkin and King, 1996), usage and perceived usefulness were also highly related. Moreover, people with high analytic ability are more frequent users. Marcolin, Munro and Campbell (1997) found similar results with the addition of computer anxiety as a variable. Ease of use was also correlated with actual use (Adams et al., 1992). Ability was later shown to influence variety of tasks and system use (Guimaraes and Igbaria, 1997) and to be directly related to efficacy, performance and job satisfaction (Henry and Martinko, 1997).

A few researchers have called for the need to concentrate on end user competence and the quality of the applications they develop. Munro, Huff, Marcolin and Compeau (1997) developed a measure for end user competence consisting of breadth and depth of knowledge and end user finesse. The authors concluded that there was need for a better measure of competence in order to determine if investment in end user technologies and training was warranted. Plavia's (1991) lab experiment found that command level users working with databases performed better when presented with data models showing their own view of reality. They found that no particular method for program development resulted in higher quality applications designed by end users. Pseudocode and direct writing proved to be most productive. Edberg and Bowman (1996) found that in a controlled experiment, students posing as surrogate IS professionals also produced higher quality applications and were more productive than end users. Both studies are evidence of Plavia's warnings that a massive amount of training may be required to make end users productive in systems development. Both studies used individual self reporting and objective measures to quantify their findings.

Amoroso and Cheney (1992) suggest the need for researchers to focus on the quality of end user developed applications. The authors define quality as the degree to which

an application attains its goals from the perspective of the user. They recommend that researchers should combine end user computing satisfaction and application utilization measures to assess the quality of user developed applications. The variables included in the Amoroso and Cheney instrument include: reliability, effectiveness, portability, economy, user friendliness, understandability, verifiability, and maintainability. This means that an end user-developed application that ranks higher on the above measures will in turn increase end user utilization of the application and satisfaction.

If we consider systems developed outside the traditional MIS department, evidence of measures of system quality is rare. Traditionally, IS quality has been measured by evaluating program reliability, user interface design, accuracy or use. In the end user computing literature, measures focus primarily on use of systems and user skills. Measures of EUC information quality are infrequently used. Presumably, if an end user is developing their own system, they have expert knowledge of the information, its timeliness and degree of accuracy that is necessary. Saleem (1996) gives support of this assumption in a series of controlled studies of user participation in IS design. The author found that user participation has a positive impact on development, if their domain knowledge is adequate. Saleem concludes that since user's expertise is invaluable to the design effort, user management need to examine which phases of development the user should be involved in.

### Measures of Individual and Organizational Impact

According to DeLone and McLean (1992), individual impact is the most difficult category to define in unambiguous terms. For example, the individual impact of an end user developed application could be related to a number of different measures such as impact on performance, understanding, decision making and/or user activity. Blili (1992) developed an end user computing impact measure that assessed managerial performance, productivity and job satisfaction. Blili's impact measures were very similar to both UIS and IS actual use measures.

Measures for organizational and societal process impacts are rare. Brown and Bostrom (1994) found evidence that EUC management strategy can support different growth objectives. The authors conclude that MIS managers and researchers should pay more attention to the degree of organizational centralization, formalization, and complexity when they evaluate the effectiveness of end user computing management in an organization. Hitt and Brynjolfsson (1997) showed that increased investment in IT is related to distributed management structures.

Other aspects of EUC success include support, skills, and task characteristics. Rainer and Harrison (1992) developed and validated the EUC activities scale that gives a mechanism for classifying specific computing work done by end users. Mirani and King (1992) developed an instrument to measure levels of EUC support, arguing that higher support

levels will better promote EUC within organizations.

End user support and skills have been studied to determine their influence on system use and adoption of new technology. Bowman et al. (1993) found that colleagues and software manuals provided the majority of end user support. The author's findings were based on a sample of twelve organizations. The authors also found that computing skill, position and personal characteristics had no correlation with the type of support chosen by an end user. Mirani and King (1994) found that information centers do not assess user needs in attempting to provide support. The authors found that when support needs were provided, user satisfaction increased.

A complete list of the independent variables found in the articles identified in Table 1. Table 2 lists the dependent variable.

### Problems with EUC Success Measurement

Measuring EUC success seems to be an intractable problem. Studies contribute to our understanding of EUC success, yet they lack consistency in measures, design and technology to gain larger understanding and insight. Problems associated with the measurement of EUC success are:

1. *Control and Clarity* - There is a need to control for task, technology and context in studies that measure EUC success. Considerations for task variety and complexity were rarely made in the literature. Given the wide variety of skill, position and types of computing work, it is imperative that we consider controlling for task in the measurement of EUC success. Similarly, wide ranges exist between the technology used in research. Surely, a fax machine has qualitatively different attributes than e-mail or virtual chat. Indeed, a menu driven e-mail package (used at many Universities) is nothing like AOL-mail (used in many homes). The problem of control is exacerbated by rapid changes in technology that make it difficult to repeat similar tests and measures over time. Context needs to be clearly defined so it is understood whether use of the information system is mandatory or voluntary or whether a competing alternative information system exists. Considerations of importance, strategic value and organizational level must also be taken into account. Researchers must be diligent in clearly defining the context of the study and the use of the IS and in controlling for task complexity and type of technology used.
2. *Creation of Meta and Longitudinal Data* - There is a shortage of studies that have any data of a longitudinal nature. Most studies identified in the literature are cross sectional and not of pre-post nature. Task, technology and context variety is keeping us from gaining longitudinal insight about individuals (measuring how individuals change as they develop higher technology skills) and insight about organizations (measuring the impacts of technology changes over longer periods of time). This is exacerbated by rapid changes in

**Management Support for Planning and Control**

- \* Top management understanding of IT
- \* Development of appropriate strategies/policy
- \* Top management integration of the organizational micro-computer strategic plan with the IS master plan
- \* Provide a budget for training programs in-house or at remote location by company trainers (software training, OS training, communications training)
- \* Provide a budget for educational programs in-house or at remote location by company personnel (general computer literacy, functional computer literacy)
- \* Encouraging experimentation with microcomputers
- \* Encouraging use of IT to support a wider variety of business tasks
- \* Rewarding efforts of using IT to meet set goals at sectional, department, divisional, and corporate levels
- \* Developing a core of internal experts who will train others (local resident experts)

**Other types of support**

- \* Training provide by other colleagues
- \* Providing software library services
- \* Access to a information center (IC), help desk or hotline
- \* Maturity of help desk to support end users

**IC Support for Hardware and Software**

- \* Guidance on selecting hardware
- \* Guidance on selecting software
- \* Hardware setup/configuration
- \* Software installation
- \* Backup/Recovery

**IC Support for Application Development**

- \* Development assistance
- \* Access to corporate data
- \* Assist users with finding data
- \* Application maintenance
- \* Troubleshooting

**Organizational Structure**

- \* Centralized
- \* Decentralized

**User Characteristics**

- \* Years of Education
- \* Cognitive Style
- \* Command Level skills
- \* Programming skills
- \* Self-efficacy
- \* Demographics: gender, age
- \* Inputs consumed to provide outputs: programming time, flow diagram, pseudocode, narrative description, direct writing, 4GL
- \* Personality
- \* Computer attitudes
- \* Computer anxiety

- \* Math anxiety
- \* Experience
- \* Skill variety
- \* Autonomy
- \* End user computing sophistication/competence: ability, usage intensity, application customization
- \* Self-efficacy

**System Characteristics**

- \* High end
- \* Low end
- \* Quality: Security, Functionality, Ease of use, Documentation
- \* Type of Application
- \* Value and Usefulness of system terminology

**Information Characteristics**

- \* Quality of output: content, structure, correctness, accuracy, format, ease of use, timeliness
- \* Number of defects/function point
- \* Quality attribute models
- \* Value and Usefulness of screen displays

**User/System/Task Interaction**

- \* End user participation in Analysis and Design
- \* End user involvement in Analysis and Design: perceived risk, degree of pleasure, status value
- \* End user usage of the system
- \* Time on project in task categories
- \* LOC/hour
- \* Function points/hour
- \* Outcome expectancy
- \* Perceived usefulness
- \* Perceived fun
- \* Satisfaction

**External Support**

- \* Good relationships with external hardware and software vendors or consultants breeds positive feelings, realistic expectations
- \* Technical support
- \* Training provided in a remote location or on company premises by external consultants, friends, vendors, or educational institutions
- \* Educational programs provided in a remote location or on company premises by external consultants, friends, vendors, or educational institutions

**Task Characteristics**

- \* Task identity
- \* Task significance
- \* Task uncertainty: complexity, volatility

**Other characteristics**

- \* EUC growth in the organization
- \* Societal pressure

**Table 1. Measures used as the Independent Variable in EUC Success**

End User Satisfaction  
 End User Productivity  
 End User Computer Skill  
 End-User Ability/Competence  
 End User Success  
 Motivation for System Use  
 Work Effectiveness  
 IS Acceptance  
 Job Performance  
 EUC Management Effectiveness  
 System Effectiveness  
 System Usage

**Table 2. Measures used as the Dependent Variable in EUC Success**

technology, and by the undocumented, hidden nature of end user developed applications. The lack of repeatability again hinders researchers in performing meta-analysis from several studies.

3. *Unit of Measurement* — Most studies in the literature tend to focus on the individual end user as the unit of analysis in EUC measurement. However, if we are concerned with overall organizational success, group, departmental and organizational measures of EUC success need to be applied. For instance, if satisfaction is a measure of EUC success, success should be measured at many levels. A CEO or departmental manager may have a very different perspective on an IS success than an end user has.

Moreover, the reason for the existence of EUC has changed. Actual and invisible backlogs in the 1980s were the prime reasons for the emergence of the EUC phenomenon. However, in the 1990s, EUC is seen as part of organizational computing strategy, requiring management evaluation. It is rare to find EUC measuring instruments at the divisional and organizational levels. One main reason is that EUC is mostly an individual activity and it is easier to obtain self-reports from the individuals. However, the portfolio approach suggested in this paper calls for organizational measures that will evaluate the efficiency of a given EUC strategy. There is, therefore, need to devise EUC measurement instruments that reflect this change. Since EUC is mostly individual, there is a lack of a general organizational view and measurement of the impact of EUC on overall organizational computing. There is need for measures that will allow managers and end users to set goals, allocate organizational computing resources effectively and eventually optimize the mix of computing in organizations. Also, the granularity of the measures posits a problem. For example, perceived usefulness could be evaluated at the future level or at the current level.

4. *Lack of objective measures of end user performance in a field setting.* - End user computing activities are rarely visible to the rest of the organization. Such activities are therefore difficult to observe, document and measure unobtrusively.
5. *Need for a more comprehensive and integrated model.* Most studies focus only on a few antecedents while ignoring others. For example, the Doll and Torkzadeh (1988) instrument focuses mostly on information quality factors while ignoring system quality, perceived net benefits of actual use. There is need to develop a more comprehensive, integrated network model to assist in adding clarity to the future study of EUC success. Currently, a lack of agreement exists on the direction and granularity of the causal variables of EUC success. A case in point is Seddon's extension of DeLone and McLean. Whereas IS use and user satisfaction are the antecedents to the benefits accruing to the individual (individual impact) and the organization (organizational impact) in the DeLone and McLean model, it is the reverse in the Seddon's extension. It is, therefore, important to realize that there will always be a feedback loop that changes the direction of the causal relationships. Researchers should therefore acknowledge that some measures may covary and none causes that other (Seddon, 1997).
6. *Lack of conceptual definitions*— The operational definition of the measuring variables must correspond with the conceptual definition. Researchers should develop and use measures that are well established and validated in IS and other disciplines. For example, are we really measuring end user satisfaction? How is this different from satisfaction with objects researched in other fields such as organizational behavior and marketing?
7. *Lack of a global view* — Most EUC research has been conducted in North America. There is belief that the results obtained in the North America setting are generalizable to other countries. This belief may be ill advised given differences in culture, socio-work roles, level of IT sophistication and access to technology. Models of EUC need to be checked for external validity across cultures. This may prove important in the future as more companies employ a global workforce.

## Conclusion

The need for a comprehensive, integrated model of IS success is apparent. If such a model existed, concepts and measures could evolve into well-defined instruments for researchers to use. When well-defined concepts and measures are at hand, studies can converge on an overall understanding of EUC success and build upon related works to expand the body of knowledge. Once we build measures upon common concepts, we can begin to accumulate a body of knowledge that validates our measurement tools. Well-established and



validated instruments can add great clarity to our understanding of all research. Measures that are direct and uncoupled from other multi-attribute constructs can lead to more generalizable results.

There is also a great need to pay attention to the contextual factors of end user computing. Too many studies are focused at the individual level, ignoring departmental, work-group, organizational or even global effects. A broader view of the implications of EUC in organizations, beyond individuals, could give great insight into productivity, quality and competition.

## References

- Adams, D. A., Nelson, R. R. & Todd, P. A. (1992) Perceived usefulness, ease of use, and usage of information technology: a replication. *MIS Quarterly*, 16(2), 227-247.
- Amoroso, D.L. & Cheney, P.H. (1991). Testing a causal model of end-user application effectiveness. *Journal of Management Information Systems*, 8(1), 63-69.
- Amoroso, D.L. & Cheney, P.H. (1992). Quality end-user developed applications: some essential ingredients. *DATA BASE* 23(1), 1-11.
- Applegate, L.M., McFarlan, F.W. & McKinney, J.L. (1996). Corporate Information Systems Management: Text and Cases, Fourth Edition, Chicago: Irwin.
- Bailey, J.E. & Pearson, S. (1983). Development of a tool for measuring and analyzing user satisfaction. *Management Science*, 29(5), 530-545.
- Barker, R. M. (1994). The interaction between end user computing levels and job motivation and job satisfaction: an exploratory study. *Journal of End User Computing*, 7(3), 12-19.
- Baroudi, J.J., & Orlikowski, W. J. (1988) A short-form measure of user information satisfaction: a psychometric evaluation and notes on use. *Journal of MIS*, 4, 44-59.
- Bergeron, F. & Berube, C. (1988). The management of the end-user environment: an empirical investigation. *Information & Management*, 14, 107-113.
- Blili, S., Raymond, L. & Rivard, S. (1998). Impact of task uncertainty, end-user involvement, and competence on the success of end-user computing. *Information & Management*, 33, 137-153.
- Blili, Samir, Raymond, Louis, and Rivard, Suzanne (1994). Definition and measurement of end user computing sophistication. *Journal of End User Computing*, 8(2), 3-12.
- Bowman, B., Grupe, F. H., Lund, D. & W. D (1993). An examination of sources of support preferred by end-user computing personnel. *Journal of End User Computing*, 5(4), 4-11.
- Brancheau, J. C. & Brown, C. V. (1993). The management of end-user computing: status and directions. *ACM Computing Surveys*, 25(4), 437-482.
- Brown, C. V. & Bostrom, R. P. (1994). Organization designs for the management of end-user computing: re-examining the contingencies. *Journal of Management Information Systems*, 10(4), 183-211.
- Brynjolfsson, E. (1993). The productivity paradox of information technology. *Communications of the ACM*, 36(12), 67-77.
- Cheney, P.H., Mann, R.I. & Amoroso, D.L. (1986). Organizational factors affecting the success of end-user computing, *Journal of Management Information Systems*, 3(1), 65-80.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.
- DeLone, W. H. & McLean, E. R. (1992). Information systems success: the quest for the dependent variable, *Information Systems Research*, 3(1), 60-95.
- Doll, W. & Torkzadeh, G. (1988). The measurement of end user computing satisfaction. *MIS Quarterly*, 12(2), 259-274.
- Doll, W. J. & Torkzadeh, G. (1991). The Measurement of End-User Computing Satisfaction: The Theoretical and methodological issues. *MIS Quarterly* 15(1), 5-10.
- Doll, W. J., Xia, W. & Torkzadeh, G. (1994). A confirmatory factor analysis of the end-user computing satisfaction instrument. *MIS Quarterly* 18(4), 357-369.
- Doll, W. J. & Xia, W. (1997). A confirmatory factor analysis of the end-user computing satisfaction instrument: a replication. *Journal of End User Computing*, 9(2), 24-31.
- Edberg, D. T. & Bowman, B. J. (1996). User-developed applications: an empirical study of application quality and development productivity. *Journal of Management Information Systems*, 13(1), 167-185.
- Etezadi-Amoli, J. & Farhoomand, A. F. (1991). On end-user computing satisfaction. *MIS Quarterly* 15 (1), 1-4.
- Galletta, D.F. and Lederer, A.L. (1989). Some cautions on the measurement of user information satisfaction. *Decision Sciences*, Vol. 20, 419-438.
- Gerrity, T. P. & Rockart, J. F. (1986). End-user computing: are you a leader or a laggard. *Sloan Management Review*, 27(4), 25-34.
- Glorfeld, K. D. & Cronan, T. P. (1992). Computer information satisfaction: a longitudinal study of computing systems and EUC in a public organization. *Journal of End User Computing*, 5(1), 27-36.
- Guimares, T., Igbaria, M. and Lu, M. (1992). The determinants of DSS success: an integrated model. *Decision Sciences*, 23, 409-430.
- Harrison, A. W. & Rainer, R. K. (1992). The influence of individual differences on skill in end-user computing. *Journal of Management Information Systems*, 9(1), 93-111.
- Henry, John W. and Martinko, Mark J. (1997). An attributional analysis of the rejection of information technology. *Journal of End User Computing*, 9(4), 3-17.
- Hitt, L. M. and Brynjolfsson, Erik (1997) Information technology and internal firm organization: an exploratory analysis. *Journal of Management Information Systems*, 14(2), 81-101.
- Igbaria, M. Parasuraman, S. and Baroudi, J.J. (1996) a motivational Model of Microcomputer usage. *Journal of Management Information Systems*, 13(1), 127-143.
- Ives, B., Olson, M. H. & Baroudi, J.J. (1983) The measurement of user information satisfaction. *Communications of the ACM*, 26(10), 785-793.
- Ives, B. & Olson, M. (1984). User involvement and MIS success: a review of research. *Management Science*, 30(5), 586-603.
- Marcolin, B. L. Munro, M. C., Campbell, K. G. (1997). End user ability: impact of job and individual differences. *Journal of End User Computing*, 9(3), 3-12.
- Markus, L., & Soh, C. (1992). Banking on Information Technology: Converting IT Spending into Firm Performance. Working Paper, University of California, Los Angeles.
- Mirani, Rajesh and King, William R. (1994). Impacts of end-user and information center characteristics on end-user computing support. *Journal of Management Information Systems*, 11(1), 141-166.
- Munro, M. C., Huff, S. L., Marcolin, B. L., Campeau, D. R. (1997). Understanding and measuring user competence. *Information & Management*, 33, 45-57.

- Niederman, F., Brancheau, J.C., and Wetherbe, J.C. (1991). Information Systems Management Issues for the 1990s. *MIS Quarterly*, 15(4), 474-500.
- Panko, R. R. (1991). Is office productivity stagnant? *MIS Quarterly*, 15(2), 191-203.
- Plavia, P. (1991). On end-user computing productivity. *Information & Management*, 21, 217-224.
- Rainer, R. K. & Harrison, A. W. (1992). Toward development of the end user computing construct in a university setting. *Decision Sciences*, 24(6), 1187-1202.
- Saleem, N. (1996). An empirical test of the contingency approach to user participation in information systems development. *Journal of Management Information Systems*, 13(1), 145-166.
- Scott Morton, M.S. (1991). Introduction. In Michael S. Scott Morton (ed.), *The Corporation of the 1990s: Information Technology and Organizational Transformation*, New York: Oxford University Press.
- Seddon, P. B. (1997). A respecification and extension of the DeLone and McLean model of IS success. *Information Systems Research*, 8(3), 240-253.
- Segars, A. H. & Grover, V. (1993). Re-examining perceived ease of use and usefulness: a confirmatory factor analysis. *MIS Quarterly*, 17(4), 517-525.
- Snitkin, S. R. & King, W. R. (1986). Determinants of the effectiveness of personal decision support systems. *Information & Management*, 10, 83-89.
- Taylor, S. & Todd, P. A. (1995). Assessing IT usage: the role of prior experience. *MIS Quarterly*, 19(4), 561-570.
- Torkzadeh, G. & Doll, W. J. (1991). Test-retest reliability of the end-user computing satisfaction instrument. *Decision Sciences*, 22, 26-37.
- Watson, R.T. & Brancheau, J.C. (1991). Key issues in information systems management: an international perspective. *Information & Management* (20), 213-223.
- Zmud, R. W. (1979) Individual differences and MIS success: a review of the empirical literature. *Management Science*, 25(10), 966-979.

Over the last 16 years, Dr. Conrad Shayo has worked in various capacities as a university professor, consultant, and manager. He holds a Doctor of Philosophy Degree and a Master of Science Degree in Information Science from the Claremont Graduate University, formerly Claremont Graduate School. He also holds an M.B.A. in Management Science from the University of Nairobi, Kenya; and a Bachelor of Commerce Degree in Finance from the University of Dar-Es-Salaam, Tanzania. Dr. Shayo's research interests are in the areas of IT assimilation, end-user computing, organizational memory, information strategy, and "virtual societies." His most recent publications can be found in the *Journal of Equal Opportunities International*, and the *Encyclopedia of Information Technology*. Currently, Dr. Shayo is an Associate Professor of Information and Decision Sciences at California State University, San Bernardino.

Ruth Guthrie is an Associate Professor of Computer Information Systems at California Polytechnic University of Pomona. She has experience in systems engineering, software test and program management of space based IR sensor programs. Ruth has a Ph.D. from Claremont Graduate University, an M.S. in Statistics from the University of Southern California and a B.A. in Mathematics from Claremont McKenna College. Her current scholarly interests include telework, virtual community and end user computing.

Magid Igbaria is a Professor of Information Science at the Claremont University and at the Faculty of Management, Graduate School of Business, Tel Aviv University. Formerly, he was a Visiting Professor of Decision Sciences at the University of Hawaii in Manoa, a Professor of MIS, College of Business & Administration, at Drexel University. He has published articles on virtual workplace, information economics, computer technology acceptance, IS personnel, management of IS, computational approaches in IS, and international IS in *Communications of the ACM*, *Computers & Operations Research*, *Decision Sciences*, *Decision Support Systems*, *Information & Management*, *Information Systems Research*, *Journal of Management Information Systems*, *Omega*, *Journal of Strategic Information Systems*, *MIS Quarterly*, and others. His current research interests focus upon electronic commerce, virtual workplace, telework, computer technology acceptance, information and computer economics management of IS, IS personnel, and international IS. He serves in the editorial board of *Information Resources Management Journal (IRMJ)*, *The Journal of The Association for Information Systems (JAIS)*, *Journal of Management Information Systems (JMIS)*, *Journal of Engineering and Technology Management (JET-M)*, *Journal of End-User Computing (JEUC)*, and *Information Technology & People (IT&P)*. He is also an associate editor of *ACM Transactions on Information Systems (ACMTOIS)*, *Journal of Information Technology Cases & Applications (JITCA)*, and *MIS Quarterly (MISQ)*. He is the co-author of *The Virtual Workplace* book.

0 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

[www.igi-global.com/article/exploring-measurement-end-user-computing/55762](http://www.igi-global.com/article/exploring-measurement-end-user-computing/55762)

## Related Content

---

### Exploring Evaluation Techniques for Children's Websites

Colleen Kaiser and Ginger Butcher (2013). *Cases on Usability Engineering: Design and Development of Digital Products* (pp. 1-25).

[www.irma-international.org/chapter/exploring-evaluation-techniques-children-websites/76794](http://www.irma-international.org/chapter/exploring-evaluation-techniques-children-websites/76794)

### The Impact of Information Technology Internal Controls on Firm Performance

Lemuria D. Carter, Brandis Phillips and Porche Millington (2012). *Journal of Organizational and End User Computing* (pp. 39-49).

[www.irma-international.org/article/impact-information-technology-internal-controls/65094](http://www.irma-international.org/article/impact-information-technology-internal-controls/65094)

### Investigating Privacy Perception and Behavior on Weibo

Clinton Amos, Lixuan Zhang and Iryna Pentina (2014). *Journal of Organizational and End User Computing* (pp. 43-56).

[www.irma-international.org/article/investigating-privacy-perception-and-behavior-on-weibo/119506](http://www.irma-international.org/article/investigating-privacy-perception-and-behavior-on-weibo/119506)

### Balancing Student Needs and Learning Theory in a Social Interactive Postdigital Textbook

Erin Walker, Ruth Wylie, Andreea Danieleescu, James P. Rodriguez III and Ed Finn (2018). *End-User Considerations in Educational Technology Design* (pp. 141-159).

[www.irma-international.org/chapter/balancing-student-needs-and-learning-theory-in-a-social-interactive-postdigital-textbook/183017](http://www.irma-international.org/chapter/balancing-student-needs-and-learning-theory-in-a-social-interactive-postdigital-textbook/183017)

### Participating in the Enterprise Web 2.0 Platform: The Influence of Trust

Fayez Hussain Alqahtani and Ibrahim Abunadi (2016). *Journal of Organizational and End User Computing* (pp. 31-48).

[www.irma-international.org/article/participating-in-the-enterprise-web-20-platform/154001](http://www.irma-international.org/article/participating-in-the-enterprise-web-20-platform/154001)