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System Quality and Information Quality: Do They Really Reflect Information System Success?

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INTRODUCTION

Currently, there are a large number of IS success measures from which to choose. However, little research has been devoted to IS success dependent variable comparisons or to a better understanding of the IS success construct. Indeed, most of the existing instruments were developed through interviews and questionnaires and from scales derived from other scales (Shirani, Aiken, and Reithel, 1994). While this approach has an intuitive appeal, a sound theoretical basis for including questionnaire items is often lacking. The result of this is that many dependent variables continue to overlap in conceptual space leading to misinterpretation and confusion.

In order to address these concerns with construct validity, we first develop a theoretical rationale to more precisely specify the IS success construct. In this way, we address issues of construct validity through an examination of face validity and content validity. This approach is definitional in nature – it assumes you have a good detailed definition of the construct and that you can check the operationalization against it (Trochim, 1999). Issues of content validity have plagued many existing dependent measures because of a lack of precise definitions for IS success.

After detailing our conceptual understanding of the IS success construct, we compare and contrast two pervasive IS success measures: Perceived Usefulness and Information Quality. Next, we critique the dimensions of the DeLone and McLean model using this basic definitional framework.

Understanding IS Success

What does it mean to produce a successful information system? In broad terms, we define a successful IS as follows:

> *A successful information system is a tool that is used in an efficient way to enhance an organization's value or profitability without unduly impacting workers' quality of life.*

To elaborate on this definition of IS success we further define the following important terms:

> *A tool is - … anything that is used as a means of accomplishing a task or purpose (Random House, Webster's College Dictionary).*

An information system, for the purposes of measurement and research on systems development, is the technical artifact, both software and hardware, which is constructed for use as a tool for workers to help in task accomplishment and organizational decision making.

> *A system is a purposeful entity comprised of interdependent components, which is unified by design to accomplish one or more objectives (Kast and Rosenzweig, 1972; Luchsinger and Dock, 1977.*

The above definitions allow us to set the groundwork to clearly and precisely define the conceptual space that comprises information systems success. Specifically, the use of the systems approach, or general systems theory, is essential as a framework since there are many ways to view an information system in an organization. One must clearly define this conceptual space before one can derive measurement scales to assess it. Specifically, we are concerned with the definition of two system concepts:

(1) The *components* of the information system, and
(2) The *boundary* of the information system.

The definition of system components and boundary is determined by the researchers conceptual viewpoint which is comprised of: (1) their *implicit metaphor of an information system*, or mental model, and (2) their viewpoint of the *context of information system use*.

The Information System as a Tool Perspective

If one agrees with the notion that an information system is a tool, then how does one compare two different tools or how does one judge a tool superior to another? Consider the case of a jackknife versus an axe. Which tool is superior? Naturally *it depends on the situation or context.* If the situation calls for "chopping down a tree" then the axe is definitely superior because it can work *effectively*. In this context, a jackknife will not work (not in your lifetime). Therefore, the axe is superior.

Keeping the current context, which tool is better: the axe or a chainsaw? In this case, both tools can effectively accomplish the task. However, clearly the chainsaw will work much more *efficiently* for the user. Therefore, the chainsaw is judged to be superior. However, one must also examine the *user* of the tool in addition to the context of use. For example, in most cases a shovel can work as effectively as a "snow blower" for clearing snow from a driveway (except for narrow areas), but certainly not as efficiently. However, some users may actually prefer the shovel because the "snow blower" may be too heavy, difficult to operate, or otherwise cumbersome (e.g., My wife finds the "snow blower" too difficult to operate).

The information system as a tool perspective is utilized by Davis (1989) in his information systems success measure that uses *Perceived Usefulness* as the dimension that assesses how well the information system helps the user to accomplish task or job responsibilities (i.e., how *effective* the tool is). Davis's *Ease of Use* dimension captures how *efficiently* the user uses the IS tool to accomplish job and task responsibilities.

The *information system as a tool* perspective or metaphor highlights two important facets of assessment. First, tools are assessed using efficiency and effectiveness criteria. Second, how effective and efficient tools are used depends upon contextual factors such as the user, the task, and the environment of use.

The Information System as a Factory Perspective (Product oriented view)

How can we compare the quality of products produced by two different companies? Consider two different automobile companies. We examine the quality of the product produced by asking the consumers to rate the automobiles' attributes such as comfort, acceleration, handling, and aesthetics. We can apply the same approach to information systems. The information system is the factory and the product produced is the information. Users can then assess the attributes of the information produced.

Doll and Torkzadeh's End User Computing Satisfaction (EUC) instrument and measures of Information Quality are examples that use this product or factory metaphor (See Table 1).

COMPARING THE INFORMATION QUALITY VERSUS USEFULNESS PERSPECTIVES

Comparing the Metaphors

In order to help address the question – "Which metaphor or instrument is better or more appropriate for information systems success measurement?" we present a hypothetical, Executive Information System that produces or displays information to users in each of the following information categories: revenue, expense, market, and environmental data (Table 2). Since the EUC instrument questionnaire items solicit feedback on the system's overall data quality by information attribute category, respondents are essentially summarizing the system's overall data quality. As can be seen in Table 2, a respondent may rate the content of the system's data as good or high, but it does not necessarily mean that all of the data item categories necessarily score high on information content. For example, certain expense items may lack appropriate content, while the system overall has good information content. Table 2 also shows in a similar way that the revenue information may be poor on accuracy, while overall the system in general is rated as good on accuracy.

Table 1: Items Measuring End User Computing Satisfaction

Content Dimension
- Does the system provide the precise information you nee
- Does the information content meet your precise needs?
- Does the system provide reports that seem to be just abou exactly what you need?
- Does the system provide sufficient information?

Accuracy Dimension
- Is the system accurate?
- Are you satisfied with the accuracy of the system?

Format Dimension
- Do you think the output is presented in a useful format?
- Is the information clear?

Ease of Use Dimension
- Is the system friendly?
- Is the system easy to use?

Timeliness Dimension
- Do you get the information you need in time?
- Does the system provide up-to-date information?

Table 2: Evaluating Information Quality

Information Attributes for a Hypothetical Executive Information System

Data Items	Content	Accuracy	Format	Timeliness	Ease of Use	Usefulness?
Revenue		**Bad**				**No**
Expense	**Bad**					**No**
Market				**Bad**		**No**
Environmental			**Bad**			**No**
Overall, data quality is:	Good	Good	Good	Good	Good	

When one evaluates the system as a whole using these two instruments (Usefulness and Information Quality), it is shown that it is possible to score high on End User Computing satisfaction or Information Quality, while the system overall is rated as less than useful. The major theoretical shortcoming with Information Quality as a dependent measure is that the quality of the information is simply a sub-goal of this system. The major or primary goal is to have an information system that helps the user to accomplish task or job responsibilities. In this example, providing high quality data for each of the particular categories is a necessary, but not sufficient condition for a useful information system.

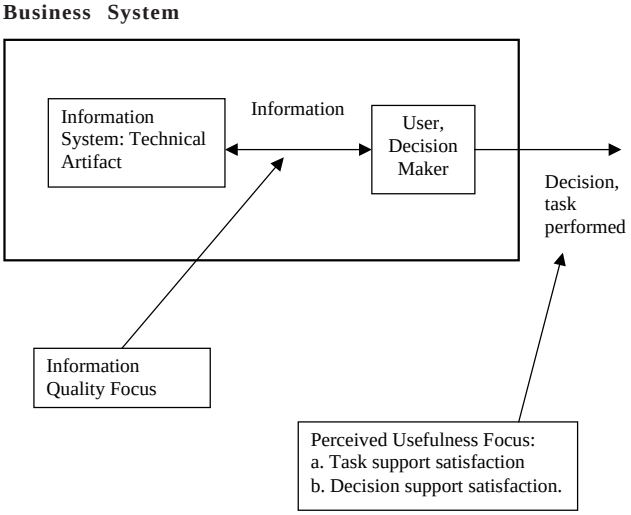
Context of Use

Figure 1 compares Perceived Usefulness and Information Quality dimensions of IS success using systems theory to highlight where the dimensions are focused in terms of context of use and outcomes or objectives. In the case of information quality, the focus is on the output generated by the technical artifact (i.e., the software and hardware system). In this case, the system of interest is the technical artifact itself and therefore the output generated by this system (viewed as a product with attributes) is then input into the next system (the user, decision maker or worker who operates within the organizational system). In the case of Perceived Usefulness, the system of interest is larger in scope, and the components consist of the technical artifact, the interface, the user, the organizational structure, and the task to be performed. In this larger or expanded definition of the system, the goal is to produce a high quality decision or to perform a task. Note that this expanded view of the system corresponds with Leavitt's (1965) view of system implementation where the components of organizational structure, task, technology, and user must all fit together in order for technology implementation to be successful.

The design implications for these two system definitions are dramatically different and will impact the development process (Garrity, 2002). In the case of the Information Quality focus, designers need only be concerned with designing technical artifacts that produce high quality information for the problem domain. However, in the case of perceived usefulness, designers are concerned with producing a technical artifact that helps achieve the goals of allowing users to make better decisions and to perform organizational tasks and job support. Certainly, the second system definition requires a broader understanding of the problem domain since from a tools perspective a properly designed system (tool) must fit its environment and the user/problem context. The distinction between the two definitions is subtle, yet important. In the case of information quality as a dependent measure, the problem is that information is simply an important sub-goal, but not the end goal itself.

The notion that the information system is also a component of the organizational system parallels Alter's (1999) view of organizational systems being composed of (1) information systems or technical

Figure 1: Information System Definition, Outcomes and Focus: Comparing Usefulness and Information Quality Viewpoints on Success



Measure	Goal of IS:	Rationale
Information Quality:	Producing high quality information	Use of IS produces a product: This information product has Attributes.
Perceived Usefulness:	Providing support for business goals.	IS is a tool used to support Workers in tasks and Decision-making.

artifacts, and (2) the work system of which the information system is a part. According to Alter, focusing on the information system (or technology) "… without looking at the work system may be cleaner and may build more directly on past IS research, but it may not be the direction of maximum value." (p. 52).

CRITIQUING DELONE AND MCLEAN'S DIMENSIONS OF INFORMATION SYSTEMS SUCCESS

The DeLone and McLean (1992) model of Information System Success is the result of a comprehensive literature review of information systems success measures, a categorization of these measures into six constructs, and the modeling of these constructs into a network of interrelationships. Thus the development of their model was a direct result of categorizing existing measures. The problem with this approach at model development is that many of the researchers who developed success measures upon which their model is derived, are using inconsistent system definitions and are building measures from different and sometimes incompatible conceptual viewpoints. We summarize potential problems with each of the success constructs of the DeLone and McLean model below.

Information Quality

As discussed earlier, the use of Information Quality as a dependent measure assumes a product-oriented viewpoint (i.e., the factory metaphor) of information from an information system. While this approach has some intuitive appeal and can be linked to communication systems theory, when viewed from a systems approach, one can see that Information Quality alone does not directly relate to information systems success. In other words, achieving a high score on Information Quality assessment does not necessarily indicate IS success or failure. It is possible for the user to rate the quality of the information as high, yet have insufficient support from the information system for task accomplishment or decision-making (See Tables 1 and 2 again).

System Quality

The primary problem with System Quality in the DeLone and McLean model is that it is unclear what System Quality is. Is System Quality the quality of the technical artifact or the computer/human interface? Is System Quality meant to encompass a wider system boundary such as the 'work system' as defined by Alter (1998)? If System Quality is meant to include the work system then shouldn't the quality of the system be measured by determining whether or not the information system has helped to accomplish the goals of the work system, such as task processing or decision-making goals?

The term 'system' as defined under the system approach, is a set of interrelated components, designed to accomplish one or more goals. However, without clear and precise definitions researchers are left to their own interpretations of systems, information systems and information systems goals. Certainly, the boundary between technical artifact and work system must be clearly indicated in order for information system success construct development and for correct interpretation of research results.

User Satisfaction

Many User Satisfaction measures are problematic for two major reasons:

1. Measures do not address the definition of the system's boundary, and
2. Measures are devoid of context and not linked to system's goals.

Lack of System Boundary Definition

An example of a User Satisfaction instrument that does not explicitly consider the information system's boundary is Baroudi and Orlikowski's (1988) short-form measure of User Information Satisfaction[1]. Items for this instrument can be classified into three distinct dimensions: (1) Assessment of the information product, (2) assessment of the EDP staff and services, and (3) Assessment of knowledge and involvement. In the second dimension, and with at least one questionnaire item from the third dimension, "Degree of EDP training provided to users," the boundary between the technical artifact and the service provided by the organizational information systems department is missing. In other words, the technical artifact and the organizational unit are considered to be a part of the information system itself. Naturally, such a wide system boundary can create problems for researchers interested in the successful development of information systems (technical artifacts) since an assessment of the support provided by an organizational unit is included in the dependent variable. Indeed, this problem is especially apparent when researchers are studying how user participation or involvement, organizational support and training and other independent variables are correlated with the successful development of the technical artifact or information system.

The boundary between independent and dependent variables in systems development studies is compromised using this measure. Researchers cannot use this instrument when conducting studies relating organizational support and user involvement to information systems success.

Measures Not Linked to System's Goals

In the DeLone and McLean model, Use of the information system should lead to higher levels of User Satisfaction (and to more Use) and User Satisfaction should then lead to Individual Impacts and then to Organizational Impacts. Unfortunately, most User Satisfaction measures do not provide a direct, logical link between User Satisfaction and Individual and Organizational Impacts. In other words, "precisely how does a higher level of User Satisfaction relate to Individual and then Organizational impacts?" In the case of Usefulness measures, a direct link exists because these measures assess the usefulness of the information system (technical artifact) toward a user's job (Kim et al., 2003). Since the organizational system is designed for the attainment of organizational goals via the attainment of organizational sub-goals (including individual job goals), a logical link is established. However, question-

naire items that assess the accuracy, precision, completeness, or reliability of output information (product) from an information system only indirectly relate to the attainment of individual and organizational goals.

System Use

Lastly, System Use has long been criticized as a dependent measure because the use of organizational systems is often mandatory for many jobs. When use is voluntary, System Use can be used as one of a number of indicators of information system success. In both the DeLone and McLean model and the Garrity and Sanders (1998) model, System Use is included and can be interpreted as a process in a process model of information system success.

SUMMARY AND CONCLUSIONS

Although a number of information systems success instruments have been developed, tested, and validated, there still exist problems and logical inconsistencies among these dependent measures. The problems and logical inconsistencies become apparent when viewed as factors in descriptive, process models of success, such as the DeLone and McLean model. The DeLone and McLean model is a valuable tool for describing the ways in which information systems success has been measured, however, the model falls short as a comprehensive and accurate model of information systems success. This paper has critiqued example dependent measures from the various categories of the DeLone and McLean model and has identified problems and inconsistencies based on researchers inadequate attention to: (1) the underlying system definition, (2) the system boundary, and (3) the context of use of the information system. Existing dependent measures have fallen short because the conceptual model upon which the measures are based is flawed. Specifically, success measures grouped under Information Quality and System Quality dimensions have erroneously been focused exclusively on the technical artifacts. The real world has fewer and fewer information systems whose effectiveness can be evaluated totally separate from the work systems they support (Alter, 1999).

This paper has shown that measures based on the viewpoint that "IS are tools," such as Davis's Perceived Usefulness and Ease of Use dimensions are superior to IS Success Measures based on the "Product oriented view of IS and Information." Information system success dimensions that are closely tied with the goals of IS are inherently superior and should be further explored by IS researchers.

ENDNOTE

[1] Baroudi and Orlikowski's (1988) User Information Satisfaction measure is by no means the only instrument that fails to explicitly define the system's boundary. We arbitrarily selected this one measure. In addition, one should also note that this measure, developed over 15 years earlier, might be appropriate for some specific studies.

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