

# **Information Systems Success Measurement**

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**William H. DeLone**  
American University, USA  
wdelone@american.edu

**Ephraim R. McLean**  
Georgia State University, USA  
emclean@gsu.edu

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## Information Systems Success Measurement

*“Success” is achieving the goals that have been established  
for an undertaking.*

(Anon.)

William H. DeLone  
American University, USA  
wdelone@american.edu

Ephraim R. McLean  
Georgia State University, USA  
emclean@gsu.edu

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## Abstract

Researchers and practitioners alike face a daunting challenge when evaluating the “success” of information systems. The purpose of this monograph is to deepen, researchers and practitioners, understanding of the complex nature of IS success measurement driven by the constantly changing role and use of information technology. This monograph covers the history of IS success measurement as well as recent trends and future expectations for IS success measurement. The monograph also identifies the critical success factors that drive information system success and provides measurement and evaluation guidance for practitioners. This comprehensive study of IS success measurement is designed to improve measurement practice among researchers and managers.

# 1

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## Introduction

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### 1.1 Why study IS success?

Regardless of whether the economy is booming or busting, organizations want to ensure that their investments in information systems (IS) are successful. Managers make these investments to address a business need or opportunity, so it is important to identify whether the systems meet the organization's goals. Keen [1980, p. 3] described the mission of IS as: "the effective design, delivery, use and impact of information technologies in organizations and society. The term 'effective' seems key. Surely, the IS community is explicitly concerned with improving the craft of design and the practice of management in the widest sense of both those terms. Similarly, it looks at information technologies in their context of real people in real organizations in a real society."

Based on Keen's view of information systems, the evaluation of the "effectiveness" or "success" of information systems is an important aspect of the information systems field in both research and practice. However, the manner in which we evaluate the success of an information system has changed over time as the context, purpose, and impact of IT has evolved. It is, therefore, essential to understand the foundations and trends in IS success measurement and what they mean for the

future. It is the purpose of this monograph to present a comprehensive review of the foundations, the trends, and the future challenges of IS success measurement in order to improve research and practice in terms of the measurement and evaluation of information systems.

Information systems success research evaluates the effective creation, distribution, and use of information via technology. As information technology has developed since the mid-1950s, information has become more voluminous, more ubiquitous, and more accessible by all. If we believe that information is power, this progress in information availability has changed the power dynamics of relationships between corporations and consumers, between buyers and suppliers, between small businesses and large businesses, and between citizens and their governments. Thus, the measurement of IS success has become ever more complex while, at its core, still simple.

The complexity arises because the uses and users of information systems are ever expanding. Therefore, the context has infinite possibilities in terms of the purpose of an IS and the definition of its stakeholders. Yet the measurement of information systems success at its core is still simple because there are consistent key elements in the measurement of success, such as information quality, system quality, use, and outcomes. The challenge that researchers and practitioners face today is, as the sophistication of information systems and their users increases, they can lose sight of the basics. Relevance, timeliness, and accuracy of information are still key to IS success, even as our information systems, and the measures of success of these systems, grow increasingly more complex.

This monograph explores the foundations and trends in the definition and measurement of information systems success. In this section, we examine how the concept of “effective” or “successful” information systems has progressed as information technology and its use has changed over the past 60 years. Later in this section, we introduce the DeLone and McLean Information Systems Success Model as an organizing framework for this monograph. In Section 2, we identify five eras or periods of information systems; and for each of these eras, we consider the types of information systems used in firms, the stakeholders impacted by these systems, the relevant research

about information systems evaluation, and the measurement of IS success in practice during each of these periods. In Section 3, we discuss some of the foundational research on IS success measurement. Based on the evolution of the field's understanding of IS success, we point out important trends in IS success measurement in Section 4. In Section 5, we share our insights on the future of IS success research. In Section 6, we review empirical findings related to success factors; those factors that influence IS success. In Section 7, we explore how managers can improve the methods they use to measure and track IS success. Finally, we offer concluding remarks in Section 8.

The DeLone and McLean [1992, 2003] IS Success Model provides a valuable framework for understanding the multi-dimensionality of IS success. We will use the D&M IS Success Model as an organizing framework for this monograph due to the Model's utility, comprehensiveness, parsimony, and popularity. We will also rely heavily on findings from the portfolio of our other previous articles on information systems success. A complete list of our research papers on information systems success can be found in Appendix A. In the next section, we introduce and explain the model, its foundations, and its application.

## 1.2 The DeLone and McLean model

Early attempts to define information system success were ill-defined due to the complex, interdependent, and multi-dimensional nature of IS success. To address this problem, we, William DeLone and Ephraim McLean, performed a review of the research published during the period 1981–1990 and created a taxonomy of IS success based on Shannon and Weaver's [1949] Theory of Communication. Shannon and Weaver defined the *technical* level of a communication system as the accuracy and efficiency of the system that produces the information; the *semantic* level, as the success of the system in conveying the intended meaning; and the *effectiveness* level, as the effect of the information on the receiver.

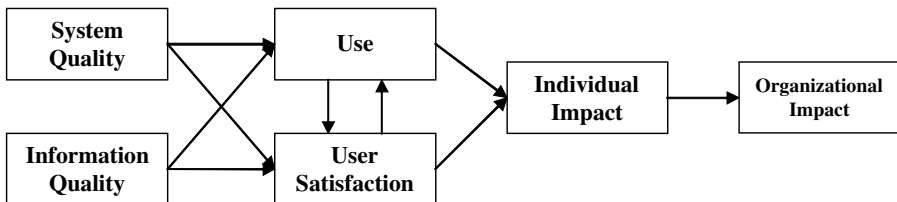
Applying Shannon and Weaver's communication theory to information systems, Mason [1978] relabeled "effectiveness" as "influence" and

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]. Based on Mason’s taxonomy of an information system and our literature review, we identified six dimensions of IS success measurement: System Quality (technical level); Information Quality (semantic level); and Use, User Satisfaction, Individual Impact, and Organizational Impact (influence level).

However, we were quick to note that these six dimensions and related measures were not *independent* success measures, but were *interdependent* variables. Therefore, to measure information system success, all six constructs must be measured and/or controlled. Failure to account for all six can lead to possible confounding results or an incomplete understanding of the system under investigation. Research on IS success that measures only some of these variables, and fails to measure or control for the others, has resulted in the many conflicting reports of success that are found in the IS success literature.

Based upon these six measures, we devised the DeLone and McLean IS Success Model, hereafter referred to as the D&M Model. The D&M Model was thus intended to be “both complete and parsimonious” and, as such, has proved to be widely used and cited by many researchers, with over 8,000 published citations to date according to Google Scholar. Figure 1.1 shows this original IS success model [DeLone and McLean, 1992].

Shortly after the publication of the D&M Model in 1992, a number of IS researchers began proposing modifications to the model. For



**Figure 1.1:** DeLone and McLean IS Success Model (1992), used with permission.

instance, Seddon [1997] proposed several changes to the D&M Model. He contended that the D&M Model was confusing, partly because both process and variance models were combined within the same framework. He claimed that this was a *shortcoming* of the model, but we responded that we believed that this was one of its *strengths*, with the insights that were provided by combining process and variance models being richer than either was alone [DeLone and McLean, 2003].

Seddon also suggested that our concept of “Use” was highly ambiguous and suggested that further clarification was needed to this construct. In response to this suggestion, we decided to add the variable “Intention to Use” to the “Use” construct. We explained this new construct as follows: “Use must precede ‘User Satisfaction’ in a *process* sense, but positive experience with ‘Use’ will lead to greater ‘User Satisfaction’ in a *causal* sense” [DeLone and McLean, 2003]. We went on to state that increased “User Satisfaction” will lead to a higher “Intention to Use,” which will subsequently affect “Use.” The concept of Use and the rationale for combining process and variance models will be discussed in more detail in Section 2.4 of this monograph.

Other researchers have suggested that the variable “Service Quality” be added to the D&M Model. An instrument from the marketing literature, SERVQUAL, has become salient within the IS success literature. SERVQUAL measures the Service Quality of information technology *organizations*, as opposed to individual IT *applications*, by measuring and comparing user expectations and their perceptions of the effectiveness of the information technology organization. Pitt et al. [1995] evaluated the SERVQUAL instrument from an IS perspective and suggested that this construct of Service Quality be added to the D&M Model. This concept of IS Service Quality is similar to the widely used ITIL [Information Technology Infrastructure Library, 1989] methodology for IT Service Management and its measures of IT Service Value.

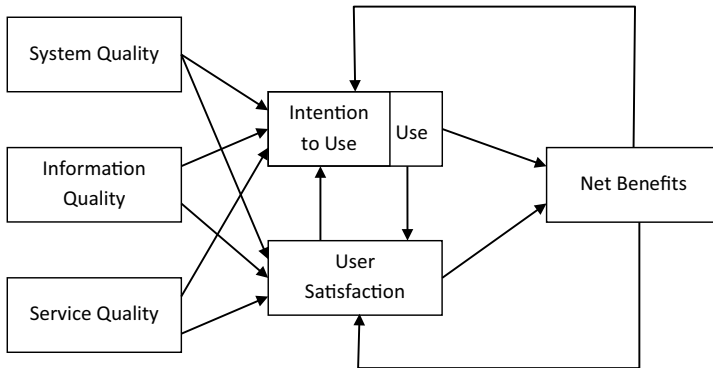
We were also moved to examine the two end constructs in the original D&M Model: Individual and Organization Impacts. Our rationale for these two levels of impact was the recognition that IS systems must first affect, i.e., impact, individuals and then, through them, the

organization. However, a number of researchers have suggested that there are other levels of IS impact, such as work-group impacts [Ishman, 1998, Myers et al., 1998], interorganizational and industry impacts [Clemons and Row, 1993, Clemons et al., 1993], consumer impacts [Brynjolfsson, 1996, Hitt and Brynjolfsson, 1994], and societal impacts [Seddon, 1997]. Clearly, there is a continuum of ever-increasing impacts, from individuals to national economic activity, which could be affected by IS systems. The choice of where impacts should be measured will depend on the system or systems being evaluated and their purposes. But rather than complicate the model with more success measures, with a measure for each impact level, we chose to move in the opposite direction and group all the “Impact” measures into a single impact or benefit category called “Net Benefits.”

Lastly, we recognized that information systems are not static but dynamic, reinforcing our use of a process perspective in our model. After the benefits, or lack of benefits, in the system are realized, there are feedback loops to “User Satisfaction” and to “Use,” causing a new iteration of more (or less) “Use” and greater (or lesser) “User Satisfaction,” depending upon whether the “Impacts” are positive or negative. To reflect this, we added these feedback loops into the model.

Responding to these proposed modifications to our model, and reviewing the empirical studies that had been performed during the years since 1992 when the original model was published, we revised the model accordingly [DeLone and McLean, 2002, 2003], adding the variables “Intention to Use” and “Service Quality,” collapsing “Individual Impact” and “Organization Impact” into “Net Benefits,” and adding feedback loops from “Net Benefits” back to “Use” and “User Satisfaction.” The 2003 D&M Model is shown in Figure 1.2.

Subsequent to the publication of the 2003 updated D&M Model, we have made two additional changes. First, in the updated D&M Model (shown in Figure 1.2) we used the term “Net Benefits” to represent the end point measure of success. We have reconsidered this name and concluded that “Net Impacts” would be a better title than “New Benefits” because “Benefits” implies only positive results. Our intent was for the model to recognize that both *positive* and *negative* outcomes could occur. With positive outcomes, this would lead to more “Use”



**Figure 1.2:** Updated DeLone and McLean IS Success Model (2003), used with permission.

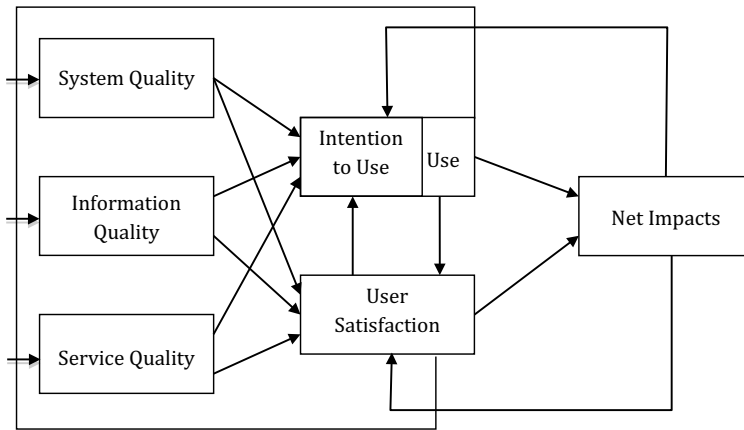
and higher “User Satisfaction.” On the other hand, negative outcomes would discourage “Use” and lead to lower “User Satisfaction.” For this reason, we have replaced the term “Net Benefits” with the term “Net Impacts” in future representations of the model.

A second change is to recognize the need for an additional set of feedback loops. With increased experience in using a system, problems come to light and possible improvements are recognized, leading to requests for changes and updates to the system, what is commonly called “maintenance.” These changes are the next steps in the evolving process of the life cycle of the system. To capture this graphically, feedback arrows are shown leading from “Use” and “User Satisfaction” back to “System Quality,” “Information Quality,” and “Service Quality.” This modified revision of the 2003 D&M Model is shown in Figure 1.3.

The last part of this discussion of the D&M Model is to describe the individual success variables: “System Quality,” “Information Quality,” “Service Quality,” “Use,” “User Satisfaction,” and “Net Impacts.” They are defined as:

- *System Quality* — the desirable characteristics of an information system. For example, ease of use, system flexibility, system





**Figure 1.3:** Updated DeLone and McLean 2003 IS Success Model (modified).

reliability, and ease of learning, as well as system features of intuitiveness, sophistication, flexibility, and response times.

- *Information Quality* — the desirable characteristics of the system outputs; i.e., management reports and Web pages. For example, relevance, understandability, accuracy, conciseness, completeness, understandability, currency, timeliness, and usability.
- *Service Quality* — the quality of the support that system users receive from the information systems organization and IT support personnel. For example, responsiveness, accuracy, reliability, technical competence, and empathy of the IT personnel staff. SERVQUAL, adapted from the field of marketing, is a popular instrument for measuring IS Service Quality [Pitt et al., 1995].
- *Use* — the degree and manner in which employees and customers utilize the capabilities of an information system. For example, amount of use, frequency of use, nature of use, appropriateness of use, extent of use, and purpose of use.
- *User Satisfaction* — users' level of satisfaction with reports, Web sites, and support services. For example, a couple of the most

widely used multi-attribute instruments for measuring user information satisfaction (UIS) are Ives et al. [1983] and Doll and Torkzadeh [1988].

- *Net Impacts* — the extent to which information systems are contributing (or not contributing) to the success of individuals, groups, organizations, industries, and nations. For example: improved decision-making, improved productivity, increased sales, cost reductions, improved profits, market efficiency, consumer welfare, creation of jobs, and economic development. Brynjolfsson, Hitt, and Yang [2000] have used production economics to measure the impacts of IT investments on firm-level productivity.

The practical application of the D&M Model as described earlier is naturally dependent on the organizational context. The selection of the particular success dimensions and the specific metrics are dependent on the nature and purpose of the system(s) being evaluated. For example, an e-commerce application, in contrast to an enterprise resource planning system application, would have some similar success measures and some different success measures. Both systems would measure information accuracy, while the e-commerce system is more likely to measure the personalization of information presentation than an ERP system that uses standard report formats. Similar differences in measures and metrics would be encountered in attempting to measure the success of IS systems in healthcare or government applications.

In the next section, the background and history of the developing of IS Success measures is discussed.

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