

Information Systems Success Revisited

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Abstract

The DeLone & McLean IS Success Model has become a standard for the specification and justification of the measurement of the dependent variable in information systems research. Attempts to apply and test the model have resulted in both confirmation and challenges. This paper reviews and analyzes over 150 articles which have referenced the model over the past eight years in order to examine what more we have learned about measuring IS success. It highlights recent contributions to IS success measurement and proposes a Reformulated IS Success Model which recognizes and incorporates those contributions. The report concludes with recommendations for future IS success measurement.

1. Introduction

The measurement of information systems success or effectiveness is critical to our understanding of the value and efficacy of IS management actions and IS investments. In 1992, we published a paper (DeLone & McLean 1992) in which we attempted to bring some awareness and structure to the “dependent variable” – information systems success – in IS research. We proposed a taxonomy and an interactive model as frameworks for con-

ceptualizing and operationalizing IS success, hereafter referred to as the D&M IS Success Model. Since then, over 150 articles in refereed journals and conference proceedings have referred to, and made use of, this IS Success Model. Five of the nine articles in Garrity & Sanders’ 1998 book, *Information System Success Measurement*, focus explicitly on issues related to the D&M IS Success Model. The IS success section of the ISWorld Web site is currently organized according to the D&M success taxonomy. The wide popularity of the model is strong evidence of the need for a comprehensive framework for integrating IS research findings.

The D&M IS Success Model, though published in 1992, was based on theoretical and empirical IS research conducted by a number of researchers in the 1970s and 1980s. The role of information systems has changed and progressed during the last decade. Similarly, academic inquiry into the measurement of IS effectiveness has progressed over the same period. The purpose of this paper therefore is to revisit, reexamine, and reformulate the D&M IS Success Model and IS measurement practice in light of this rich body of recently published research.

2. The D&M IS Success Model

The primary purpose of the 1992 article in *Information Systems Research* was to synthesize previous research involving MIS success into a

more coherent body of knowledge and to provide guidance to future researchers. Based on the communications research of Shannon and Weaver (1949) and the information “influence theory” of Mason (1978), as well as empirical MIS research studies from 1981-1987, a comprehensive, multidimensional model of IS success was postulated. The model consists of six interrelated dimensions of success: SYSTEM QUALITY, INFORMATION QUALITY, SYSTEM USE, USER SATISFACTION, INDIVIDUAL IMPACTS, and ORGANIZATIONAL IMPACTS.

The resultant D&M IS Success Model is reproduced in Figure 1 (DeLone & McLean 1992, p.87).

The primary conclusions of the original paper were:

1. The multidimensional and interdependent nature of I/S success requires careful attention to the definition and measurement of each aspect of this dependent variable. It is important to measure the possible interactions among each of the success dimensions in order to isolate the effect of various independent variables with one or more of these dependent success dimensions.
2. Selection of success dimensions and measures should be contingent on objectives

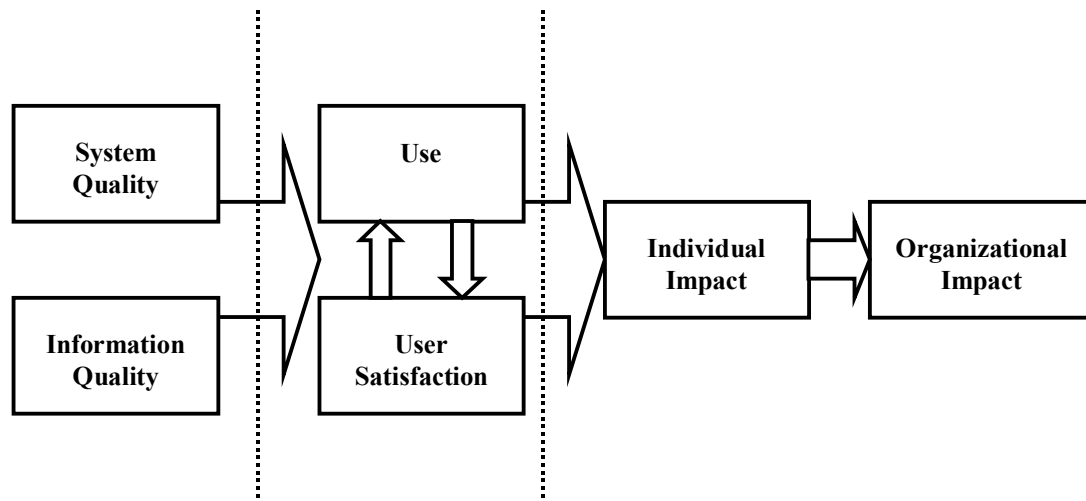
and context of the empirical investigation; but, where possible, tested and proven measures should be used.

3. Despite the multidimensional and contingent nature of IS success, an attempt should be made to reduce significantly the number of different measures used to measure IS success so that research results can be compared and findings validated.
4. More field-study research should investigate and incorporate organizational impact measures.
5. Finally, “This success model clearly needs further development and validation before it could serve as a basis for the selection of appropriate IS measures,” (DeLone & McLean 1992, p.88).

3. Subsequent Research

As we had hoped, each of the above five conclusions has been tested and challenged over the past eight years, resulting in a deeper understanding of IS success. In this section, we summarize the research work that relates to the D&M IS Success Model, focusing both on researchers who have used our model in some aspect of their own research and, more particularly, on those scholars who have provided critiques of the model itself.

FIGURE 1. D&M IS Success



(Source: DeLone & McLean, 1992, p. 87)

4. Citations of the D&M IS Success Model

A citation search in the fall of 1999 yielded 144 refereed journal articles and 15 papers from the International Conference on Information Systems (ICIS) that have referenced the D&M Model during the period 1993 to mid 1999. Many of these articles positioned their measurement and/or the development of their dependent variable within the context of the D&M framework. By using the model as a common framework for reporting and comparing research work involving I/S success or effectiveness, one of the primary purposes of the original article has been achieved. Table 1 summarizes the frequency with which the model has been cited in articles published in a number of prominent MIS journals.

Although many of these cited articles tended to justify their empirical measurement of IS

success by citing the D&M Model, a number of them have failed to heed our cautions. They used the model like a drunkard uses a lamppost -- for support rather than for illumination. They missed the main conclusion of the article -- that IS success is a multidimensional construct -- and thus failed to study the interrelationships among, or to control for, these dimensions.

“Researchers should systematically combine individual measures from the IS success categories to create a comprehensive measurement instrument” (DeLone & McLean 1992, pp. 87-88). While it is disappointing that our article did not influence these researchers to take more care in defining and measuring the various dimensions of IS success, other authors have used multidimensional measures of IS success in their empirical studies. Some of those are summarized in the next section.

Table 1

Journal Articles Citing the DeLone & McLean IS Success Model
(Excludes a number of conference proceedings that also cite the model)

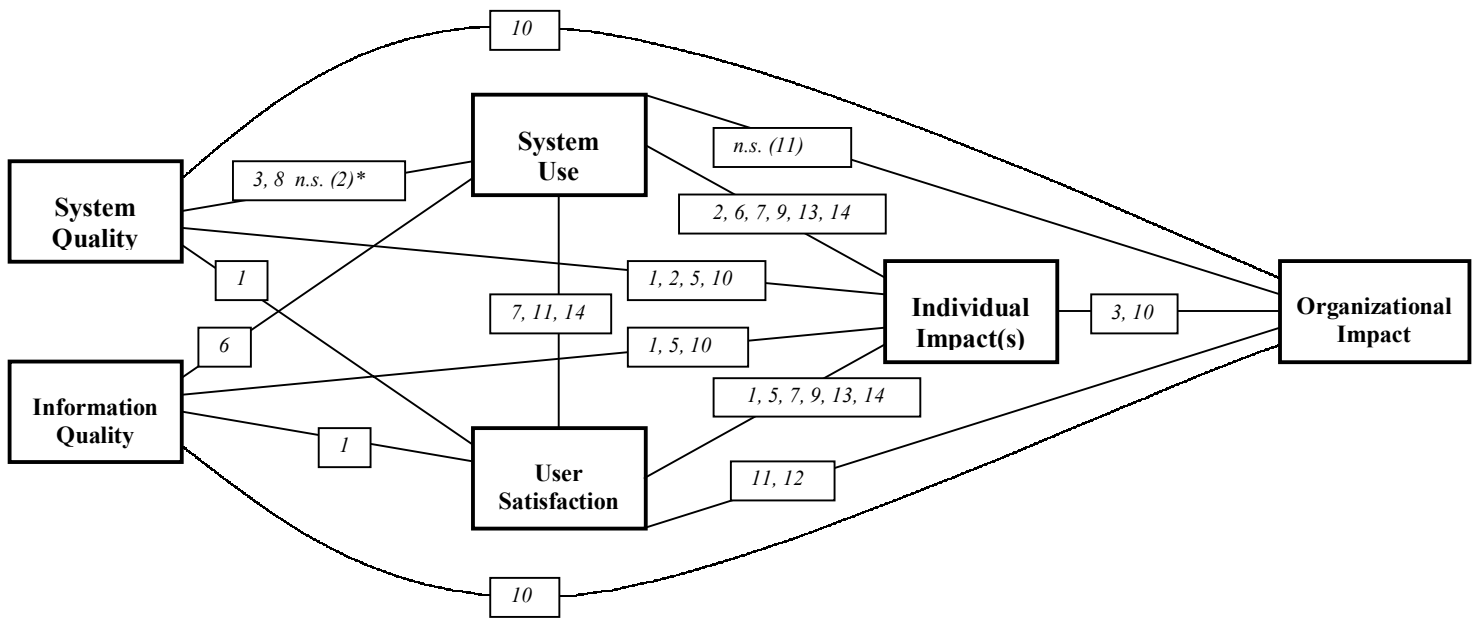
| Journals | Number of Articles Citing the Model |
|--|--|
| <i>Information & Management</i> | 24 |
| <i>Journal of Management Information Systems</i> | 11 |
| <i>MIS Quarterly</i> | 15 |
| <i>European Journal of Information Systems</i> | 10 |
| <i>Information Systems Research</i> | 7 |
| <i>Decision Sciences</i> | 6 |
| <i>Omega – International Journal of Management Science</i> | 6 |
| <i>Management Science</i> | 4 |
| <i>IEEE journals</i> | 4 |
| <i>Communications of the ACM</i> | 2 |
| <i>IBM Systems Journal</i> | 1 |
| Other journals | 54 |
| Total | 144 |

5. Empirical Tests of the D&M Model

Unlike a process model, which merely states that B follows A, a causal model postulates that A causes B; i.e., increasing A will cause B to increase (or decrease). In the 1992 article, we proposed such interrelationships among the dimensions in our model; but we did not test them empirically. Since 1992, a number of studies have undertaken empirical investigations of the multidimensional relationships among the measures of IS success. Some of these studies explicitly tested the associations among the measures identified in the D&M IS Success Model (Seddon & Kiew 1994, Goodhue & Thompson 1995, Etezadi-Amoli & Farhoomand

1996, Jurison 1996, Guimaraes & Igarria 1997, Igarria & Tan 1997, Teo & Wong 1998). Other empirical studies have implicitly tested the model by investigating multiple success dimensions and their interrelationships (Teng & Calhoun 1996, Igarria et al. 1997, Gelderman 1998, Yoon, Guimaraes & Clevenson 1998, Yuthas & Young 1998, Trokzadeh & Doll 1999). Figure 2 displays the D&M IS Success Model and the relationships confirmed (or not confirmed) in the cited empirical studies. Taken as a whole, these empirical studies give strong support for the proposed associations among the success dimensions and help to confirm the causal structure in the model.

FIGURE 2. Tests of Associations Among IS



- | | |
|---|--|
| 1. Seddon & Kiew (1994) | 8. Igarria, Zinatelli, Cragg & Cavaye (1997) |
| 2. Goodhue & Thompson (1995) *mandatory use | 9. Guimaraes & Igarria (1997) |
| 3. Taylor & Todd (1995) | 10. Teo & Wong (1998) |
| 4. Jurison (1996) | 11. Gelderman (1998) |
| 5. Etezadi-Amoli & Farhoomand (1996) | 12. Yoon, Guimaraes & Clevenson (1998) |
| 6. Teng & Calhoun (1996) | 13. Yuthas & Young (1998) |
| 7. Igarria & Tan (1997) | 14. Torkzadeh & Doll (1999) |

6. Model Enhancements

In addition to the many papers which have cited and used the D&M IS Success Model, several articles have been published which directly or indirectly validate, challenge, critique, or extend the model itself. On balance, these articles have contributed to a better understanding of success and its dimensions. These articles and the issues they raise to the IS Success Model are summarized below.

7. Process vs. Causal Models

The D&M IS success taxonomy and its six success categories are based on a process model of information systems (Shannon & Weaver 1949). In addition, we argue that the six dimensions are interrelated, resulting in a success model which indicates that causality flows in the same direction as the information process flows. However, Seddon (1997) argues that DeLone and McLean have “attempted to combine both process and causal explanations of IS success in their model. After working with this model for some years, it has become apparent that the inclusion of both variance and process interpretations in their model leads to so many potentially confusing meanings” (Seddon 1997, p.240). Seddon goes on to propose a respecified variance model of IS success.

We agree with Seddon’s premise that the combination of process and variance interpretations of IS success in one model can be confusing. However, we believe that Seddon’s reformulation of the D&M Model into two partial variance models (Seddon, 1997, p. 245) unduly complicates the success model, defeating the intent of the original model. His extensive discussion of use-as-a-behavior verses use-as-a-surrogate-for-benefits causes him to reject “use” as a success variable, substituting “perceived usefulness” for it. However, perceived usefulness and user satisfaction are so conceptually intertwined that they defy separate measurement. For the reasons discussed below, use as a construct is not without its problems; but, we believe, it still deserves a place in the model.

8. System Use as a Success Measure

Seddon (1997) argues for the removal of SYSTEM USE as a success variable in the causal success model, claiming that *use* is a behavior, appropriate for inclusion in a process model but not in a causal model. He argues that use must *precede* impacts and benefits, but it does not *cause* them. We disagree. We believe that system usage is an appropriate measure of success in many cases.

The problem to date has been a too simplistic definition of this complex variable. Simply saying that more use will yield more benefits, without considering the nature of this use, is clearly insufficient. Researchers must also consider the extent, nature, quality, and appropriateness of the system use. Is the full functionality of a system being used for the intended purposes? Is it being used to the fullest extent? Simply measuring the amount of time a system is used does not properly capture the relationship between usage and the realization of expected results. On the other hand, it can be argued that *declining* usage may be an important indication that the anticipated benefits are not being realized.

The rejection of system use as a success variable when system usage is mandatory is also flawed for the reasons cited above. Even when use is required, variability in the quality and intensity of this use is likely to have a significant impact on the realization of the system benefits. Furthermore, no systems use is totally mandatory. At some level of the organization, an executive or management committee has chosen to implement a system and to require employees to use it. Thus, while usage of a system may be mandatory at one level, the continued adoption and use of the system itself may be wholly voluntary, based upon management judgment, at a higher level. Management always has the option of discontinuing a system that is not providing the desired results and benefits.

System usage continues to be used as a dependent variable in a number of empirical studies and continues to be developed and tested by IS researchers. We agree with them and believe that use, *especially informed and effective use*, will continue to be an important indication of IS success.

9. Model Extensions -- Service Quality

The emergence of end-user computing in the mid-1980s placed information systems organizations in the dual role of *information provider* (producing an information product) and *service provider* (providing support for end-user developers). Pitt et al. observed that “commonly used measures of IS effectiveness focus on the products rather than the services of the IS function. Thus, there is a danger that IS researchers will mismeasure IS effectiveness if they do not include in their assessment package a measure of IS service quality” (Pitt et al. 1995, p. 173). Other researchers have agreed with this, citing the need for a service quality measure to be a part of IS success (Kettinger & Lee 1995, Li 1997, Wilkin & Hewitt 1999).

Researchers who have argued that service quality be added to the success model have applied and tested the SERVQUAL measurement instrument from marketing (Pitt, Watson & Kavan 1995, Kettinger & Lee 1995). This instrument uses the dimensions of *tangibles*, *reliability*, *responsiveness*, *assurance*, and *empathy* to measure service quality. However, recent empirical research (Van Dyke, Prybutok, & Kappelman, 1999) has challenged this SERVQUAL metric, identifying “problems with the reliability, discriminant validity, convergent validity, and predictive validity of the measure. . . [F]urther work is needed in the development of measures for assessing the quality of information services.” While we agree with the concerns expressed about this particular metric, we nevertheless believe that SERVICE QUALITY, properly measured, deserves to be added to SYSTEM QUALITY and INFORMATION QUALITY as components of IS success. Although a claim could be made that SERVICE QUALITY is merely a subset of the model’s SYSTEM QUALITY, the changes in the role of IS over the last decade argue for a separate variable -- the SERVICE QUALITY dimension.

Of course, each of these quality dimensions will have different weights depending upon the level of analysis. To measure the success of a single system, INFORMATION QUALITY or SYSTEM QUALITY may be the most important quality component. For measuring the overall

success of the IS department, as opposed to individual systems, SERVICE QUALITY may become a more important variable.

10. Model Extensions -- Impacts

As the impacts of information systems have evolved beyond the immediate user, researchers have suggested additional IS impact measures, such as workgroup impacts (Myers et al. 1998, Ishman 1998), interorganizational and industry impacts (Clemons & Row 1993; Clemons, Reddi & Row 1993), consumer impacts (Hitt & Brynjolfsson 1994; Brynjolfsson 1996), and societal impacts (Seddon 1997). Clearly, there is a continuum of ever-increasing entities, from individuals to national economic accounts, which could be impacted or affected by IS activity. The choice of where the impacts should be measured will depend on the system or systems being evaluated and their purposes. Rather than complicate the model with more success measures, we prefer to move in the opposite direction and group all the impact measures into a single impact or benefit category called NET BENEFITS. This is discussed further in the Analysis and Recommendations section.

11. Independent versus Dependent Variables

In addition to the many published critiques and extensions to the D&M Model, a number of people have come forward privately to offer suggested improvements to the model. These suggestions have taken two forms. One, like the discussion above on impacts, has urged greater granularity, breaking down a dimension like ORGANIZATIONAL IMPACT into workgroup impact, departmental impact, divisional impact, and so forth. Although, for some studies, such finer granularity might be appropriate, we resisted such further refinements for the sake of parsimony.

The second set of suggestions flow from a confusion between what is an independent variable and what is part of the dependent variable, IS success. “User involvement” and “top management support” are but two examples of suggested additions to the D&M Model; yet these are clearly variables that may *cause* success rather than being a part *of* success.

“Investing in ERP” may (or may not) lead to improved INFORMATION QUALITY (an aspect of IS success), but the former is an independent variable while the latter is part of the dependent variable.

12. Role of Context

Several researchers have commented on the difficulty of applying the D&M IS Success Model in order to define and operationalize IS success in specific research contexts. This was not unexpected: “This success model clearly needs further development and validation before it could serve as a basis for the selection of appropriate IS measures” (DeLone & McLean 1992, p. 88). Jiang & Klein (1999) found that users prefer different success measures depending on the type of system being evaluated. Whyte et al. found that “there are important differences deriving from organizational, user, and systems variations which can modify the view as to which attributes (success measures) are important” (Whyte et al. 1997, p. 65). Seddon et al. (1998) make an important contribution by proposing a two-dimensional matrix for classifying IS effectiveness measures based on the type of system studied and on the stakeholder in whose interest the information system is being evaluated. In this regard, we completely agree. As stated in the 1992 article “no single variable is intrinsically better than another, so the choice of success variables is often a function of *the objective of the study, the organizational context* [emphasis added], . . . etc. (DeLone & McLean 1992, p. 80).

13. Other Success Frameworks

Not all of the researchers have attempted to critique or modify the D&M IS Success Model. Some have developed and proposed alternate frameworks for measuring IS effectiveness with little attempt to reconcile their frameworks with our model. Grover, Jeong & Segars (1996) created six effectiveness categories based on Unit of Analysis and Evaluation Type context dimensions. The six effectiveness classes are *infusion measures, market measures, economic measures, usage measures, perceptual measures, and productivity measures*. Smithson and

Hirschheim (1998) proposed a framework that consists of three “zones” of measures: namely, *efficiency, effectiveness, and understanding*.

We reviewed these alternate frameworks carefully in order to see if they introduced new success dimensions that are not covered in the D&M Model. We have concluded that, while interesting and informative, these frameworks do not introduce any new constructs not present in our original model.

14. Analysis and Recommendations

As discussed earlier in the section on Model Enhancements, Seddon (1997) poses a challenge to the D&M Success Model. Citing an earlier paper by Newman and Robey (1992), Seddon states that “the boxes and arrows in variance- and process-model diagrams represent quite different concepts and cannot be combined meaningfully in one model. . . . Unfortunately, combining variance and process models is exactly what [DeLone and McLean] attempted to do.”

In the present context, a process model has just three components: the creation of a system, the use of the system, and the consequences of this system use. Each of these steps is a *necessary, but not sufficient, condition* for the resultant outcome(s). For instance, without system use, there can be no consequences or benefits. However, with system use, even extensive use, which is inappropriate and/or ill-informed, there may also be no benefits. Thus, to understand fully the dimensions of IS success, a variance model is also needed.

The creation of the D&M IS Success Model was driven by a process understanding of information systems and their impacts. On the other hand, as Seddon (1997) has found, the application of our model to empirical research requires a contextual variance specification of the model. Here too there are three components: the first is production, the second is use, and the third is net benefits. As discussed earlier, it now seems appropriate to add a third dimension, SERVICE QUALITY, to the two original system characteristics, SYSTEMS QUALITY and INFORMATION QUALITY. Conversely, as discussed earlier, it appears more parsimonious to combine INDIVIDUAL and ORGANIZATIONAL IMPACTS into a single variable, NET BENEFITS.

This new variable, NET BENEFITS, immediately raises three issues that must be taken into account: what qualifies as a “benefit”? for whom? and at what level of analysis? In the original formulation of the D&M Model, the term “impact” was used. Seddon (1997) used “consequences” and “net benefits” in his characterization of the outcomes. We have come to prefer the term NET BENEFITS ourselves because our original term IMPACTS may be positive or negative, thus leading to a possible confusion as to whether the results are good or bad. Also, the inclusion of “net” in NET BENEFITS is important because no outcome is wholly positive, without any negative consequences. Thus “net benefits” is probably the most accurate descriptor of the final success variable.

The second issue of concern is: benefits for whom -- the designer, the sponsor, the user, or others? Different actors or players may have different opinions as to what constitutes a benefit to them. Thus it is impossible to define these NET BENEFITS without first defining the context or frame of reference. The fact that the D&M Model does not define this context is a matter of detail, not of oversight. The focus of any proposed study must be defined. Our model may be useful both to Microsoft and to the user community, but each may have a very different definition of what constitutes net benefits and thus IS success.

Finally, the level of analysis must be addressed. Are the benefits to be measured from the individual’s perspective, his or her employer, or that of the industry or of the nation? Collapsing INDIVIDUAL and ORGANIZATIONAL IMPACTS into a single variable, NET BENEFITS, does not make the problem go away. It merely transfers the need to specify the focus of analysis to the researcher.

Based on these considerations, we have reformulated the original D&M IS Success Model as a foundation for framing future IS empirical research.

15. The Reformulated D&M IS Success Model

Based on research contributions since our original article and based on changes in the role

and management of information systems, we have reformulated our original success model. The reformulated model is presented on Figure 3.

As discussed earlier, quality has three major dimensions: INFORMATION QUALITY, SYSTEMS QUALITY, and SERVICE QUALITY. Each should be measured – or controlled for -- separately, because singularly or jointly, they will affect subsequent USE and USER SATISFACTION.

Given the difficulties in interpreting the multidimensional aspects of USE – mandatory versus voluntary, informed versus uninformed, effective versus ineffective, etc. – we suggest INTENTION TO USE may be a worthwhile alternative measure. INTENTION TO USE is an attitude, while USE is a behavior. Substituting the former for the latter may resolve some of the process versus causal concerns that Seddon (1997) has raised. However, attitudes, and their links with behavior, are notoriously difficult to measure; and many researchers may choose to stay with USE, but hopefully with a more informed understanding of it.

As was true in the original formulation of the D&M Model, USE and USER SATISFACTION are closely interrelated. USE must precede USER SATISFACTION in a *process* sense, but positive experience with USE will lead to greater USER SATISFACTION in a *causal* sense. Similarly, increased USER SATISFACTION will lead to increased INTENTION TO USE and thus USE.

As a result of this USE and USER SATISFACTION, certain NET BENEFITS will occur. If the information system or service is to be continued, it is assumed that the NET BENEFITS from the perspective of the owner or sponsor of the system are positive, thus influencing and reinforcing subsequent USE and USER SATISFACTION. These feedback loops are still valid, however, even if the NET BENEFITS are negative. The lack of positive benefits is likely to lead to decreased use and possible discontinuance of the system or of the IS department itself (e.g., wholesale outsourcing). The challenge for the researcher is to define clearly and carefully the stakeholders and context in which NET BENEFITS are to be measured.

16. Conclusions

Despite the recent research studies which both support and challenge the original D&M IS Success Model, we believe that our original conclusions still form a sound basis for IS success measurement. The changes in the Reformulated IS Success Model are largely changes in degree, not in kind. The addition of SERVICE QUALITY and the collapsing of INDIVIDUAL IMPACTS and ORGANIZATIONAL IMPACT into NET BENEFITS still preserves the parsimonious nature of the Model.

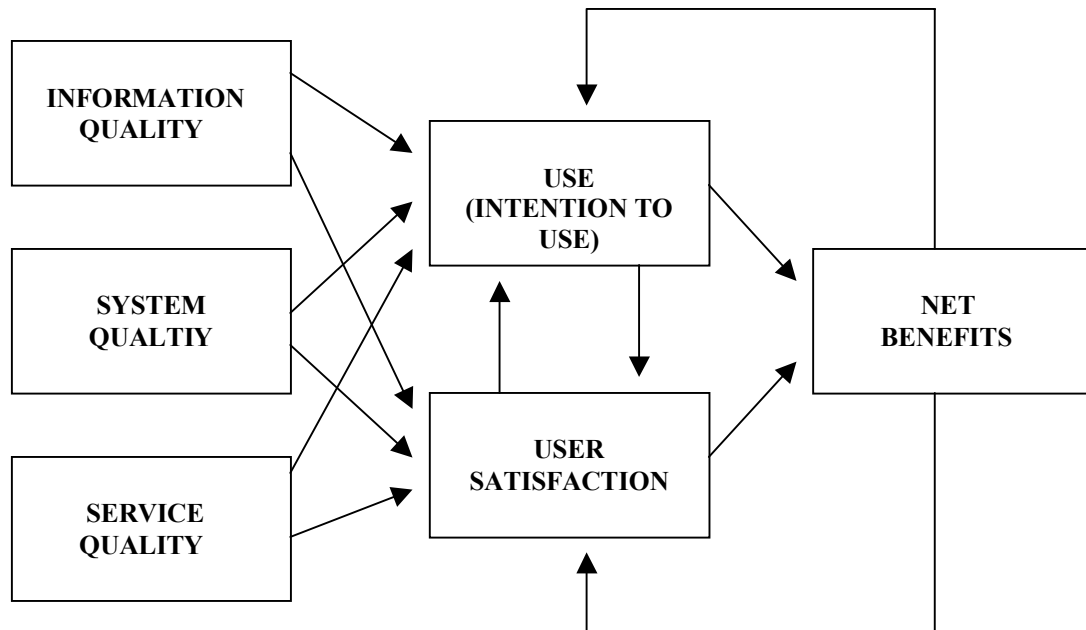
In closing, it is worth repeating some of the conclusions contained in our original paper, as modified by the experience of the last eight years.

1. The multidimensional and interdependent nature of I/S success requires careful attention to the definition and measurement of each dimension of this dependent variable.

It is important to measure the possible interaction of these success dimensions in order to isolate the effect of various independent variables with one or more of these dependent success dimensions. The Reformulated D&M IS Success Model in Figure 3 presents the interdependent relationships which should continue to be tested. The selection of success dimensions and measures should be contingent on the objectives and context of the empirical investigation; but, where possible, tested and proven measures should be used.

2. Despite the multidimensional and contingent nature of IS success, an attempt should be made to reduce significantly the number of measures used to measure IS success so that research results can be compared and findings validated.

FIGURE 3. The Reformulated IS Success



3. Despite the multidimensional and contingent nature of IS success, an attempt should be made to reduce significantly the number of measures used to measure IS success so that research results can be compared and findings validated.
4. More field-study research should investigate and incorporate NET BENEFITS measures. Yuthas and Young (1998) support this conclusion: “[E]xamining satisfaction and usage measures is not an acceptable alternative to measuring performance (Net Benefits) directly. Although the three variables are correlated, the relationships between them are not sufficiently strong to warrant their use as substitutes for one another,” (Yuthas & Young 1998, p. 121). Good progress has been made in the development and testing of NET BENEFITS measures.
5. Finally, we propose that the Reformulated D&M IS Success Model continue to serve as a foundation for the positioning and comparing of IS empirical research. The Model should continue to be tested and challenged. The changes introduced in this report are examples of this continued growth and refinement. We encourage others to join in this effort.

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