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A Methodological Examination of Empirical Research on Information Systems Success: 2003 to 2007

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ABSTRACT

Measuring information systems (IS) success has been and is of great interest to both researchers and practitioners. This article examines multidimensional approaches to measuring IS success and explores the current state of IS success research through a literature review and by classifying empirical articles that were published between 2003 and 2007. Based on a total of 41 academic journal and conferences publications, this paper identifies the relevant research carried out, categorizes and consolidates the research results, and discusses them. The results show that the dominant empirical research is that which analyzes the individual impact of a certain type of information system that the users evaluate by means of surveys and structural equation modeling. The DeLone and McLean Information Systems Success Model is the main theoretical basis of the reviewed studies. The results provide researchers who are new to this topic with a comprehensive review of IS success research. Furthermore, opportunities for additional development are identified and future research directions suggested.

Keywords

Information Systems Success, Information Systems Effectiveness, Literature Review.

INTRODUCTION

The annual worldwide spending on information technology (IT) has been increasing for many years. By 2010, International Data Cooperation expects the total expenditure on IT to reach 1.48 trillion US dollars (IDC 2007). Simultaneously, however, a greater number of information systems (IS) failures are still emerging. A questionnaire-based survey carried out at US financial institutions and various companies in northeastern USA in 2006 indicated that only 62% of software projects were considered successful (Verner, Cox and Bleistein 2006). The measurement of investments and developed systems' success remains a top concern for both practitioners and researchers due to the high investments, the number of IS failures, and the paradox of high investments and low productivity returns (productivity paradox).

During the last two and a half decades, research measuring information systems success – thus clarifying the dependent variable in IS research – has been popular. A number of models have been proposed in attempts to define IS success and identify the various causes of success. The purpose of this article is to present and classify the current state of research on the measurement of IS success. More concretely, the following questions are addressed:

- Which multidimensional approaches for assessing IS success are found in the scientific literature?
- Which research designs were applied in past empirical studies?
- What were the analysis objects evaluated in this empirical research?

Literature published between 2003 (the publication year of the updated DeLone and McLean IS Success Model (D&M IS Success Model)) and 2007 was analyzed by means of a structured literature review approach to answer these questions. The review attempted to systematically analyze, categorize, and synthesize a specified pool of journal and conference papers to provide a comprehensive overview of prior research in this area. According to Webster and Watson (1998), an effective

literature review creates a firm foundation for advancing knowledge, eliminates areas where there is a plethora of literature, and uncovers areas where research is needed. This article tries to provide such an effective review and, thus, a theoretical basis for future research. The results of this paper could be especially relevant for researchers who are new to this field of research and who wish to obtain an overview of the topic, as well as insights into the latest publications.

FOUNDATIONS

The IS literature provides several definitions and measures of IS success. As DeLone and McLean (1992) state, there are nearly as many measures as there are studies. Obviously, there is no ultimate definition of IS success. As there are different stakeholders who assess IS success in an organization (Grover, Jeong and Segars 1996), each group has a different definition. From a software developer perspective, a successful information system is completed on time and under budget, has a set of features that is consistent with the specifications, and functions correctly. Users may find an information system successful when it improves their work satisfaction or work performance. From an organizational perspective, a successful information system may contribute to the company's profits or create a competitive advantage. Consequently, success is always assessed from a certain stakeholder's point of view. Furthermore, IS success also depends on the type of system that is evaluated (Seddon, Staples, Patnayakuni and Bowtell 1999).

In order to provide a more general and comprehensive definition of IS success that covers these different points of view, DeLone and McLean (1992) reviewed the existing definitions of IS success and their corresponding measures, and classified them into six major categories. Thus, they created a multidimensional measuring model with interdependencies between the different success categories. The D&M IS Success Model received much attention from IS researchers. Since its publication, many researchers have treated IS success as a multidimensional construct and have measured it as such.

Motivated by DeLone and McLean's call for further development and validation of their model, many researchers have attempted to extend or respecify the original model. A number of researchers claim that the DeLone and McLean model is incomplete and suggest that more dimensions should be included in the model or present alternative success models (e.g., Seddon 1997; Seddon and Kiew 1994). Other researchers focus on the application and validation of the model (e.g., Rai, Lang and Welker 2002). Although some weaknesses have been revealed, the D&M IS Success Model has become the dominant model for measuring IS success (e.g., Hu 2003).

Ten years after the publication of their first model and based on the evaluation of the many contributions to it, DeLone and McLean proposed an updated IS success model, as depicted in Figure 1 (DeLone and McLean 2002, 2003). The primary differences between the original and the updated model are: (1) the addition of "service quality" to reflect the importance of service and support in successful e-commerce systems; (2) the addition of "intention to use" to measure user attitude as an alternative measure of "use"; and (3) the collapsing of "individual impact" and "organizational impact" into a more parsimonious "net benefits" construct. The updated model consists of six interrelated dimensions of IS success: information, system and service quality, (intention to) use, user satisfaction, and net benefits. The arrows demonstrate proposed associations between the success dimensions. The model can be interpreted as follows: a system can be evaluated in terms of information, system, and service quality; these characteristics affect subsequent use or intention to use and user satisfaction. As a result of using the system, certain benefits will be achieved. The net benefits will (positively or negatively) influence user satisfaction and the further use of the information system.

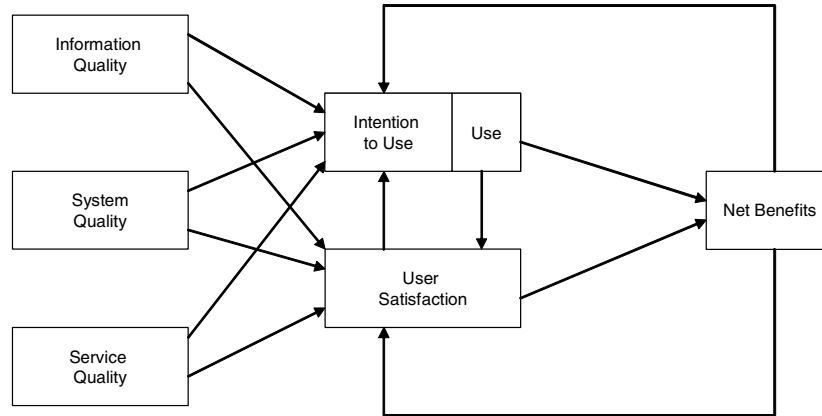


Figure 1. Updated IS Success Model (DeLone and McLean 2003)

Some researchers use the term “information systems effectiveness” synonymously with “information systems success.” Others use IS effectiveness to subsume what DeLone and McLean label individual impact and organizational impact (DeLone and McLean 1992) or net benefits (DeLone and McLean 2003). In the context of this article, the term IS success is used in the sense of DeLone and McLean’s comprehensive understanding to explicitly cover the whole range of suggested measures.

METHODOLOGY

Literature Review

The increasing number of published books and journals, as well as arranged conferences and workshops has made the research process more complex and time-consuming. Consequently, there is a greater need to describe, synthesize, evaluate, and integrate the results of articles on a particular field of research. The process of conducting a literature review can be regarded as a scientific procedure that should be guided by an appropriate research method (Fettke 2006).

According to the newest edition of the Publication Manual of the American Psychological Association (APA 2001, p. 7), review articles are critical evaluations of material that has already been published. By organizing, integrating, and evaluating previously published material, the author of a review article examines current research’s progress toward clarifying a problem. In a sense, a review article is a tutorial in that the author

- defines and clarifies the problem;
- summarizes previous investigations in order to inform the reader of the state of current research;
- identifies relations, contradictions, gaps, and inconsistencies in the literature; and
- suggests the next step or steps in solving the problem.

Literature Selection Process

The basis of a literature review is the relevant literature on the topic to be examined. A systematic search should ensure that a relatively complete number of relevant articles are accumulated. The process of selecting literature to be included in this review consisted of three steps: (1) selecting the literature sources, (2) defining a time frame for analysis, and (3) selecting articles to be reviewed.

Source Selection

In the first step of the literature selection process, relevant literature sources were identified. The objective was to create a list of literature sources that was as comprehensive as possible. As a starting point, the journals surveyed by DeLone and McLean (1992, 2002, 2003) were taken into consideration. As a field’s major contributions are likely to be in leading journals (Webster and Watson 2002), the initial list of twelve journals was extended by adding additional top journals. Based

on Saunders' (2007) MIS journal ranking, more journals were added in ascending order according to their average rank points. The MIS journal ranking is a meta-analysis based on nine separate journal rankings and therefore does not represent the perception of a single researcher, but that of many. Journals that were ranked by only one original meta-analysis source were not taken into consideration as they were regarded as lacking representativeness. Some journals were excluded from this review due to their specialized character (e.g., "Operations Research"). In total, 34 leading North American and European IS journals were selected. In addition, the proceedings of four reputable IS conferences were added. Table 1 lists all of the 38 literature sources that were surveyed to identify relevant articles.

| Literature Sources | |
|---------------------------|---|
| Journals | AMJ, AMR, ASQ, CACM, CAIS, DATABASE, DSI, DSS, EJIS, HBR, HCI, IBMSJ, IEETrans, IEESw, I&M, I&O, IS, ISJ, ISM, ISR, IT&P, IJEC, JCIS, JIS, JMIS, JSIS, JACM, JAIS, MS, MISQ, Omega, OS, SMR, WIRT |
| Conferences | AMCIS, ECIS, HICSS, ICIS |

Table 1. Literature Sources

Time Frame Selection

The second step of the literature selection process was the definition of an appropriate time frame for the literature search. As a basis for their original model, DeLone and McNeal (1992) reviewed publications that appeared between January 1981 and January 1988. For their updated model of IS success (DeLone and McLean 2003), literature published between 1992 and mid-2002 was surveyed. In keeping with the current article's objective – the examination of research on measuring IS success after the publication of the updated D&M IS Success Model – the period between 2003 and 2007 was considered an appropriate time frame for the literature search.

Paper Selection

Finally, papers had to be selected from the selected literature sources that had appeared in the defined time frame. Searches of electronic databases (EBSCO, ScienceDirect, ProQuest) and individual journal and conference websites were carried out to select papers for inclusion in the review. An initial list of papers was generated by using the search strings "information systems success," "IS success," "information systems effectiveness," and "IS effectiveness" to search titles, abstracts, and keywords. The resulting list of papers was then manually reviewed to select the relevant ones.

Literature Pool

In total, the literature research identified 64 articles by means of database searches and examinations of individual websites. Of the papers included in the review, 35 are journal articles and 29 conference papers. These papers were subjected to a more detailed review in keeping with the review framework presented below.

Review Framework

An analytical framework was defined to classify and describe the selected literature systematically. The framework comprises eight dimensions: (1) theoretical foundation, (2) research approach, (3) object of analysis, (4) unit of analysis, (5) evaluation perspective, (6) data gathering, (7) data analysis, and (8) methodological type. Figure 2 presents an overview of these categories.

LITERATURE REVIEW FRAMEWORK

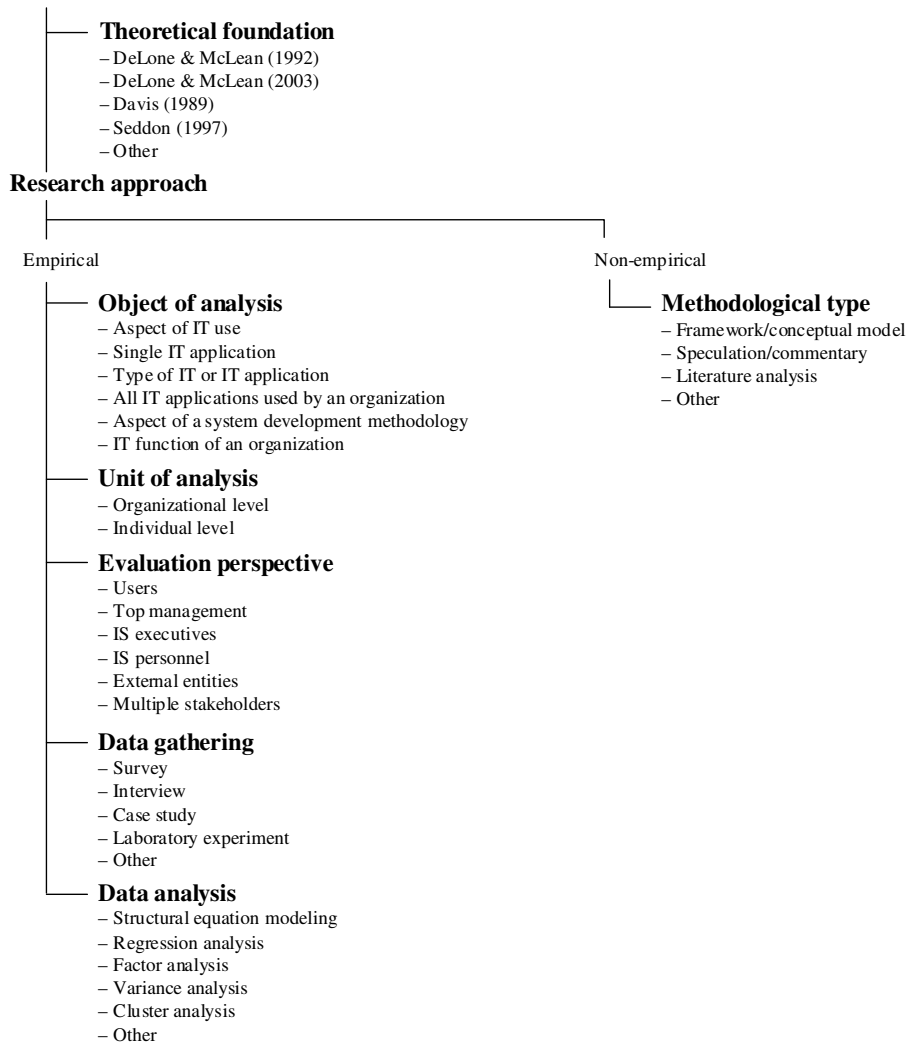


Figure 2. Literature Review Framework

RESULTS

Selection of Relevant Literature

After reviewing the selected publications, their relevancy was analyzed in respect of this article’s objective. Of the 64 articles identified in the literature selection process, 16 journal articles and 7 conference papers were subsequently considered “not relevant.” Since the focus of this review is on comprehensively assessing IS success through multidimensional approaches, publications examining single success dimensions were excluded. Consequently, 19 journal articles and 22 conference papers remained, thus totaling 41 relevant publications that would be analyzed in depth. Figure 3 illustrates the selection process of the relevant literature.

For the in-depth analysis, the 41 remaining publications were classified as either empirical or non-empirical papers according to their research approach. 28 of the relevant articles were classified as empirical papers and 13 as non-empirical.

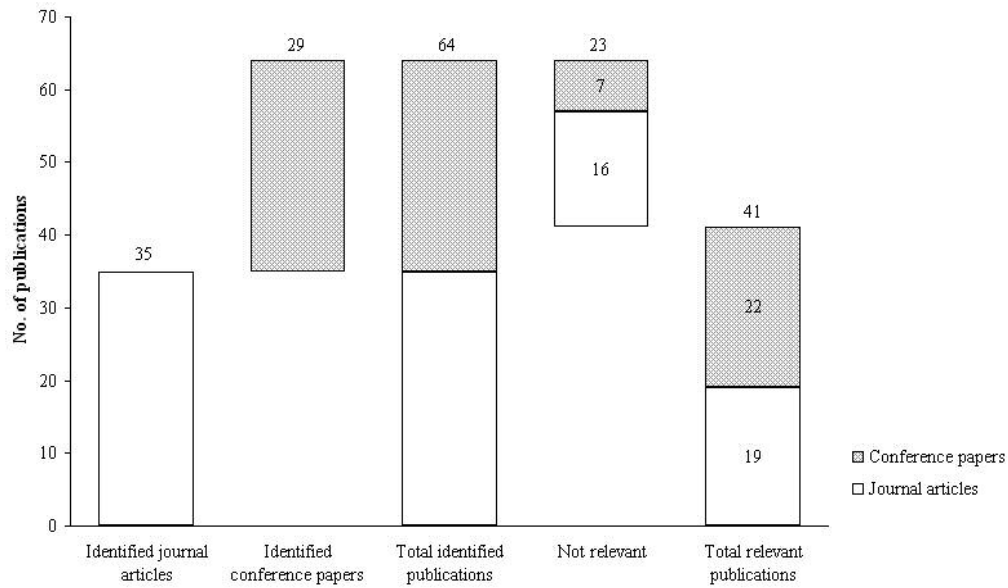


Figure 3. Selection of Relevant Literature

Analysis of Empirical Papers

The focus of this literature review is on the empirical literature in the field under examination. Thus, an in-depth analysis was conducted of the selected empirical papers’ research design. The results of this analysis are presented in the following section. To answer the question “what” was measured, an examination is provided of the studies’ analysis objects. Furthermore, an overview is given of those associations between the D&M IS Success Model’s success dimensions that the reviewed studies verified as statistically significant.

The analysis of the non-empirical papers has not been completed and will therefore be presented and discussed in a later article.

Research Design

The categorization of the empirical papers according to their research design is illustrated in Figure 4. The results show that the dominant research is that which analyzes the individual impact of a certain type of information system that users evaluate by means of surveys and structural equation modeling. The main theoretical basis of the reviewed studies is the DeLone and McLean IS Success Model (either the original or updated version).

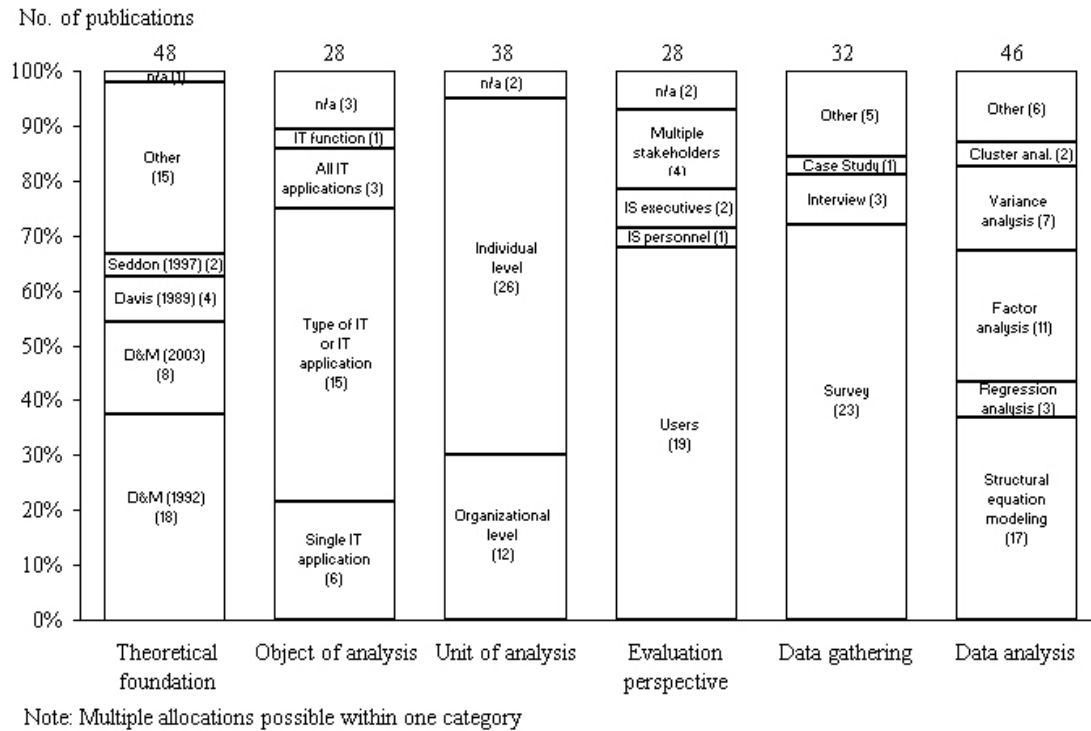


Figure 4. Classification of Empirical Publications

Object of Analysis

The review dimension “object of analysis” is used to classify the type of information system that is being evaluated. Following Seddon et al. (1999), this dimension consists of the following six components: an aspect of IT use, a single IT application, a type of IT or IT application, all IT applications used by an organization or sub-organization, an aspect of a system development methodology, and the IT function of an organization or sub-organization.

Approximately half of the empirical studies analyze the success of a certain type of IT application (15). In six publications, the success of a single IT application is assessed. Few studies evaluate the success of all of an organization’s IT applications (3) or an organization’s IT function (1). Empirical studies validating general conceptual models without applying them (e.g., by conducting focus group interviews) were categorized as not applicable. The results of the classification in terms of the object of analysis are presented in Table 2.

| Object of Analysis | Publication | |
|------------------------------|---|---|
| Single IT application | Finance and accounting system | Iivari (2005) |
| | Data warehouse | Shin (2003) |
| | E-portal | Cheung and Lee (2005) |
| | Knowledge management system | Clay et al. (2005) |
| | Picture archiving and communications system | Pare et al. (2005) |
| | Work time registration system | Bartis and Mitev (2007) |
| Type of IT or IT application | Data warehouses | Nelson et al. (2005), Wixom and Todd (2005) |

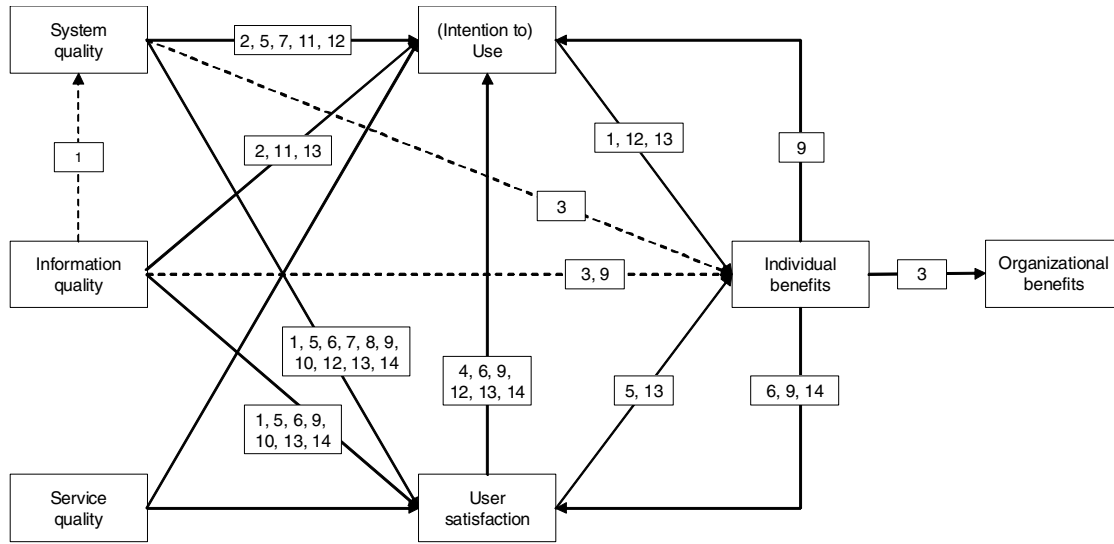
| | | |
|--|---|--|
| | Delivered information systems | Wilkin and Castleman (2003) |
| | Email systems | Mao and Ambrose (2004) |
| | Enterprise systems | Gable et al. (2003), Sedera (2006), Sedera and Gable (2004a), Sedera and Gable (2004b), Sedera et al. (2004a), Sedera et al. (2004b) |
| | Knowledge management systems | Kulkarni et al. (2006), Wu and Wang, (2006) |
| | Knowledge repository systems | Qian and Bock (2005) |
| | Web-based systems | Garrity et al. (2005) |
| | Websites | Schaupp et al. (2006) |
| | All IT applications used by an organization or sub-organization | Almutairi and Subramanian (2005), Bradley et al. (2006), Byrd et al. (2006) |
| | IT function of an organization or sub-organization | Cha-Jan Chang and King (2005) |

Table 2. Objects of Analysis in Empirical Studies

Validation of Multidimensional Constructs

Most of the reviewed empirical studies test the associations between a multidimensional success model's success dimensions. Since most of the models are based on DeLone and McLean's success model (either the original or revised version), the tested associations between the success dimensions adopted from the D&M IS Success Model were subsequently analyzed. Only those empirical studies that measured the association between the D&M IS Success Model's success constructs were chosen for the analysis of the associations. In total, twelve of the 24 empirical studies were chosen for this analysis.

Figure 5 displays the success dimensions of the (original and updated) D&M IS Success Model and the associations confirmed as significant in the empirical studies.



(1) Almutairi and Subramanian (2005); (2) Bradley et al.(2006); (3) Byrd et al. (2006); (4) Garrity et al. (2005); (5) Iivari (2005); (6) Kulkarni et al.(2006); (7) Sabherwal et al.(2006); (8) Shin (2003); (9) Wu and Wang, (2006); (10) Cheung and Lee (2005); (11) Clay et al. (2005); (12) Mao and Ambrose (2004); (13) Qian and Bock (2005); (14) Schaupp et al.(2006)

Figure 5. Dimension Association Tests

The link with the strongest empirical support is the association between “system quality” and “user satisfaction.” Ten of the twelve studies found this association to be statistically significant. Other links with a strong empirical support are the associations between “information quality” and “user satisfaction,” “(intention to) use” and “user satisfaction,” as well as “system quality” and “(intention to) use.” All of these associations were found to be significant by more than three studies.

None of the studies investigated the success dimension “service quality.” Thus, no empirical evidence could be found of associations between this and any of the other dimensions. Consequently, none of the twelve studies could validate the complete DeLone and McLean model in the updated version.

CONCLUSIONS

Summary of Findings

This article examines the existing literature on multidimensional approaches to measuring IS success by means of a literature review and a classification of articles published between 2003 and 2007 in order to explore the current state of research. 41 articles were identified in a systematic search of 34 leading North American and European IS journals and four reputable IS conferences. 28 empirical publications were analyzed with regard to their theoretical foundation, research approach, and research design.

Based on an in-depth analysis of the 28 empirical papers, we have deduced the following findings:

- The DeLone and McLean model of IS success is still the dominant basis of IS success measurement. Of the 28 empirical articles reviewed, 22 refer directly to this model. Some studies test the model in its original version; the majority of the studies use the D&M IS Success Model, often in combination with other theoretical models as a basis for deriving new research models that are applicable to the specific requirements of the corresponding problem domains.
- A quantitative-empirical analysis is the primary methodology used in IS success measurement. The results of the literature classification indicate that the dominant empirical research is that which analyzes the impact of a certain type of information system that users evaluate by means of surveys and structural equation modeling.

- Most of the empirical studies assess IS success as an “individual impact” and thus from a micro view. Only twelve of the 28 empirical papers consider IS success from both the individual and the organizational level, thus building a more comprehensive picture of IS success.
- None of the reviewed studies considered all of the updated DeLone and McLean dimensions of IS success. All of the empirical papers therefore only employed a subset of the proposed dimensions. The associations between the different success dimensions for which there are the strongest empirical evidence are the links between “system quality” and “user satisfaction,” and between “information quality” and “user satisfaction.”
- The success dimension “service quality” remains uninvestigated within the reviewed studies. No statistically significant association could be found between this and any of the other dimensions. A reason for this non-consideration could be the view that service quality is not an important quality measure of a single system.
- Several success models for evaluating specific types of information systems, like knowledge management or enterprise systems, have been developed on the basis of existing theoretical models and frameworks. The adaptation of existing general models to more specific approaches might serve as a basis for other researchers doing research in the same area.

Limitations

The present article has its limitations. One limitation is that this review is based on a limited number of journals and conferences as publication sources. Although major contributions to the field are likely to be found in leading journals, the decision on the scope may have omitted potentially important publications. Another limitation clearly results from the database-driven approach. By relying on database queries for the literature search, this review may have failed to identify relevant publications that do not include any of the search terms in their title, abstracts, or keywords. A manual scanning of the table of contents, which could not be realized due to resource constraints, would have circumvented this shortcoming. A further limitation is the fact that the term “IS success” was decisively influenced by DeLone and McLean’s work. Thus, the probability of identifying publications that refer to the D&M IS Success Model may have been higher than finding article with a different theoretical foundation with the applied search strings. Finally, the analysis and classification of the publications was based on a single researcher’s assessment. A parallel analysis by a second researcher would have increased the results’ validity.

Recommendations for Future Research

Measuring the success of information systems has been a popular stream of research during the last decades, resulting in many articles. The present literature review classifies the existing literature to provide an overview of the prior research in the area. Based on the presented results, we make the following suggestions for further research:

- In the light of the observation by King and He (2005) that analyzed reviews reflect a sampling bias towards empirical studies, non-empirical papers like frameworks, conceptual models, and/or opinion papers should also be addressed by future research for a comprehensive overview of the research domain.
- To make results comparable, researchers have recommended the reuse of proven success measures. The in-depth analysis of the empirical papers in this review focuses on the associations between the different success dimensions. The measures used in these studies remain uninvestigated. An analysis of the success measures used in recent publications would further contribute to a comprehensive overview of prior research.
- The inclusion of the success dimension “service quality” in the DeLone and McLean IS Success Model is not indisputable. Some researchers argue that service quality is not an important quality measure of a single information system. Since none of the reviewed empirical studies analyzed the service quality of the analysis objects, the authors of these studies seem to agree with the non-inclusion. Further research should analyze the problem domains for which service quality is an appropriate success dimension and for which it can be omitted.
- Most of the reviewed empirical papers only employ a subset of the proposed dimensions. In order to gain a full view of IS success according to DeLone and McLean understanding, the complete set of success dimensions should be employed in future research.
- Many theoretical models for measuring IS success are found in scientific literature. The usefulness of these approaches for practitioners is mostly relatively unknown. The “reality check” of Rosemann and Vessey (2005) is a

first step in understanding the relevance of the D&M IS Success Model for practice. Further research should be undertaken in this direction to increase the relevance of research in this area without compromising its rigor.

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