December 2006

An empirical investigation of the salient characteristics of IS-Success models

Darshana Sedera
Queensland University of Technology

An empirical investigation of the salient characteristics of IS-Success models

Darshana Sedera
Queensland University of Technology
d.sedera@qut.edu.au

ABSTRACT

This paper investigates four salient characteristics of IS-success models that are largely ignored in prior literature. Using data gathered from 600 responses, this study establishes the importance of (1) completeness of the model dimensions and measures, (2) mutual exclusivity of the model dimensions and measures, (3) model parsimony, and the (4) additivity of the model dimensions to yield an overarching score. These characteristics are rarely established and are seldom reported in academic literature that spans over three decades. Lack of discussion and little consensus on the aforementioned issues has led to incomparable results and a compromised cumulative research tradition. The paper demonstrates the importance of these issues and provides prescriptive guidelines for future research.

Keywords: IS success, Dimensions and Measures of IS success, model completeness, mutual exclusivity, additivity, model parsimony

INTRODUCTION

Research assessing the success of Information Systems (IS-success) has been ongoing for nearly three decades (King et al. 1978b; Martin 1979; Myers et al. 1998; Rolefson 1978). However, the scope and approach of these IS success evaluation studies has varied greatly, with little consensus on measures of IS-success. The irreconcilable results have compromised the cumulative research tradition. Despite the important contributions made by prior IS-success models towards our understanding of IS, there are several issues largely ignored in IS-success models. (Gable et al. 2003) suggest four salient characteristics that are required in a success measurement model. They include: (1) completeness of the model dimensions and measures, (2) mutual exclusivity of the model dimensions and measures, (3) model parsimony, and the (4) additivity of dimensions to yield an overarching score. These characteristics are rarely established and the procedures are seldom reported in academic literature.

The two main objectives of this paper are to (1) demonstrate the importance and to (2) provide guidelines to minimize the aforementioned issues pertaining to prior IS-success models. Using the ES-Success Measurement Model (Gable et al. 2003; Sedera 2004), this paper provides procedures and prescriptions to establish the importance and guidelines to overcome them. Based on our understanding developed through the conduct of this research, in developing a psychometrically sound ES-success measurement scale applicable for research and the practice, these four issues play an important role in both conduct of the study and interpretation of study results. Such a model with dimensions that are complete, additive but mutually exclusive from one another, and not contingent upon contextual differences, would initialize a cumulative tradition of research heretofore was not possible, thereby expanding the external validity.

The paper begins with a literature review that serves to demonstrate the weaknesses in a range of prior IS-success studies. The review also introduces the four issues that this paper attempts to reconcile. Next, the research strategy of the study is discussed; outlining the three separate surveys conducted to gather information. The empirical data analysis, reported according to each of the issues, is then provided. The paper concludes with a summary of the key findings.

LITERATURE REVIEW

The literature review achieves two related objectives: (1) to provide an overview of prior IS-success models to relate the (2) issues and gaps identified earlier in more detail. The review on success models is included to sufficiently exemplify the issues and gaps introduction to the issues stated above – not as a complete review of IS-success models. Though the review below does not include all IS-success models (due to space limitations) reported in literature, it provides a representative sample prior work that reflects common these common characteristics.

IS-Success Models and Frameworks

(DeLone et al. 1992) IS-success model is one of the most widely cited (Heo et al. 2003; Myers et al. 1998). Based on the work of (Shannon et al. 1963) and (Mason 1978), Delone and McLean proposed an IS-success model that reflects the systematic combination of previously reported individual measures. The model is an attempt to represent the interdependent, process nature of six IS success constructs: (1) system quality, (2) information quality, (3) use, (4) user satisfaction, (5) individual impact, and (6) organizational impact. While it is unclear whether the process paths proposed by Delone and McLean were originally intended to suggest causality, many researchers have sought to test these as causal paths and have found them to be broadly valid (Rai 2002; Seddon et al. 1992; Seddon 1994). According to Seddon and Kiew and to Myers et al., the main contributions Delone and McLean make to our understanding of IS evaluation are: (1) the constructs of the model provide a classification for the many IS evaluation measures reported in the prior literature, (2) their approach begins to identify relevant stakeholder groups in the process of evaluation, and (3) they suggest a model of interdependencies among the constructs. Myers et al bring together the Delone and McLean dimensions of IS success, with the notion of a contingency framework as developed by (Saunders et al. 1992).

The MIT 90's IT impacts framework (Scott Morton 1991) and the Balanced Scorecard (Kaplan et al. 1992) are important contributions to IS-management. The MIT 90's IT impacts framework assesses the impact of IT in organizations related to business missions, organizational structures and operating practices. The framework proposes that the organization's strategy, structure, management processes, individual roles and skills and IT should be consistent with each other. The impacts are evaluated using dimensions such as 1) Technology, 2) Individual roles, 3) Structure, 4) Management Processes, 5) Strategy. The Balanced Scorecard (Kaplan et al. 1992) was developed to evaluate business performance, and was later adapted to measure performance of IT (Kaplan et al. 2000). In addition to traditional financial measures, the balanced scorecard proposes to employ three other perspectives: 1) customer, 2) business process, 3) innovation and learning. Though the frameworks aid organizations to evaluate impact of IS beyond traditional measurements to evaluate IS-success, they demonstrate several weaknesses. Neither framework includes validated measures of success. Instead, both frameworks leave organizations to choose their respective measures. The selection of appropriate measures for individual circumstances requires high resources. Furthermore, results of such evaluations are less comparable within and across organizations and thus lose its value.

Rigorous research into ES success and benefits is sparse. (Shang et al. 2002) introduced one of few existing ES benefits frameworks after completing in-depth case studies of four Australian utility companies. The Shang and Seddon framework classifies potential ERP benefits into 21 lower level measures organized around five main categories: operational benefits, managerial benefits, strategic benefits, IT infrastructure benefits, and organizational benefits. Their framework has yet to be operationalized.

Issues in IS-success studies

As the second objective of the literature review, the following section describes these four key issues[1] of prior IS-success studies.

Model Completeness

The assertions about completeness deal with whether all dimensions and measures that should be in the ES-Success are included. (Gable 1996) suggests that the employment of only one or a subset of the dimensions of success as a surrogate for overall success may be one of the reasons for mixed results reported in the literature regarding the antecedents of success (Barki et al. 1989; Gatian 1994; Ginzberg 1981; Hawk et al. 1990; Ives et al. 1984; Myers et al. 1998). Through a review of alternative models from the literature, (Melone 1990) highlights the subjectivity inherent in the selection of a single effectiveness measure. This suggests that where the aim is to gain a full, overarching view of success, it is critical that the 'complete' set of success dimensions be employed – not a selected subset. In the exemplary analysis reported in table 1 of studies that had used the Delone and McLean success dimensions, it was evidenced that only two studies have used all six dimensions, with a majority of studies opting only to measure few dimensions of success.

[1] The four weaknesses of prior IS-success studies identified earlier in the study are (1) completeness, (2) mutual exclusivity, (3) additivity, and (4) model parsimony.

# of constructs dimensions	Total Studies		
	#	%	Cumulative
1	88	59%	59%
2	26	17%	77%
3	21	14%	91%
4	9	6%	97%
5	3	2%	99%
6	2	1%	100%
Total	149	100%	

Table 1: Empirical studies of Delone and McLean (1992)

Mutual Exclusivity and Additivity

The dimensions and measures are treated as mutually exclusive, if within the model, all dimensions and measures are genuinely distinct from each other. While some feel that the various success dimensions information quality vs. system quality) offer 'surrogate', or perhaps 'alternative' measures of success (Bailey et al. 1983; Doll et al. 1988; Ives et al. 1983; Saarinen 1996), other researchers have suggested they represent distinct dimensions of a complex, higher-order phenomenon (Chandler 1982; Ein-Dor et al. 1978; King et al. 1978a). An analogous example of the latter view, to which we subscribe, is Gable's (1996) study of 150 computer system selection projects involving external consultants, wherein he tested a multidimensional model of consultant engagement success. Once the dimensions are mutually exclusive, the dimensions can be usefully combined to yield an over-arching measure of success. A similar approach is employed in the Balanced Scorecard, where the quadrant-scores are added to yield an overarching measure of organizational performance (Rosemann et al. 1999; Van der Zee 1999).

Model Parsimony

As a general rule, one should specify the smallest and the simplest measures and dimensions that adequately describe the data. This is especially important where estimations and predictive models involved. In general, simple models are easier to estimate, easier to forecast, and easier to analyze using a given data set. The law of parsimony (William of Ockham, 1285 – cited in (Jefferys et al. 1992) states "a rule in science and philosophy stating that entities should not be multiplied needlessly". With prior literature on IS-success suggesting an abundance of success dimensions and measures, selecting only the optimally appropriate dimensions and measures is a challenge. From a practical view-point, compared to longer questionnaire, a parsimonious questionnaire makes the completion of surveys easy, thus increasing the number of quality responses.

RESEARCH STRATEGY

In attention to the aforementioned gaps and issues in IS-success research, this study was conducted in multiple survey rounds, following the research strategy guidelines of (MacKenzie et al. 1979) and (McGrath 1979), to develop a success measurement model for Enterprise Systems (ES)2. The 'research cycle' of MacKenzie and House (1979) and McGrath (1979) entails two main phases: (1) exploratory phase to develop hypothesized measurement models and (2) confirmatory phase to test hypothesized measurement models against new data gathered. Figure 1 depicts the two-phased of research design and the surveys associated with each of the phase. The three surveys henceforward referred to as Identification, Specification and Confirmation, were employed to complete the research cycle. The three surveys received responses from a total of six hundred (600) respondents. Two of the three surveys were conducted in the exploratory phase: (1) identification-survey and (2) specification-survey. Every survey served one or more specific objective in minimizing the four issues identified earlier in the study. The identification and the specification-survey were conducted across twenty-seven (27) Queensland State Government organizations that had implemented SAP R/3 in the late 1990s. The confirmatory-survey was conducted gathering new data from 153 respondents in a large University that had implemented a different ES—the ORACLE Financials. The section below outlines the key objectives and outcomes of the three surveys.

[2] ES being an example of a contemporary IS

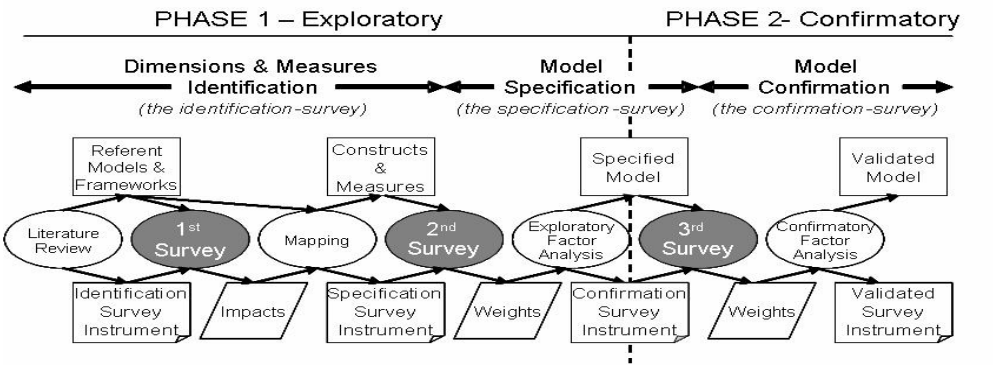

Figure 1: Research Design

The primary purpose of the **identification-survey** was to identify the salient ES-Success dimensions and measures. The identification-survey posed a specific question: "What do you consider have been the impacts of SAP in your agency, since its implementation?" The use of the word 'impact', instead of success in the above question was deliberate. With many, if not most, of these large system implementations at the time, emotions run high, with much proselytizing for the pro- or con-camps. Though some time had passed since initial implementation and the situation had become more settled, the researchers were loath to ask any questions that probe levels of 'success' directly. Furthermore, the word "impacts" in the exploratory survey round question was used in the broadest sense, to encompass impacts on individuals, the organization, information, the system and any other aspect on SAP that occurred to the respondent. The 'open' and 'exploratory' nature of question one of the identification-survey which gathered information on impacts of ES yielded a wealth of textual information. As the first step of data analysis all answers were isolated into single citations3 yielding 485 individual citations from the 137 respondents that depicted a wide spectrum of impacts of ES4. The 485 citations were then mapped into 1195 candidate measures identified from the literature using the Delone and Mclean model (supplemented by Myers et al.) as the basis with the intention of identifying the appropriate measures and dimensions of ES-success (for more details of the mapping approach and results, see (Sedera et al. 2002)). Of the 485 citations, 456 were mapped into the identified measures, leaving 29 un-mapped citations. In the process of mapping citations, 14 measures of system quality, 10 measures of information quality, 4 measures of individual impact, 4 measures of organizational impacts and 4 measures of satisfaction were instantiated, thus deemed suitable for the inclusion into the ES-success a-priori model. Five (05) new measures were created (1 for system quality and 4 for organizational impact) and added to the a-priori model using 29 un-mapped citations. Table 2 depicts the results of the mapping exercise.

	Citations	
Dimensions of Success	#	%
System Quality	139	30.48%
Information Quality	103	22.59%
Individual Impacts	84	18.42%
Organizational Impacts	91	19.96%
Satisfaction	27	5.92%
Use	12	2.63%
TOTAL	456	

Table 2: Citation mapping results

Consequently, the focus of the **specification-survey** was to specify and conduct preliminary testing of the validity of the 37 a-priori ES-success measures. Using the data of the 310 respondents (which consists of 35 strategic level, 122 management, 108 operational and 45 technical staff), the a-priori model and related instrument items were tested for construct and criterion validity and reliability. The a-priori measures were included in an exploratory factor analysis. In order to attain a more interpretable and parsimonious factor solution, of the 15 System Quality items and 10 Information Quality items, 6 and 4

[3] The textual data analysis tool AtlasTi was particularly useful in forming the paragraphs into single citations.
[4] The citation ranged from the quality of reports gained through SAP to downtime of the system to the cost savings attained through the advent of the system.
[5] The initial 119 measures consist of 18 System Quality, 25 Information Quality, 21 Organizational Impact, 19 Individual Impact, 7 Satisfaction and 29 measures of Use.

items were dropped respectively, leaving 27 valid measures. The exploratory factor analysis revealed 4 factors, namely System Quality, Information Quality, Individual Impact and Organizational Impacts (See details in Gable, Sedera and Chan 2003). In the confirmatory-phase, a **confirmation-survey** gathered new data to further confirm the validity of the 27 measures and the 4 dimensions of the ES-success measurement model employing confirmatory factor analysis (See details in Sedera and Gable 2004). The data of the confirmation-survey was analysed using Structural Equation Modeling (SEM) with five different factor models. The analysis provided further evidence of the goodness of 27 measures and the four dimensions.

ADDRESSING THE ISSUES USING THE ES-SUCCESS MEASUREMENT MODEL

The 27 measures and the 4 dimensions of ES-Success are posited to be complete, mutually exclusive, correlated and additive measures of the same higher-order multidimensional phenomenon: ES-success. The discussion below first addresses the 'completeness' of the ES-Success dimensions and measures, followed by the mutually exclusivity and additivity. Last it provides evidence of model parsimony. Evidence of all characteristics is gathered and triangulated using findings of the three surveys that this study has followed.

Completeness

The completeness is evidenced by the extent to which the dimensions and measures adequately capture the level of success. This depends on the amount of appropriate measures employed and the applicability of those dimensions and measures to the multiple employment cohorts of ES.

The study commenced with a literature review which identified 119 measures of IS-success. This is by-far the largest number of success measures ever considered in a single study for logical inclusion in a survey instrument. Next, the citations of the identification-survey were mapped into the 119 tentative IS-success measures. Furthermore, the citations of the identification-survey that were used to instantiate the 119 measures were derived from a 'complete' set of ES-users (Strategic, Management, Operational and Technical) and organizations (with multiple organizational characteristics). The number of initial measures considered and the breadth of the ES-users / organizations employed in the identification-survey provide strong confidence of completeness of the dimensions and measures of ES-Success Measurement Model.

The first empirical evidence of the completeness of these measures and dimensions is demonstrated through the total variance explained by the measures in the exploratory factor analyses conducted with the specification and confirmation-survey data. In the specification-survey, using the data of 310 respondents, the 27 measures of ES-Success accounted for the 67% of the total variance. Similarly, using the 153 new respondents in the confirmation-survey, the measures of ES-Success explained 75% of the total variance. The high total variances explained by both surveys demonstrate the completeness of the measures and dimensions captured in the ES-Success model (See details in table 4).

Further evidence of the completeness of the measures is provided using the criterion validity of the specification-survey data. Besides 27 items referenced thus far, the specification-survey instrument elicited criterion measures of overall success in response to each of two statements: (A) 'Overall, the impact of SAP on the agency has been positive,' and (B) 'Overall, the impact of SAP on me has been positive.' With the objective of further assessing the content, construct and criterion validity of the factor solution, two composite measures of overall success were next computed as follows: (C) Criterion Average is the simple average of the two criterion items; and (D) Dimensions Average is the simple average of the four success dimensions[6]. The three largest correlations are (A), (B) and (C) with (D), yielding r's of 0.80, 0.83 and 0.86 respectively. These large correlations further increase our confidence in the completeness of each of the four dimensions (See table 3). The reliability of the measures gauged through the Cronbach Alpha provides additional evidence of the completeness of the success measures. The Cronbach Alpha of both specification and confirmation-survey for all the dimensions of ES-Success exceed 0.9 providing auxiliary evidence of the completeness of the measures and dimensions.

In addition to the items pertaining to ES, the specification-survey attempted to measure the impact of Knowledge Management Structure Adequacy using separate measures (See results and discussion in Sedera Gable Chan 2004). It is argued, that to the extent the antecedent demonstrates a strong correlation with the dimensions and measures of ES-Success, shows further evidence of the completeness of the ES-Success model. As discussed in Sedera Gable Chan 2004, the Knowledge Management Structure Adequacy demonstrated a strong (0.6) and significant (0.001) correlation with the dependent variable: ES-Success. Therefore, it is argued, that the high correlations observed between the antecedent and the dependant variable (ES-Success) would not have been possible, if the ES-Success dimensions and measures were incomplete.

[6] All correlations are significant at the .001 level suggesting strong correspondence between the Criterion measures and Success Dimensions

		Impact on Agency (A)	Impact on Individual (B)	Criterion Average (C)
1	Information Quality	0.63	0.64	0.67
2	System Quality	0.72	0.72	0.75
3	Individual Impact	0.64	0.79	0.76
4	Organizational Impact	0.76	0.71	0.77
D	Dimension Average	0.8	0.83	0.86

Table 3: Correlations between criterion items and dimensions of success

Mutual Exclusivity

The first attempt to identify the overlapping measures and dimensions were completed using the citation mapping exercise of the identification-survey.

		Specification-survey				Confirmation-survey			
		Loadings				Loadings			
	Items	SQ	OI	IQ	II	SQ	OI	IQ	II
System Quality (SQ)	SQ4	**0.74**	0.16	0.28	0.28	**0.50**	0.25	0.21	0.49
	SQ5	**0.72**	0.14	0.23	0.21	**0.52**	0.16	0.29	0.42
	SQ7	**0.52**	0.35	0.33	0.31	**0.57**	0.46	**0.28**	0.23
	SQ8	**0.57**	0.20	0.37	0.20	**0.55**	0.26	0.47	0.06
	SQ9	**0.57**	0.16	0.37	0.05	**0.74**	0.14	0.34	0.07
	SQ10	**0.68**	0.19	0.25	0.14	**0.65**	0.20	0.19	0.39
	SQ13	**0.62**	0.17	0.32	0.13	**0.77**	0.27	0.08	0.22
	SQ14	**0.55**	0.20	0.24	0.11	**0.73**	0.19	0.32	0.01
	SQ15	**0.66**	0.26	0.14	0.14	**0.72**	0.24	0.26	0.19
Organization Impact (OI)	OI1	0.16	**0.73**	0.18	0.23	0.29	**0.71**	0.25	0.19
	OI2	0.16	**0.82**	0.13	0.11	0.10	**0.85**	0.12	0.09
	OI3	0.14	**0.83**	0.17	0.15	0.11	**0.87**	0.17	0.18
	OI4	0.30	**0.68**	0.20	0.43	0.26	**0.82**	0.20	0.33
	OI5	0.43	**0.62**	0.15	0.42	0.25	**0.71**	0.32	0.32
	OI6	0.25	**0.54**	0.26	0.37	0.30	**0.76**	0.28	0.29
	OI7	0.21	**0.62**	0.33	0.15				
	OI8	0.37	**0.59**	0.25	0.34	0.42	**0.69**	0.22	0.31
Information Quality (IQ)	IQ2	0.29	0.36	**0.63**	0.21	0.16	0.26	**0.78**	0.28
	IQ3	0.31	0.24	**0.63**	0.13	0.27	0.12	**0.75**	0.08
	IQ4	0.35	0.24	**0.80**	0.17	0.27	0.20	**0.81**	0.19
	IQ5	0.36	0.18	**0.78**	0.25	0.33	0.14	**0.70**	0.42
	IQ6	0.34	0.14	**0.80**	0.18	0.29	0.23	**0.71**	0.34
	IQ8	0.33	0.23	**0.58**	0.20	0.22	0.27	**0.76**	0.26
Individual Impact (II)	II1	0.11	0.17	0.18	**0.83**	0.21	0.19	0.21	**0.83**
	II2	0.24	0.26	0.19	**0.82**	0.20	0.25	0.24	**0.85**
	II3	0.23	0.30	0.19	**0.82**	0.10	0.34	0.22	**0.85**
	II4	0.28	0.34	0.21	**0.79**	0.12	0.30	0.33	**0.80**
	Alpha	0.90	0.92	0.91	0.93	0.91	0.95	0.94	0.96
	KMO Sampling Adequacy				0.94				0.92
	Bartlett's test of Sphericity	Chi-square			6752	Chi-square			3943
		D of Freedom			351	D of Freedom			325
		Significance			0	Significance			0

Table 4: Exploratory factor analysis results of specification and confirmation-surveys

In the process of mapping citations, if one of the 485 citations were mapped into more than one measure (out of 119), those measures were identified as overlapping measures. In such situations, only the most appropriate ***single*** measure was selected[7].

Statistical evidence of mutual exclusivity was demonstrated in the exploratory factor analysis of the specification and confirmation-surveys. As reported earlier (in Gable Sedera Chan 2003 and Sedera Gable 2004), the four factor solution that did not subscribe to significant cross factor loadings is evidence of the mutual exclusivity (See Table 4).

Additivity of the ES-Success dimensions

The **additivity** of ES-Success dimensions is evidenced through the results of the second-order exploratory factor analysis conducted using the specification-survey data. Using the saved factor-scores, a second-order factor analysis was conducted yielding a single factor. This provides first evidence of the validity of the ES-Success measures into a single overall measure of success. Furthermore, as discussed earlier in the correlation analysis (table 3), the (D) Dimensions Average yields the largest correlation with all the criteria supports the view that the Dimensions are additive, and thus when combined yield a stronger overall measure of success than possible from any single dimension. This further strengthens the evidence of additivity of ES-Success dimensions.

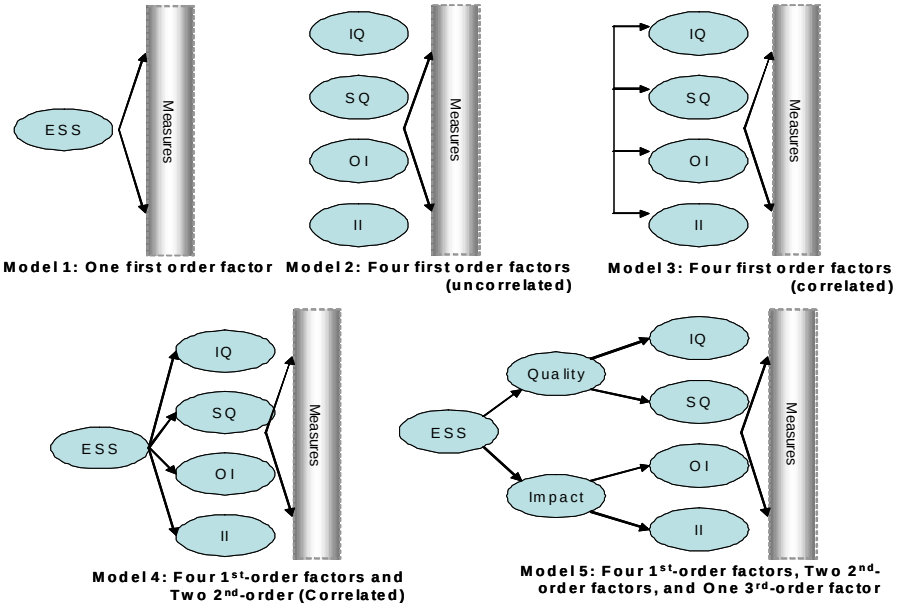

Figure 2: Confirmatory Models

However, the most compelling evidence of dimension additivity is demonstrated using Structural Equation Modeling (SEM) using the confirmation-survey data. Using logic and theory, five plausible alternative models were tested using confirmatory factor analysis models (See figure 2 – include a single diagram with all of it). Out of the five models, model 4 (4F1S) depicted four 1st order factors (Information Quality, System Quality, Organizational Impact, Individual Impact) and one higher 2nd order (Enterprise System Success) correlated model. Compared to the four other competing models and the confirmatory statistics, model 4 revealed the best fit with data, depicting the additivity of the four dimensions of ES-Success.

As a further test of the additivity of the success dimensions, we next posited that each of the four dimensions explains a unique portion of the variance in overall success (as represented by the criterion items). To test this proposition, we regressed each of the four dimensions on the variance remaining after having partialled out of overall success all variance explained by the other three dimensions. It is noted that in each case, the incremental r^2 was significant ($p=0.001$), thereby supporting our proposition. Note that this further supports our contention that the sum of the four dimensions yields a more comprehensive, overall measure of success, than does any subset the dimensions.

Parsimony of ES-Success dimensions and measures

As evidenced by the collection of the 119 measures of IS-success, prior literature suggested an abundance of success dimensions and measures. Therefore, selecting only the optimally appropriate dimensions and measures was a challenge. In addition to have measures that are mutually exclusive, several others dimensions were excluded that further strengthen model

[7] In rare cases, the overlapping measures were combined into a single composite measure.

parsimony. For example, (Teo et al. 1997) and (Rai et al. 2002), suggested the inappropriateness of satisfaction as a dimension of ES-Success and were taken into consideration. (Sedera et al. 2005) conducted a content analysis of 192 satisfaction-related items from 16 Satisfaction instruments reported in leading IS academic journals and conferences. From their results it is observed that 98% (189) of the measures readily map into the four dimensions of the Delone and McLean (1992) model: System Quality, Information Quality, Individual Impact and Organizational Impact; with only 2% (3) of the items appearing to measure satisfaction explicitly[8]. In light of past concerns with the Satisfaction dimension and results of content analysis of 192 prior Satisfaction items, it is our view that Satisfaction is not a dimension of Success, but rather that 'pure' satisfaction may represent a measure of overall success. This view is consistent with the findings of (Teo et al. 1998) who, having studied the impact of IT investment on organizational performance, concluded that satisfaction was not a distinct dimension. Although we clearly had concerns with the validity of the satisfaction dimension as a separate dimension of success, in order to test its discriminant validity, it remained in the a-priori model.

The USE dimension was excluded as a dimension of ES-Success from the a-priori model for the following reasons: (1) USE does not portray the level of success when the information system usage is mandatory, (2) The inherent issues associated with measuring the USE and (3) The USE dimension was poorly populated in the identification-survey. Each of the issues of the USE dimension is discussed in detail below. One of the main criticisms of the Delone and McLean model has centred on the 'use' dimension, which many feel to be an inappropriate measure of IS success (Barki et al. 1985; Gelderman 1998; Seddon 1997; Young 1989; Yuthas et al. 1998). Delone and McLean (1992, p. 68) themselves suggest that "usage, either perceived or actual is only pertinent when such use is not mandatory". When use of a system is mandatory, the extent of use of a system conveys little information about the success of the system (Robey 1979; Welke et al. 1980). In contemporary information systems, such as ES, USE of the system is non-volitional[9]. Furthermore, measures of the USE dimension appeared to be problematic in deciding the goodness of Usage. The extent of usage of a system or part of the system is a function of the intended functionality of the system. For example, some functionality of a system is periodically necessitated compared to daily transactions. In such situations, understanding the extent of use only conveys a confusing result. In further support of the removal of USE dimension, it is noted that only 12 of the 485 citations (2%) of identification-survey round mapped into the 29 measures of 'use'. This further illustrated the inconsequentiality of having USE dimension in the a priori model of ES-Success. The evolution of the measures through the three surveys depicted in table 5 reveals the true extent of the researcher's efforts to select the optimal number of IS-success dimensions and measures.

Research Stages	Literature Review			Identification Survey				Specification Survey		Confirmation Survey	
Analytic Approach	Literature Review			Content Analysis & Mapping				Exploratory Factor Analysis		Confirmatory Factor Analysis	
Dimension	**Start**	**Drop**	**Remain**	**Drop**	**Remain**	**Add**	**Remain**	**Drop**	**Remain**	**Start**	**Remain**
Systems Quality	18	4	14	0	14	1	15	6	9	9	9
Information Quality	25	10	15	5	10	0	10	4	6	6	6
Individual Impact	19	7	12	8	4	0	4	0	4	4	4
Organizational Impact	21	13	8	4	4	4	8	0	8	8	8
Satisfaction	7	1	6	2	4	0	4	4	0	0	0
Use	29	29	0	0	0		0	0	0	0	0
Total	**119**	**64**	**55**	**19**	**36**	**5**	**41**	**14**	**27**	**27**	**27**

Table 5: Summary of measures retained across study phases

[8] Rai et al. (2002) agree that user satisfaction has been measured indirectly through information quality, system quality, and other variables in prior studies.

[9] Seddon, P.B. "A Respecification And Extension Of The DeLone And McLean Model Of IS Success," Information Systems Research (8:3), September 1997, pp 240-253. argues that the true underlying construct IS researchers have been trying to gauge is Usefulness, not Usage or Use. The expert workshops and review of related literature, suggested that the Usefulness of a system derives from such factors as the quality of the system and the information it produces. When attempting to adapt Seddon and Kiew's measures of 'usefulness' to the study purpose, it was noted that most of these measures had already been addressed by measures previously adapted from the Meyers et al framework for the System Quality and Information Quality dimensions. With the aim of arriving at a set of ostensibly mutually exclusive dimensions of success that exhibit discriminant validity, neither was Usefulness included in the a priori ES success model.

CONCLUSION

This paper identified and demonstrated the importance of four model characteristics that relates to IS-success models. These characteristics include: (1) model completeness, (2) mutual exclusivity of the model dimensions and measures, (3) additivity of dimensions and measures and (4) parsimony of dimensions and measures. The literature review defined each of these characteristics and demonstrated how prior studies lacked attention to these important characteristics. The review of literature also established that lack of attention to one or more of these characteristics may have contributed to the confounding results reported in prior IS-success studies. Using the ES-Success Measurement Model, the paper provides prescriptive guidelines of incorporating such aspects to IS-success research and demonstrated how each of these characteristics can be tested. Consequently, it facilitated further validity and acceptability of the ES-Success Measurement Model as the most complete and comprehensive measurement model published in academic literature. Further research is strongly recommended required to standardize and formalize these aforementioned characteristics in future model derivation studies.

REFERENCES

1. Bailey, J.E., and Pearson, S.W. "Development Of A Tool For Measuring And Analyzing Computer User Satisfaction," *Management Science* (29:5) 1983, pp 530-545.
2. Barki, H., and Hartwick, J. "Rethinking The Concept Of User Involvement," *MIS Quarterly* (13:1), March 1989, pp 52-63.
3. Barki, H., and Huff, S.L. "Change, Attitude To Change, And Decision Support System Success," *Information & Management* (9:5) 1985, pp 261-268.
4. Chandler, J. "A Multiple Criteria Approach For Evaluating Information Systems," *MIS Quarterly* (6:1), March 1982, pp 61-74.
5. DeLone, W.H., and McLean, E.R. "Information Systems Success: The Quest For The Dependent Variable," *Information Systems Research* (3:1) 1992, pp 60-95.
6. Doll, W.J., and Torkzadeh, G. "The Measurement Of End-User Computing Satisfaction," *MIS Quarterly* (12:2), June 1988, pp 259-274.
7. Ein-Dor, P., and Segev, E. "Organizational Context And The Success Of Management Information Systems," *Management Science* (24:10) 1978, pp 1064-1077.
8. Gable, G., Sedera, D., and Chan, T. "Enterprise Systems Success: A Measurement Model," Proceedings of the 24th International Conference on Information Systems, Association for Information Systems, Seattle, Washington, 2003, pp. 576-591.
9. Gable, G.G. "A Multidimensional Model Of Client Success When Engaging External Consultants," *Management Science* (42:8) 1996, pp 1175-1198.
10. Gatian, A.W. "Is User Satisfaction A Valid Measure Of System Effectiveness," *Information and Management,* (26:3) 1994, pp 119-131.
11. Gelderman, M. "The Relation Between User Satisfaction, Usage Of Information Systems And Performance," *Information & Management* (34:1), August 1998, pp 11-18.
12. Ginzberg, M.J. "Early Diagnosis Of MIS Implementation Failure: Promising Results And Unanswered Questions," *Management Science* (27:4) 1981, pp 459-478.
13. Hawk, S.R., and Aldag, R.J. "Measurement Biases In User Involvement Research," *Omega* (18:6) 1990, pp 605-613.
14. Heo, J., and Han, I. "Performance Measure Of Information Systems (IS) In Evolving Computing Environments: An Empirical Investigation," *Information & Management* (40:4), 2003/3 2003, pp 243-256.
15. Ives, B., Olson, M.H., and Baroudi, J.J. "The Measurement Of User Information Satisfaction," *Communications of the ACM* (26:10) 1983, pp 785-793.
16. Ives, B.M., and Olson, M.H. "User Involvement And MIS Success: A Review Of Research," *Management Science* (30:5) 1984, pp 586-603.
17. Jefferys, W., and Berger, J. "Ockham's Razor And Bayesian Analysis," *American Scientist* (80) 1992, pp 64-72.
18. Kaplan, R.S., and Norton, D.P. "The Balanced Scorecard - Measures That Drive Performance," *Harvard Business Review* (70:1), 1992/01//Jan/Feb92 1992, pp 71-79.

19. Kaplan, R.S., and Norton, D.P. "Having Trouble With Your Strategy? Then Map It," *Harvard Business Review* (78:5), 2000/09//Sep/Oct2000 2000, pp 167-176.
20. King, J.L., and Schrems, E.L. "Cost Benefit Analysis In Information Systems Development And Operations," *Computing Surveys* (10:1) 1978a, pp 19-34.
21. King, W.R., and Rodriguez, J.I. "Evaluating Management Information Systems," *MIS Quarterly* (2:3) 1978b, pp 43-51.
22. MacKenzie, K.D., and House, R. "Paradigm Development In The Social Sciences," in: *Research In Organizations: Issues And Controversies*, R.T. Mowday and R.M. Steers (eds.), Goodyear Publishing, Santa Monica, CA, 1979, pp. 22-38.
23. Martin, G. "What Is The Value Of Investment In Information Systems?," *MIS Quarterly* (3:3) 1979, pp 5-34.
24. Mason, R.O. "Measuring Information Output: A Communication Systems Approach," *Information & Management* (1:4) 1978, pp 219-234.
25. McGrath, J.E. "Toward A 'Theory Of Method' For Research On Organizations," in: *Research In Organizations: Issues And Controversies*, R.T. Mowday and R.M. Steers (eds.), Goodyear Publishing, Santa Monica, CA, 1979, pp. 4-21.
26. Melone, N.P. "A Theoretical Assessment Of The User-Satisfaction Construct," *Management Science* (36:1) 1990, pp 76-91.
27. Myers, B.L., Kappelman, L.A., and Prybutok, V.R. "A Comprehensive Model For Assessing The Quality And Productivity Of The Information Systems Function: Toward A Theory For Information Systems Assessment," in: *Information Systems Success Measurement*, E.J. Garrity and G.L. Sanders (eds.), Idea Group, Hershey, 1998, pp. 94-121.
28. Rai, A., Lang, S.S., and Welker, R.B. "Assessing The Validity Of IS Success Models: An Empirical Test And Theoretical Analysis," *Information Systems Research* (13:1) 2002, pp 50-69.
29. Rai, A., Lang, S.S., and Welker, R.B. "Assessing the Validity of IS Success Models:
30. An Empirical Test and Theoretical Analysis," *Information Systems Research*, (13:1), March 2002, 2002, pp 50-69.
31. Robey, D. "User Attitudes And Management Information System Use," *Academy of Management Journal* (22:3) 1979, pp 527-538.
32. Rolefson, J.F. "The DP Check-Up," *Journal of System Management* (29:11) 1978, pp 38-48.
33. Rosemann, M., and Wiese, J. "Measuring The Performance Of ERP Software: A Balanced Scorecard Approach," Proceedings of the 10th Australasian Conference on Information Systems, Association for Information Systems, Wellington, New Zealand, 1999, pp. 773-784.
34. Saarinen, T. "An Expanded Instrument For Evaluating Information System Success," *Information & Management* (31:2) 1996, pp 103-118.
35. Saunders, C.S., and Jones, J.W. "Measuring Performance Of The Information Systems Function," *Journal of Management Information Systems* (8:4), 1992 Spring 1992, pp 63-82.
36. Scott Morton, M.S. (ed.) *The Corporation Of The 1990s: Information Technology And Organizational Transformation*. Oxford University Press, New York, 1991.
37. Seddon, P., and Yip, S.-K. "An Empirical Evaluation Of User Information Satisfaction (UIS) Measures For Use With General Ledger Accounting Software," *Journal of Information Systems* (6:1) 1992, pp 75-92.
38. Seddon, P.B. "A Respecification And Extension Of The DeLone And McLean Model Of IS Success," *Information Systems Research* (8:3), September 1997, pp 240-253.
39. Seddon, P.B., and Kiew, M.Y. "A Partial test and development of the DeLone and McLean Model of IS Success," International Conference on Information Systems, Vancouver, British Columbia, Canada, 1994.
40. Sedera, D., and Gable, G. "A Factor and Structural Equation Analysis of the Enterprise Systems Success Measurement Model," International Conference of Information Systems, Washington, D.C, 2004.
41. Sedera, D., Gable, G., and Palmer, A. "Enterprise Resources Planning Systems Impacts: A Delphi Study Of Australian Public Sector Organisations," Proceedings of the 6th Pacific Asia Conference on Information Systems, Association for Information Systems, Tokyo, Japan, 2002, pp. 584-600.
42. Sedera, D., and Tan, F. "User Satisfaction: An Overarching Measure of Enterprise System Success," 10th Pacific Asian Conference on Information Systems (PACIS 2005), Bangkok, Thailand, 2005.

43. Shang, S., and Seddon, P.B. "Assessing And Managing The Benefits Of Enterprise Systems: The Business Manager's Perspective," *Information Systems Journal* (12:4) 2002, pp 271-299.
44. Shannon, C.E., and Weaver, W. *Mathematical Theory Of Communication* University of Illinois Press, Urbana, IL, 1963.
45. Teo, H.-H., Tan, B.C.Y., and Wei, K.-K. "Organizational Transformation Using Electronic Data Interchange: The Case Of TradeNet In Singapore," *Journal of Management Information Systems* (13:4) 1997, pp 139-165.
46. Teo, T.S., and Wong, P.K. "An Empirical Study Of The Performance Impact Of Computerization In The Retail Industry," *Omega* (26:5), October 1998, pp 611-621.
47. Van der Zee, J.T.M. "Defining And Implementing An IT Measurement Program," Proceedings of the International Symposium on the IT Balanced Scorecard, Antwerp, Belgium, 1999.
48. Welke, R.J., and Konsynski, B.R. "An Examination Of The Interaction Between Technology, Methodology And Information Systems: A Tripartite View," Proceedings of the 1st International Conference on Information Systems, Association for Information Systems, Philadelphia, Pennsylvania, 1980, pp. 32-48.
49. Young, S.T. "Hospitals Materials Management: Systems And Performance," *Journal of Purchasing and Materials Management* (25:3) 1989, pp 31-35.
50. Yuthas, K., and Young, S.T. "Material Matters: Assessing The Effectiveness Of Materials Management IS," *Information & Management* (33:3), 1998/1/12 1998, pp 115-124.