Chapter IV

A Validation Test of an Adaptation of the DeLone and McLean's Model in the Spanish EIS Field[1]

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ABSTRACT

INTRODUCTION

From a systemic approach, we develop a research model adapting the DeLone and McLean's information systems success model to the executive information systems (EIS) field. We aim to test the validity of our adaptation, studying the interdependencies among the variables and examining its predictive

power. Applying the Partial Least Squares (PLS) technique, we test the model using data from a survey conducted on 100 Spanish users in 55 organizations.

BACKGROUND

Systems and Models

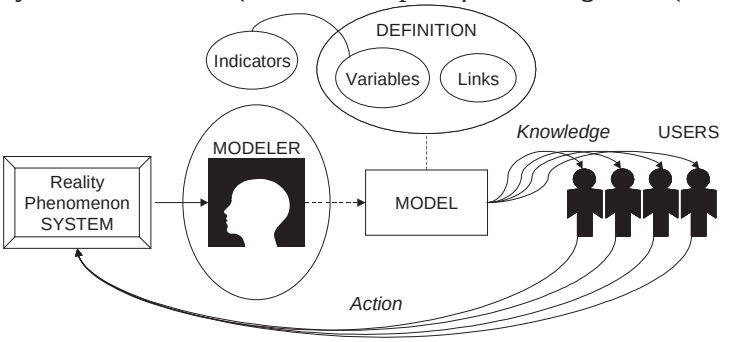
The systems thinking has always borne in mind the idea of complexity (Espejo, 1994). According to Flood and Carson (1988), the complexity concept is associated with people, and things or systems (situations as perceived by people). In relation to the former, it comprises the following aspects concerning individuals: perceptions and notions, interests, and capabilities. With regard to systems, complexity includes the ideas of the number of parts, and the number of relationships between the parts.

Since we cannot deal with the entire complexity of our environment, we use abstractions of the latter, i.e. we develop models. In this sense, "models are representations of real-life phenomena, situations or systems" (Faucheaux, Laurent, & Makridakis, 1976, p. 108). Therefore, models help us to understand, research, and act on systems or phenomena (Ortigueira, 1987) (Figure 1). Besides, a model can have three general types of purposes (Finkelstein & Carson, 1985): description, prediction, and explanation of the modeled system.

Models are defined by groups of variables and links between these variables (Figure 1). Each variable can be observed as a bridge between a theoretical concept (which provides the variable with meaning), and observable magnitudes. In empirical models, each variable can be expressed by one indicator or several.

On the other hand, model and system are inseparable entities. In fact, a model is a system itself. A model is a representative system of another specific system or phenomenon. In a complementary way, Flood and Carson (1988) state that since a system can be defined as an abstraction from the world, a system is a model.

Figure 1: System and model (Source: adapted from Ortigueira (1987, 1995)



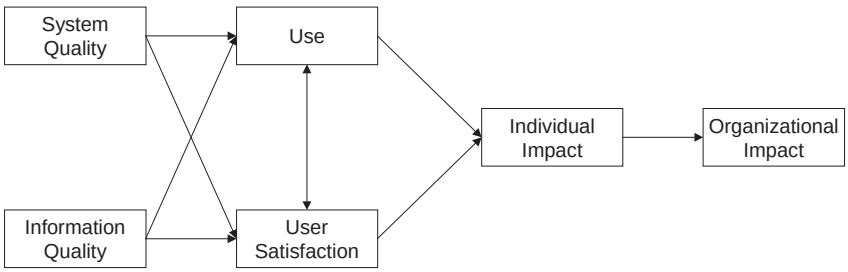
It is a utopia to think that it is possible to build models with all attributes, properties and characteristics of a specific system (Ortigueira, 1995). If this situation were possible, it would mean both systems (model and represented system) are isomorphous. However, in the real world, all the models and their respective systems are homomorphous, because it is impossible to obtain a total correspondence between the attributes of the system and the model. Notwithstanding, in each science every researcher should aim to come close to the perfect isomorphous model in relation to the represented system. "The effectiveness of any model used to describe and understand behavior of a particular system as a whole ultimately depends on the degree to which that model accurately represents that system" (Ackoff, 1999, p. 34).

DeLone and McLean's Model of Information Systems Success

Information systems (IS) success is one of the most researched topics in IS literature. DeLone and McLean (1992) become aware of the complex reality that surrounds the identification and definition of the IS success concept. They organize the large number of studies on IS success and present a comprehensive and integrative model. DeLone and McLean, in their study, identify six main dimensions for categorizing the different measures of IS success: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. They develop an IS success model in which these categories are interrelated shaping a process construct. Their model proposes that "system quality and information quality singularly and jointly affect both use and user satisfaction. Additionally, the amount of use can affect the degree of user satisfaction as well as the reverse being true. Use and user satisfaction are direct antecedents of individual impact; and, lastly, this impact on individual performance should eventually have some organizational impact" (DeLone & McLean, 1992, pp. 83, 87) (Figure 2).

DeLone and McLean (1992) state that their model is "an attempt to reflect the interdependent, process nature of IS success" (p. 88), undertaking to describe the IS success concept and the causes for the success.

Figure 2: DeLone and McLean's IS success model



According to Ballantine et al. (1996) and Seddon (1997), DeLone and McLean's work makes several important contributions to the understanding of IS success. Firstly, it consolidates previous research. Secondly, it provides a scheme for classifying the different measures of IS success that have been proposed in the literature into six dimensions. Thirdly, it suggests a model of temporal and causal interdependencies between the identified categories. Fourthly, it makes the first moves to identify different stakeholder groups in the process. Fifthly, it has been considered an appropriate base for further empirical and theoretical research. Sixthly, it has met general acceptance in the IS community.

Nevertheless, this model has received different critical reviews from different points of view (Ballantine et al., 1996; Seddon, 1997) and modifications (Fraser & Salter, 1995; Pitt, Watson, & Kavan, 1995; Wilkin & Hewett, 1999).

Executive Information Systems

Executive information systems (EIS) have, in recent years, become a major IS topic. An EIS is defined as a computer-based information system designed to provide executives with an easy access to internal and external information relevant to their management activities. This kind of information system has experienced a great expansion since the 1980s as a consequence of facilitating and pressuring (internal and external) factors (Watson, Rainer, & Koh, 1991). In Spain, EIS has become widespread since 1990. Although, at the beginning, the target public for this type of IS was the top managers, nowadays, this system has often spread to other non-executive users such as middle managers, support staff, analysts, and knowledge workers (Frolick, 1994). Because of this common use, it has been suggested that the EIS acronym should actually stand for everyone information system. Accordingly, EIS have increased their applications available to users, including some or all of the following capabilities (Watson, Houdeshel, & Rainer, 1997): support for electronic communications, data analysis capabilities, and organizing tools.

MAIN THRUST OF THE CHAPTER

Models play a linking role between two fields, connecting, on the one hand, a theoretical area (which is interpreted by the model), and, on the other, an empirical sphere (which is synthetically represented by the model) (Ortigueira, 1995). Referring to the second field, the validation question arises; it is necessary to corroborate the model with empirical data. This validation of a model can be inserted in the process of the scientific method (Rivett, 1980) whose phases are as follows (Ackoff, 1999): (1) formulating the problem, (2) constructing the model, (3) testing the model, (4) deriving a solution from the model, (5) testing and controlling

the solution, and (6) implementing the solution. This process is usually cyclic. If, when testing a model, it is found to be deficient, i.e. the facts fail to fit some of the proposed hypotheses, the model could be re-examined and modified, for instance incorporating new factors that had not been taken into account. Following Espejo's arguments, it could originate the emergence of holons or insightful ideas whose purpose is to allow us to think more creatively about the world (Espejo, 1994).

In this chapter, we will play a modeler and tester role. We have developed a research model adapting the DeLone and McLean's IS success model to the EIS area. We aim to test the validity of our adaptation, studying the interdependencies among the six categories and, at the same time, examining its predictive power.

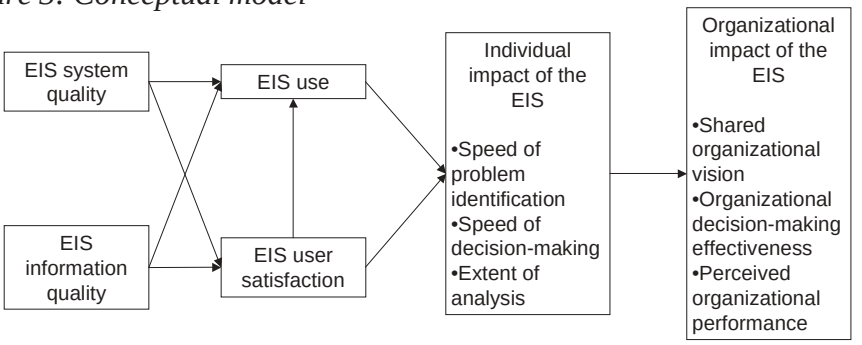
Research Model and Hypothesis

The conceptual model used to guide this study is shown in Figure 3. This one is based on the DeLone and McLean's IS success model, adapting it to the EIS context. Because of the difficulty in defining the impact concepts, we have opted to use different variables to study the individual and organizational impact. In this sense, we have followed the works of Leidner (1996), and Leidner and Elam (1994, 1995) on EIS to select the different variables subsumed, both in the individual and organizational impact dimensions.

Our conceptual model proposes the following linkages: EIS system quality and information quality affect both EIS use and user satisfaction. According to the Attitude Theory of Fishbein and Ajzen (1975), user satisfaction influences EIS use. Both EIS use and user satisfaction are direct antecedents of individual impact variables. The organizational impact variables are affected by the individual impact of the EIS. We are going now to define all these variables.

EIS system quality refers to the desired characteristics of the EIS itself which produces the information. EIS information quality relates to the quality of the executive information system output. This construct is also related to issues such as the relevance, timeliness, and accuracy of information generated by an EIS. EIS

Figure 3: Conceptual model



user satisfaction refers to the recipient response to the use of the output of an executive information system. EIS use is defined as recipient consumption of the output of an EIS. Use also means to employ the executive information system.

The individual impact dimension is defined by DeLone and McLean (1992) as "the effect of information on the behavior of the recipient" (p. 69). Following Leidner and Elam (1994, 1995), we have selected three variables for analyzing the influence of the EIS on the individual: speed of problem identification, speed of decision-making, and extent of analysis. These variables are congruent with the cognitive perspective identified by Isenberg that is useful in understanding how an EIS may affect the management process: manager as decision-maker (Rockart & DeLong, 1988). The article of Leidner and Elam (1995) presents the following definitions: (1) Speed of problem identification is defined as "the length of time between when a problem first arises and when it is first noticed" (p. 142). (2) The speed of decision-making refers to "the time between when a decision maker recognizes the need to make some decision to the time when he or she renders judgment" (p. 142). (3) Extent of analysis is defined as "time spent on interrelating symptoms to get at the root cause of problems and the effort spent to generate solutions" (p. 142).

DeLone and McLean (1992) define organizational impact as "the effect of information on organizational performance" (p. 74). We have followed the work of Leidner (1996) to select two variables that indicate potential benefits of the EIS on the organization as a whole: shared organizational vision, and organizational decision-making effectiveness. Moreover, we have included a third construct from the strategic management area: perceived organizational performance. Therefore, we can define shared organizational vision as "a shared perspective of what is important for managers at all levels, indicating what areas need their attention" (Leidner, 1996, p. 5). Organizational decision-making effectiveness is concerned with the enhancement of the organizational decision-making process. Finally, perceived organizational performance refers to the business performance, which embraces financial performance (sales growth, profitability, earnings per share and so forth) and operational performance (market-share, new product introduction, product quality, etc.) (Venkatraman & Ramanujam, 1986).

In Figure 4, we depict the hypotheses to be tested. These derive from the DeLone and McLean model and are outlined in Table 1. In addition to the theoretic support provided by the DeLone and McLean model, we have added a relation of supplementary references from IS literature that support the different hypotheses.

Methodology

Procedures

A survey instrument was used to gather data to test the relationships shown in the research model. The study was conducted in Spain from January to June 1998.

Figure 4: Research model and hypotheses

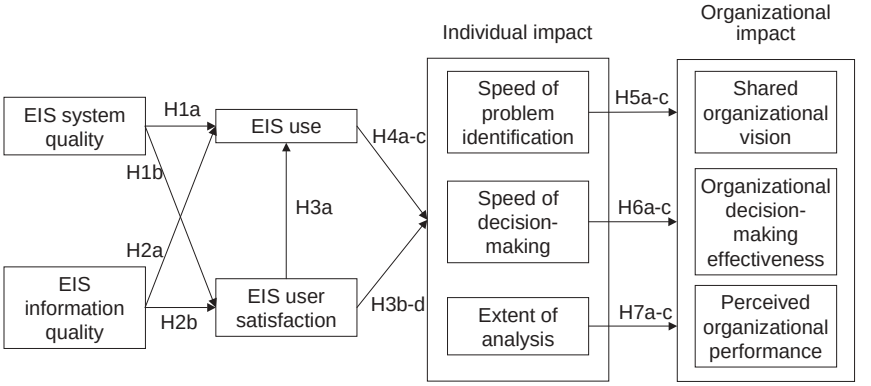


Table 1: Hypotheses to be tested

Conceptual model	Hypotheses	Supplementary supporting references
System quality and information quality of the EIS singularly and jointly affect both use and user satisfaction	H1a: EIS system quality will be positively related to EIS use	Davis (1989); Hwang, Windsor, & Pryor (2000); O'Reilly (1982)
	H1b: EIS system quality will be positively related to EIS user satisfaction	Barki & Hartwick (1989); Fraser & Salter (1995); Hwang, Windsor, & Pryor (2000); Igbaria & Nachman (1990); McGill, Hobbs, & Klobas (2000); Seddon & Kiew (1996); Sherman (1997)
	H2a: EIS information quality will be positively related to EIS use	Hwang, Windsor, & Pryor (2000); O'Reilly (1982); Szewczak (1988)
	H2b: EIS information quality will be positively related to EIS user satisfaction	Gluck (1996); Hwang, Windsor, & Pryor (2000); Fraser & Salter (1995); McGill et al. (2000); Seddon & Kiew (1996); Sherman (1997); Zviran (1992)
The degree of user satisfaction can affect the amount of EIS use	H3a: EIS user satisfaction will be positively related to EIS use	Bergeron, Raymond, Rivard, & Gara (1995); Downing (1999); Fishbein & Ajzen (1975); Fraser & Salter (1995); Igbaria & Tan (1997); McGill et al. (2000)
EIS use and user satisfaction are direct antecedents of individual impact variables	H3b-d: EIS user satisfaction will be positively related to individual impacts of the EIS.	Etezadi-Amoli & Farhoomand (1996); Gatian (1994); Gelderman (1998); Igbaria & Tan (1997); McGill et al. (2000); Sherman (1997)
	H4a-c: EIS use will be positively related to individual impacts of the EIS.	Igbaria & Tan (1997); Leidner (1996); Leidner & Elam (1994, 1995); Vlahos & Ferrat (1995)
This impact on individual performance should eventually have some organizational impact	H5a-c: Speed of problem identification will be related to organizational impacts of the EIS	Huber (1990); Leidner (1996); Mirani & Lederer (1998); Molloy & Schwenk (1995); Ragowsky, Ahituv, & Neumann (1996); Straub & Wetherbe (1989)
	H6a-c: Speed of decision-making will be related to organizational impacts of the EIS	
	H7a-c: Extent of analysis will be related to organizational impacts of the EIS	

A pilot test of the survey was conducted in order to assess content validity (Straub, 1989). The instrument was pre-tested with EIS consultants (n = 4) and business and information systems professors (n = 3). Suggestions were incorporated into a second version that was then tested by two other management professors. No additional suggestions were made. Thus, bias in response from misinterpretation of the instrument should be reduced. Based on the positive feedback from pretest respondents, a survey was conducted on a cross-section of Spanish companies using EIS.

Respondents to the survey were EIS users. Contacts were made with EIS software vendors and consultants to obtain the names of organizations that had an operational EIS. In addition, we used a list of participants in an EIS seminar organized by an important Spanish business school. In each organization, we contacted the EIS or IS manager to ensure that the EIS was in full operation and to achieve their cooperation with the study. Once we obtained their commitment (n = 132), we requested them to deliver the surveys to three senior managers that used the EIS. A total of 396 questionnaires were sent to the EIS/IS contacts, and if we didn't obtain any response from an organization within 45 days, we proceeded to call our contact again. As a result, we attained 100 useable user surveys from 55 organizations. It represents a response rate of 25.25%. A summary of the demographic characteristics is shown in Table 2.

Measures

Whenever possible items were derived and translated from previously verified sources. However, in some cases, the items used to measure the variables of interest were created specifically for this study. Because of chapter length limits, we only show our developed or adapted measures in Table 3.

Tabel 2: Demographic characteristics of the sample

Demographic variable	Sample composition	
Departments	Planning / management control	21.7%
	General management	17.4%
	Finance / accounting	15.2%
	Marketing / sales	14.1%
	Information systems	6.5%
	Production / operations	4.3%
	Human resources	2.2%
	General management staff	2.2%
	Other	12%
Hierarchical level	Level 1	24%
	Level 2	31.3%
	Level 3	30.2%
	Level 4	12.5%
	Under level 4	2%
Experience	M = 80 months; SD = 64.76; range = 5-300	
Experience as EIS user	M = 30 months; SD = 21.71; range = 1-120	

Tabel 3: Measures developed or adapted by the authors

Item	Measure
	(EIS system quality). To what extent has EIS helped you?
sq1	Faster access to information
sq2	Easier and more comfortable access to information
sq3	Availability of an improved access to the organizational data base
sq4	Have the benefit of new or additional information
sq5	Enjoy an improved presentation of data
	(EIS information quality). To what extent has EIS helped you?:
iq1	Obtain more current and timely information
iq2	Have more relevant, useful and significant information
iq3	Have more concise and summarized information
iq4	Enjoy more accurate information
iq5	Obtain more orderly and clear information
iq6	Obtain more reasonable and logical information
	(Perceived organizational performance). Using a five-point scale, indicate how EIS has influenced the global performance of your organization:
pop1	Our EIS has dramatically increased our organization's productivity
pop2	Our EIS has improved our competitive position
pop3	Our EIS has dramatically increased our profitability
pop4	Our EIS has dramatically increased our revenues
pop5	Our EIS has dramatically improved our overall performance

Items measuring EIS system quality were adapted from two former relations of EIS system characteristics (Bergeron & Raymond, 1992; Young & Watson, 1995), and those items measuring EIS information quality were mainly adapted from the information dimensions identified by Zmud (1978).

EIS user satisfaction was measured by five items developed by Sanders and Courtney (1985) who examined user satisfaction with DSS. Like the study of Leidner (1996), "DSS" in their instrument was changed to "EIS". EIS use was measured by one item: hours of EIS use per week.

The items measuring speed of problem identification, speed of decision-making, and extent of analysis were borrowed from Leidner and Elam (1994, 1995). The items aimed at identifying the shared organizational vision, and the organizational decision-making effectiveness were taken from Leidner (1996). Perceived organizational performance was measured by five items developed by Powell (1995) who studied the influence of TQM programs on the organizational performance. "TQM program" in this instrument was changed to "EIS".

Except for the use variable, the remaining ones were measured on a five-point scale ranging from "to no extent" (1) to "to a great extent" (5). On the other hand, perceived organizational performance was measured on a five-point scale, from "strongly disagree" (1) to "strongly agree" (5).

Data Analysis

A structural equation modeling (SEM) is proposed in order to assess the relationships among the constructs together with the predictive power of the

research model. We have used the Partial Least Squares (PLS) technique because this tool is primarily intended for causal-predictive analysis in which the explored problems are complex and theoretical knowledge is scarce. PLS is an appropriate technique to use in a theory development situation (Wold, 1979), such as this research. We have used PLS-Graph software version 2.91.03.04 (Chin & Frye, 1998).

A PLS model is analyzed and interpreted in two stages: (1) the assessment of the reliability and validity of the measurement model, and (2) the assessment of the structural model. This sequence ensures that the constructs' measures are valid and reliable before attempting to draw conclusions regarding relationships among constructs (Barclay, Higgins, & Thompson, 1995).

Results

Measurement Model

The measurement model in PLS is assessed in terms of individual item reliability, construct reliability, convergent validity, and discriminant validity. Individual item reliability is considered adequate when an item has a factor loading that is greater than 0.7 on its respective construct (Carmines & Zeller, 1979). Most our individual item loadings are above 0.7 or very near (sq5, us3, ea3) (Table 4).

Construct reliability is assessed using two measures of internal consistency: Cronbach's alpha and composite reliability (r_c). The interpretation of both values is similar. We can use the guidelines offered by Nunnally (1978) who suggests 0.7

Table 4: Individual item reliability–individual item loadings

EIS system quality (SQ)		EIS information quality (IQ)		EIS user satisfaction (US)		EIS use (U)		Speed of problem identification (SPI)	
Item	Loading	Item	Loading	Item	Loading	Item	Loading	Item	Loading
sq1	0.8669	iq1	0.7600	us1	0.7399	u1	1	spi1	0.8585
sq2	0.8762	iq2	0.8564	us2	0.7484			spi2	0.8450
sq3	0.7356	iq3	0.7892	us3	0.6963			spi3	0.7776
sq4	0.7342	iq4	0.7775	us4	0.8468				
sq5	0.6973	iq5	0.8103	us5	0.8166				
		iq6	0.8539						

Speed of decision-making (SDM)		Extent of analysis (EA)		Shared organizational vision (SOV)		Organizational decision-making effectiveness (ODME)		Perceived organizational performance (POP)	
Item	Loading	Item	Loading	Item	Loading	Item	Loading	Item	Loading
sdm1	0.8856	ea1	0.8268	sov1	0.8641	odme1	0.8552	pop1	0.8307
sdm2	0.9024	ea2	0.7526	sov2	0.9218	odme2	0.9051	pop2	0.8445
sdm3	0.8445	ea3	0.6962	sov3	0.8432	odme3	0.8857	pop3	0.8413
sdm4	0.7594	ea4	0.8199					pop4	0.8280
								pop5	0.8704

as a benchmark for a 'modest' reliability applicable in early stages of research. In our research, all of the constructs are reliable (Table 5). They all have measures of internal consistency that exceed 0.75 (alpha) and 0.85 (r_c). To assess convergent validity we examine the average variance extracted (AVE) measure, which was created by Fornell and Larcker (1981). AVE values should be greater than 0.50. Consistent with this suggestion, AVE measures for all constructs exceed 0.59 (Table 5).

To assess discriminant validity AVE should be greater than the variance shared between the construct and other constructs in the model (i.e. the squared correlation between two constructs). For adequate discriminant validity, the diagonal elements should be significantly greater than the off-diagonal elements in the corresponding rows and columns (Barclay et al., 1995). The majority of our constructs satisfy this condition with the exception of system quality in relation to information quality (Table 6). Notwithstanding, the difference between them is very tight (0.005). For this reason, we maintain the discriminant validity of the constructs of the model, but taking into consideration the special situation of system quality variable.

Structural Model

Figure 5 shows the variance explained (R^2) in the dependent constructs and the path coefficients (b) for the model. Consistent with Chin (1998) bootstrapping

Table 5: Construct reliability and convergent validity coefficients

Construct	Cronbach's alpha	Composite reliability (ρ_c)	AVE
EIS system quality (SQ)	0.8376	0.8887	0.6171
EIS information quality (IQ)	0.8969	0.9188	0.6540
EIS user satisfaction (US)	0.8302	0.8798	0.5953
EIS use (U)	1	1	1
Speed of problem identification (SPI)	0.7701	0.8670	0.6852
Speed of decision-making (SDM)	0.8795	0.9119	0.7221
Extent of analysis (EA)	0.7877	0.8574	0.6017
Shared organizational vision (SOV)	0.8498	0.9089	0.7691
Org. decision-making effectiveness (ODME)	0.8612	0.9133	0.7784
Perceived organizational performance (POP)	0.9018	0.9247	0.7108

Table 6: Discriminant validity coefficients

	SQ	IQ	US	U	SPI	SDM	EA	SOV	ODME	POP
SQ	(0.786)	--	--	--	--	--	--	--	--	--
IQ	0.791	(0.809)	--	--	--	--	--	--	--	--
US	0.709	0.674	(0.772)	--	--	--	--	--	--	--
U	0.308	0.292	0.277	(1.000)	--	--	--	--	--	--
SPI	0.665	0.674	0.716	0.246	(0.828)	--	--	--	--	--
SDM	0.664	0.677	0.667	0.337	0.751	(0.850)	--	--	--	--
EA	0.687	0.677	0.736	0.258	0.709	0.751	(0.776)	--	--	--
SOV	0.550	0.654	0.629	0.149	0.701	0.607	0.640	(0.877)	--	--
ODME	0.585	0.617	0.674	0.051	0.663	0.666	0.606	0.698	(0.882)	--
POP	0.492	0.546	0.541	0.037	0.588	0.580	0.509	0.582	0.684	(0.843)

Note. Diagonal elements (values in parentheses) are the square root of the variance shared between the constructs and their measures. Off-diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

(500 resamples) was used to generate standard errors and t-statistics. This allows us to assess the statistical significance of the path coefficients.

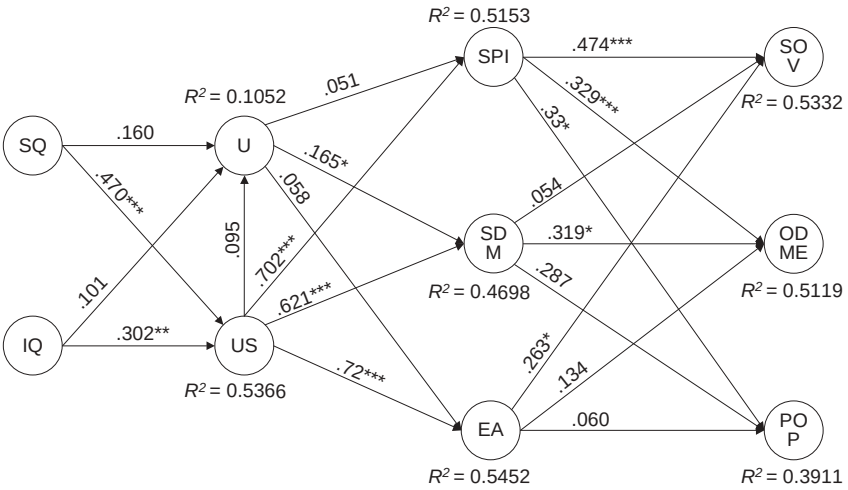
Eleven of the twenty hypotheses were supported. H1b and H2b were supported. This shows that system quality and information quality of the EIS exert a significant positive influence on EIS user satisfaction. However, we haven't found significant links between use (hours per week) and its predictor variables, i.e. H1a, H2a and H3a weren't supported. On the other hand, the study strongly proves the hypotheses H3b-d. All the links between EIS use and individual impact variables have been rejected except H4b that shows a weak relationship between EIS use and speed of decision-making. We have proved different links between individual impact and organizational impact variables (H5a-c; H6b; H7a). With regard to the subject under discussion, we should highlight the influence of the speed of problem identification on organizational impact variables (H5a-c).

Except for use variable, the research model seems to have an adequate predictive power for the majority of implied variables. Excluding EIS use variable, the mean of explained variances for the rest of dependent constructs is 50%.

Discussion and Limitations

The empirical results of this study indicate that information quality and system quality influence EIS user satisfaction. These factors explain more than 53% of the variance in the overall user satisfaction measure. This is consistent with the findings of Seddon and Kiew (1996), and McGill et al. (2000). However, we haven't found significant relationships between use and its predictor variables, i.e. system quality, information quality and user satisfaction. This supports the results of Fraser and

Figure 5: Structural model results



* p < .05; ** p < .01; *** p < .001 (based on $t_{(499)}$, two-tailed test)

Salter (1995), Klobas (1995), and McGill et al. (2000), whose works show neither system quality nor information quality significantly influences use. On the other hand, these outcomes are congruent with Collopy (1996), who didn't find a relationship statistically significant between user satisfaction and amount of use (using self-assessments). Nath (1989) offers an alternative explanation when he reports that the length of time of the usage for lower level managers correlates to high levels of satisfaction. For upper level managers who are the target of this study, higher levels of satisfaction are associated with frequency of use. Therefore, we think further research is necessary to identify other predictor variables of the EIS use.

Inconsistent with prior research, insufficient support was found for the influence of EIS use on individual impact constructs; the study only indicates a significant but weak relationship between use and speed of decision-making. Nevertheless, the findings demonstrate that user satisfaction is a dominant construct in explaining all the individual impact variables considered. All the links between user satisfaction and individual impact variables have path coefficients greater than 0.62. This supports the conclusions of Gelderman (1998), Igbaria and Tan (1997), and McGill et al. (2000) who found that user satisfaction had a greater influence on individual performance than use construct. At the same time, these results are consistent with Seddon's (1997) opinion that the link between use and individual impact may not exist.

We have found different links between individual impact and organizational impact variables. The speed of problem identification variable is the main individual impact construct for explaining the organizational impact variables. Indeed, the results suggest significant relationships between speed of problem identification and all organizational impact constructs. This result supports the EIS contribution to problem opportunity finding, the first phase of the Simon-based process of decision-making (Turban & Aronson, 1998). It suggests how the environmental scanning role of executives, supported by EIS, leads to important organizational benefits.

There are several limitations to the study that warrant mention. The first relates to organization bias. It seems likely that organizations that are unhappy with their EIS would be less inclined to participate in this study. Hence, the sample of EIS includes a larger proportion of "good" systems than is the case in the population of all EIS. Second, the study addressed only users of EIS at the point in time the survey was conducted. Users who, for various reasons, had discontinued use of the system were not included in the sample. Third, while evidence of causality was provided, causality itself was not proven. Fourth, the research relied mainly on user perceptions and a single method to elicit those perceptions. Fifth, a single data collection was used to test the structural model in the survey data analysis, assuming that a second data collection would have been more convincing. Finally, the study was

conducted in a particular geographical context (Spain) focusing on a type of information system (EIS). Therefore, we must be cautious in generalizing the results to other contexts and types of information system.

FUTURE TRENDS

As future research lines, we point out the following two: (1) To identify and test other predictor variables of EIS use. We think that alternative theoretical models could offer constructs that influence the use variable. In this sense, we could consider the technology acceptance model (Davis, Bagozzi, & Warshaw, 1989), the task technology fit model (Goodhue & Thompson, 1995), and the updated model of IS success (Garrity & Sanders, 1998). (2) To adapt and analyze other information success models in the EIS domain. For instance, the approaches proposed by Seddon (1997) and Ballantine et al. (1996).

CONCLUSION

From a systemic point of view, we have developed an adaptation of DeLone and McLean's information system success model. At the same time, we have undertaken a validation test of this model using the Partial Least Squares approach. This work represents the first analysis of the complete DeLone and McLean's model in the EIS context using a structural equation modeling.

As a conclusion, we would like to highlight that our findings have the following implications for researchers and practitioners. First, our adaptation of DeLone and McLean's model to the EIS field in Spain seems to have an adequate predictive power for most implied variables (excluding the use variable): the mean of the explained variance is 50% for the rest of dependent constructs. Second, except for the use variable, several relationships among IS success dimensions have been demonstrated. Third, the research model helps to understand the influence of EIS on both individual and organizational benefits. Fourth, the study shows hierarchical relationships among variable groups, i.e. connections between variables that stand out from the rest. In this matter we would highlight: (a) the preponderance of the system quality in the explanation of user satisfaction; (b) user satisfaction is strongly related to individual impact constructs; (c) the EIS contribution to speed problem identification is critical for all organizational impact variables. Fifth, as a result of the validation process, new ideas and possibilities for the design of the model emerge: (a) further research is necessary to identify other predictor variables of the EIS use variable; (b) the same as Seddon's (1997) model we could question the existence of links between the use variable and the group of impact constructs; (c) since

system quality and information quality are two important predictors of user satisfaction, an adequate planning of the design, implementation and sustaining phases of EIS is necessary in order to obtain a satisfactory level in both dimensions that contributes to EIS success.

ENDNOTE

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