A PRELIMINARY ASSESSMENT OF THE IMPACT OF E-COMMERCE TECHNOLOGIES IN SUPPLY CHAIN MANAGEMENT

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ABSTRACT

This empirical study assesses the organizational impact of using eCommerce technologies in supply chain management utilizing the following constructs: system quality, information quality, system usage, and user satisfaction. A sample data set was collected from *maquiladoras* in Juárez, Mexico to investigate relationships among these constructs. A SEM analysis was undertaken, using AMOS, on the dataset. The analysis provided statistically significant relationships among some constructs.

Keywords: Supply Chain Management, eCommerce Technologies, e-Enabled Supply Chain Management

INTRODUCTION

The use of eCommerce technologies (the Internet/World Wide Web, intranets, and extranets) in supply chain management (SCM) is a relatively recent phenomenon. Accordingly, very few studies have been conducted to date on the extent to which eCommerce technologies have been utilized in SCM, and, more importantly, on whether or not e-enabled supply chain management (eSCM), with the use of such technologies, has brought about improvements in managing supply chains.

DeLone and McLean [1] proposed interrelationships among six IS dimensions in what is referred to as the 'DeLone and McLean (D&M) IS Success Model'. The six dimensions in the D&M model are (1) system quality, (2) information quality, (3) system usage, (4) user satisfaction, (5) individual impact, and (6) organizational impact. While DeLone and McLean postulated causal relationships, the 1992 article did not test these relationships empirically.

Since 1992, however, a fairly good number of empirical investigations have been undertaken of the various interrelationships proposed in the D&M model. DeLone and McLean [2] themselves provided a ten-year update of the model, reviewing the results of 16 empirical investigations that have supported (or *not* supported) the postulated

relationships. They also updated their model with new or revised constructs as follows: (1) the addition of *service quality* as a new construct, to address a third major dimension of quality, and (2) the replacement of the earlier individual impact and organizational impact constructs by a *net benefits* construct (cost savings, expanded markets, incremental additional sales, reduced search costs, and time savings).

DeLone and McLean [3] more recently proposed that the same six dimensions in their updated IS success model [2]—i.e., (1) system quality, (2) information quality, (3) service quality, (4) usage, (5) user satisfaction, and (6) net benefits—may be used for measuring eCommerce success. They proceeded to apply these eCommerce success measures to two case examples, Barnes & Noble and 'ME Electronics' (with the name of the latter company changed for confidentiality). While they argued that the two case examples provide logically compelling support for these eCommerce success measures, they did admit that there is a need to test these measures empirically.

The present research is an attempt to empirically investigate the impact of eSCM on organizational performance and productivity. It examines the use of eCommerce technologies in SCM in terms of five of the six constructs in the updated D&M model: (1) eSCM system quality [SQ], (2) eSCM information quality [IQ], (3) eSCM system usage [SU], (4) eSCM system user satisfaction [US], and (5) organizational impact [OI], or net benefits. Our study did not address the new service quality construct in the updated D&M model. The rest of the manuscript is structured as follows: the next section presents the methodology used in the current study. Hypotheses and a proposed model follow. The results are presented next, along with a discussion of these results. Finally, conclusions and limitations, including plans for future research, are provided.

HYPOTHESES AND PROPOSED MODEL

In the present research, we put forth the following hypotheses which are based largely on the D&M IS success model. Figure 1 shows the proposed eSCM success model.

[H1]   eSCM system quality will positively influence eSCM user satisfaction.

One of the most important qualities of a system is perceived usefulness. One of the most accepted measures of acceptance is user satisfaction [4] [5] [6]. Various studies have reported that user acceptance of a system is positively associated with its perceived usefulness [7] [8] [9]. Igbaria et al. [10] also established that perceived usefulness has a direct effect on user acceptance of a system.

[H2]   eSCM system quality will positively influence eSCM system usage.

Igbaria et al. [10] evaluated the impact of system quality on system usage and found that system quality has a significant influence on system usage. Taylor and Todd [11] also found a significant impact of system quality on system usage. Mahmood et al. [12] concluded that there is a strong and significant positive relationship between the perception of ease of use and the perceived usefulness of an IT system to the actual

amount of usage. This is consistent with TAM and TPB, which postulates that attitudes toward using a system will influence the system usage.

[H3]   eSCM information quality will positively influence eSCM user satisfaction.

Research studies empirically validated the relationship between information quality and user satisfaction. Hunton and Flowers [13] and Seddon and Kiew [14], for example, found support for the relationship between user satisfaction and information quality. Kuan et al. [15] found empirical support for information quality positively influencing user satisfaction with the system. Chae et al. [16] also found a positive relationship between the two variables.

[H4]   eSCM information quality will positively influence eSCM system usage.

Current literature shows that the higher the quality of the information derived from a system the more is the system usage [17] [18]. Khalil and Elkordy [19] found a highly significant correlation between information quality and system usage. Kuan et al. [15] found empirical support for information quality positively influencing the usage of the system.

[H5]   eSCM user satisfaction will positively influence eSCM system usage.

The literature provides primarily evidence of linear correlation between system usage and user satisfaction, although Igbaria and Tan [20] find user satisfaction to be an important factor that affects system usage. Yoon and Guimaraes [21] find a highly significant relationship between system usage and user satisfaction. Likewise, Torkzadeh and Doll [22] also find a highly significant correlation between system usage (expressed as "usage pattern") and user satisfaction. Gelderman [23], in a survey of Dutch managers, finds a significant correlation between frequency of direct usage, as a measure of system usage, and user satisfaction, and a moderately significant correlation ($p < 0.10$) between hours of direct usage and user satisfaction.

[H6]   eSCM user satisfaction will lead to enhanced organizational performance.

In the present literature review on the relationship between user satisfaction and organizational impact, we also include the literature on the relationship between user satisfaction and individual impact, on the assumption that individual impact leads to organizational impact. Etezadi-Amoli and Farhoomand [24] find a strong relationship between user satisfaction and organizational performance. Gelderman [23] also finds a positive and significant relationship between user satisfaction and organizational performance. Igbaria and Tan [20] find a significant and positive impact of user satisfaction on individual performance. Hunton and Flowers [13], on the other hand, find no significant relationship between user satisfaction and individual impact.

[H7]   eSCM system usage will lead to enhanced organizational performance.

As stated earlier, it has been established in the literature that there is a strong correlation between user satisfaction and system usage [20] [21] [22]. It has also been established in the literature that there is a strong correlation between user satisfaction and organizational performance [23] [24]. It is, therefore, postulated here that eSCM system usage will lead to increased organizational performance.

METHODOLOGY

A 47-item instrument was designed to measure organizational impact stemming from eSCM system quality (7 items), eSCM information quality (6 items), eSCM user satisfaction (7 items), eSCM system usage (11 items), and organizational impact (16 items). The organizational impact construct, for example, was measured in terms of effectiveness, efficiency, performance, and productivity. A seven-point Likert-type scale (strongly agree = 7, agree = 6, somewhat agree = 5, neutral = 4, somewhat disagree = 3, disagree = 2, and strongly disagree = 1) was used for each item in the instrument.

A sample of the automotive and electronic industry-related *maquiladoras* in ciudad Juárez, Mexico, was used for the study. The instrument for collecting data was mailed to 210 *maquiladoras* in phases over a period of six months, to be filled out by plant managers/directors/vice presidents or managers for logistics/materials/supply/purchasing. The list of *maquiladoras* was obtained from the Greater El Paso Chamber of Commerce. Thirty-six responses were received, for a 17.1% response rate. This low response rate is attributable to the problem in reaching these plant managers and other high level executives and the lack of time on their part to complete the questionnaires. Thirty-three responses were found usable.

RESULTS

Reliability and Validity

We use Cronbach's alpha as a measure of reliability. The main diagonal along Table 1 shows Cronbach's α values for the five constructs ranging between 0.83 and 0.94. All are well over the 0.72 threshold specified by Nunally [25].

Table 1 also reports correlations pair-wise between constructs as being mostly highly significant (p-value < 0.01), although correlations were only moderately significant (p-value < 0.10) for organizational impact in relation to system quality, information quality, and user satisfaction.

We applied factor analysis for construct validation. Kerlinger [26] points out that factor analysis is considered to be one of the most powerful methods of construct validation. All factor loadings are between 0.84 and 0.98, except for the eSCM user satisfaction (US) construct with a factor loading of 0.77. These factor loadings are all well above the norm of 0.40 cited by Mahmood and Sniezek [27].

Table 1. Cronbach's α Values and Correlations

Construct	SQ	IQ	SU	US	OI
SQ	0.93				
IQ	0.84***	0.94			
SU	0.63***	0.52***	0.83		
US	0.72***	0.57***	0.55***	0.92	
OI	0.34*	0.33*	0.56***	0.32*	0.91

Cronbach's α values for the constructs are shown along the main diagonal.
Sample correlations between constructs are reported below the main diagonal.
*** p-value < 0.01   * p-value < 0.10

Statistical Validation of the Proposed Model

We have used the AMOS/SEM to analyze the hypothesized model because it offers numerous useful statistics [28]. The AMOS approach has been used for the analysis of small data sets. Wold [29], for example, used this approach to analyze a model based on a data set consisting of 10 cases and 27 variables.

The SEM methodology incorporates both measurement aspects and structural elements of the model. Since there is no consensus on a single measure, or even a set of measures, of fit, it is standard practice to report several measures [30]. We obtained a chi-square value of 0.483 with two degrees of freedom (df), resulting in a probability level of 0.786 which indicates that the data fit the model.

Table 2 shows the resulting estimates and associated p-values corresponding to the relationships among constructs, as specified in our seven hypotheses. The first and seventh hypotheses (SQ → US and SU → OI) are both strongly supported while the second hypothesis (SQ → SU) is moderately supported. None of the other hypotheses are supported. Figure 1 provides a visual summary of the results in relation to the model.

Table 2. Results of Hypothesis Tests

Hypothesis	Construct Association	Estimate	p-value	Significance of Hypothesis Test	Support of Hypothesis
H1	SQ → US	0.687	< 0.001	Highly significant	Strongly supported
H2	SQ → SU	0.432	0.099	Moderately significant	Somewhat supported
H3	IQ → US	-0.118	0.599	-	Not supported
H4	IQ → SU	0.010	0.972	-	Not supported
H5	US → SU	0.213	0.311	-	Not supported
H6	US → OI	0.011	0.938	-	Not supported
H7	SU → OI	0.422	0.002	Highly significant	Strongly supported

DISCUSSION AND CONCLUSION

Our results confirm that eSCM system quality plays a strong role for eSCM user satisfaction (H1). This influence is highly significant and positive. Our results are consistent with earlier studies [7] [8] [9] [10]. Our result showing that eSCM system

usage significantly leads to enhanced organizational performance goes one step further than the correlation earlier found between these two constructs [20] [21] [22].
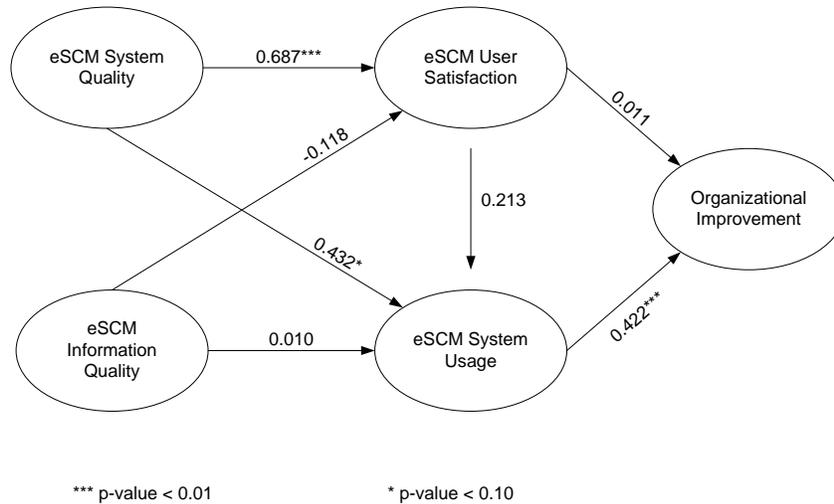

*** p-value < 0.01   * p-value < 0.10

Figure 1. Statistical Validation of the Model

Our results also show that system quality moderately and positively influences eSCM system usage. This is in line with earlier findings [11] [12], even though our result is weaker than that found in these two studies.

We are unable to validate the rest of the hypotheses. One possible reason is that our sample size is small.

LIMITATIONS

This study, like most studies, has several limitations. One of the limitations includes the low response rate to the questionnaire. This low response rate reflects the difficulty of reaching the plant managers and other higher level executives in an international environment. Many of these participants clearly do not have the time or motivation to participate. A second limitation of the present study has to do with the generalizability of the study, due to the small sample size. Another limitation is that the study is limited to the border area between El Paso, Texas and Juárez, Mexico. Subsequent research will be expanded to include areas outside this narrow region and to replicate the findings in different contexts and surroundings.

REFERENCES

References available upon request from M. Adam Mahmood, mmahmood@utep.edu