Perceived Strategic Value and Adoption of Electronic Commerce:
An Empirical Study of Small and Medium Sized Businesses

Elizabeth E. Grandon
Southern Illinois University at Carbondale, USA
University of Bío-Bío, Chile
grandon@siu.edu

J. Michael Pearson
Southern Illinois University at Carbondale, USA
jpearson@siu.edu

Abstract

By combining two independent research streams, we examine the strategic value and adoption of electronic commerce (e-commerce) as perceived by top managers in small and medium sized enterprises (SME). We propose a research model that posits three factors that have been found to be influential in previous research in the perception of strategic value of other information technologies. Inspired by the technology acceptance model of Davis [14] and other relevant research in the area, we also identify four factors that we believe will influence e-commerce adoption. We hypothesize a causal link between the perceived strategic value of e-commerce and e-commerce adoption. To validate the research model, we collected data from top managers/owners of SME via an Internet survey. Confirmatory factor analysis was used to test the factors utilized in this study while canonical correlation analysis was employed to validate the causal link between the two main constructs of this study.

1. Introduction

Even though the Internet has existed for decades, electronic commerce (e-commerce) has become a reality only with the development of the World Wide Web (WWW). E-commerce, as defined by Schneider and Perry [35], is the "business activities conducted using electronic data transmission via the Internet and the WWW". E-commerce provides many benefits not only to sellers but also to buyers. For example, Napier et al. [30] pointed out that by using e-commerce, sellers could access narrow markets segments that may be widely distributed geographically, thereby extending accessibility globally. Buyers could also benefit from accessing global markets and having larger product availability from a wider variety of sellers. Improvements in product quality and the creation of new ways of selling existing products are other benefits cited in the literature [30, 12, 34].

Although there are many potential advantages and predictions of an increasing use of e-commerce (see for example, http://www.gigaweb.com), the application of e-commerce by SMEs remains limited. According to a survey by The Gallup Organization (http://www.gallup.com) small businesses are establishing Web sites primarily to advertise and promote their business, rather than to conduct e-commerce. Similar results are reported by Access Markets International (http://www.ami-usa.com). They found that SME use the Internet to mainly buy, not to sell products. Among the SMEs with a Web site, only 27 percent are currently selling on the Internet, and these organizations average less than three Web based orders per month (Dun & Bradstreet's 20th Annual Small Business Survey (http://www.dnb.com)). These results are consistent with the findings reported by the "Second Annual Small Business Internet Survey" (http://www.business-survival.com/reports/Verizonsurvey.html). This survey found that the number of small firms that established a Web site to advertise and promote their business increased 123 percent from 1999 to 2000, while small businesses establishing a web site primarily to sell products decreased 48 percent during the same period. These results are quite interesting. While top managers and owners of SME seem to recognize the importance of having an Internet presence (Ciber Atlas, November 2001, OPEN Small Business Network 2002 Monitor [32]), only a small portion of them use the Internet for commercial purposes. Does this mean that top managers/owners of SME do not realize the strategic value e-commerce may provide to their businesses? In the hypothetical scenario that top managers recognize the strategic value of e-commerce, does this mean they encounter many barriers to implementing e-commerce? Thus, the major inquiry of this study is to find answers to questions such as: What are the perceptions of top managers/owners about the strategic value of e-commerce? Do managers know and understand the potential factors that influence e-commerce adoption?

Given the potential benefits that e-commerce may provide not only for business organizations but also for consumers and considering the importance e-commerce may have in the years to come, the objective of this study

is three-fold: a) to test a predictive model that proposes three factors as determinants of the perceived strategic value of e-commerce for SME, b) to determine how top managers perceptions of the strategic value of e-commerce influence their attitude toward e-commerce adoption, and c) to test the predictive model that posit four determinant factors for e-commerce adoption. To construct the proposed model, we identified those factors that were found to be influential in previous research relating to the perception of strategic value of other information technologies: *operational support, managerial productivity*, and *strategic decision aid*. Regarding the factors that influence e-commerce adoption, we identified factors that were found to be significant in prior research about technology adoption: *organizational readiness, external pressure, perceived ease of use,* and *perceived usefulness*. Finding support for the proposed model is important not only for managers who would be able to make better decisions when facing e-commerce adoption issues but also for scholars who can explore opportunities for additional research and validation of the proposed model in other arenas.

The rest of this paper is presented as follows. In section 2, we briefly review related studies. In section 3 we propose a predictive model for the perceived importance and adoption of e-commerce. Along with this, we state the research questions we will explore. In sections 4 and 5 we describe our research design, perform data analysis, and present the results. Finally, we conclude the study and indicate its limitations, implications, and future research questions in section 6.

2. Literature review

This study represents a fusion of two independent research streams developed over the last decade. The first stream can be characterized as identifying the strategic value of certain information technologies (IT) as seen by top managers. The second stream investigates factors that influence the adoption of IT. The former has been studied by Subramanian and Nosek [39] and others (e.g. [5], [41], [10]) while the latter has been investigated by Davis [14] and others (e.g. [1], [42], [27]) primarily through the technology acceptance model (TAM).

2.1 Perceived strategic value of information technologies

A vast number of studies regarding strategic value of IT have been carried out over the last decade. These studies have typically focused on the relationship between IT investment and firm's performance. For example, Hitt and Brynjolfsoon [19] investigated how IT affects productivity, profitability, and consumer surplus. They found that IT increases productivity and consumer surplus but not

necessarily business profits. They pointed out that IT could create strategic value but destroy profits. This interesting finding leads us to conclude that IT investments are important to maintain competitive parity but do not necessarily support competitive advantage. Similar results were found in Barua et al.'s study [5] where they concluded that the productivity gains from IT investments have generally been neutral or negative. In a similar line of inquiry, Tallon et al. [41] measured IT payoffs through perceptual measures. They argued that executives rely on their perceptions in determining whether or not a particular IT investment creates value for the firm.

Few studies have focused on identifying the perceptions of top management regarding the strategic value of e-commerce. As far as we know, the study by Amit and Zott [4] is one of the few that has tried to deal with this issue. Even though they focused their analysis on e-business, their results can be generalized to e-commerce since e-commerce is generally viewed as part of e-business [20]. Based on literature in entrepreneurship and strategic management, they developed a value-drivers model which included four factors that were found to be sources of value creation of e-commerce: transaction efficiency, complementarities, lock-in, and novelty. Some of these factors were also revealed in Saloner and Spence's [34] work. For example, they pointed out that the most important area in which e-commerce will create value is in reducing transaction costs involved in bringing buyers and sellers together.

In a more specific study about IT, Subramanian and Nosek [39] created an instrument to validate the strategic value that an IS may provide. Through an empirical study of 73 firms, they tested three factors that were found to create strategic value in IS: operational support, managerial productivity, and strategic decision aid. In each of these constructs they utilized different items that were found to have high convergent validity and reliability. The factors tested in Subramanian and Nosek's [39] work seem to be applicable to other IT, especially to e-commerce. Due to the lack of research in identifying factors that create strategic value of e-commerce, Subramanian and Nosek's [39] model was the basis for the strategic value portion of this study.

2.2 Information technology adoption

The seminal work of Davis [14] has set the basis for later studies in the area of information technology adoption. He proposed the Technology Acceptance Model (TAM) which has been tested in numerous studies (e.g. [40], [38], [18], [22], [1]). Lederer et al. [27] has summarized sixteen articles published from 1991 to 1999 in leading MIS journals that have tested the TAM for different technologies (e.g. ATM, e-mail, Netscape, Access, Internet, Word, and Excel). TAM has been shown

to explain a reasonable amount of the variance in intentions to use a technology and/or actual use of the technology. In Lederer et al.'s [27] model, they considered beliefs about ease of use and perceived usefulness as the major factors influencing attitudes toward use, which, in turn, affect intentions to use.

Many other studies have attempted to describe the factors influencing technology adoption. The findings vary according to the type of technology addressed. For example, Beatty et al. [6] studied the factors influencing corporate web site adoption. They found that the factors involved in the adoption process differ depending on the time in which the technology has been adopted. In their empirical study of 286 medium-to-large US firms, they found that early adopters placed significantly more emphasis on perceived benefits for having a Web site than later adopters. The earliest adopters viewed using the Web as being more compatible with their current organizational processes and their existing technological infrastructure. Firms that adopted corporate web sites much later appear not to have placed as much emphasis on benefits, and adopted in spite of the lack of compatibility between the Web and their existing technology and organizational norms.

Similarly, Iacovou et al. [21] studied the factors influencing the adoption of electronic data interchange (EDI). They considered seven organizations in different industries that were pursuing EDI initiatives. Among the factors included were perceived benefits, organizational readiness, and external pressure. In a similar line of inquiry, Kuan and Chau [26] determined the factors influencing the adoption of EDI in small businesses using a technology, organization, environment framework. The technology factor as in Iacovo's [21] study incorporated perceived direct and indirect benefits of EDI. The organization factor consisted of perceived financial cost and perceived technical competence. The environment factor included a new variable: perceived government pressure.

In a novel study by Chang and Cheung [11], the determinants of the intention to use an information technology such as the Internet/WWW were established. Instead of determining the factors affecting adoption, they studied those affecting the intention to use the Internet/WWW. Interesting results were found. Among the factors considered were near and long-term consequences, complexity, affect, social factors, and facilitation conditions. Complexity and long-term consequences were not found to influence the intention to adopt the Internet/WWW.

The emerging field of e-commerce has not been left behind in the analysis of adoption. However, few studies have addressed this issue. One of these is the study by Mirchandani and Motwani [29]. They investigated the factors that differentiate adopters from non-adopters of e-

commerce in small businesses. The relevant factors included enthusiasm of top management, compatibility of e-commerce with the work of the company, relative advantage perceived from e-commerce, and knowledge of the company's employees about computers. The degree of dependence of the company on information, managerial time required to plan and implement the e-commerce application, the nature of the company's competition, as well as the financial cost of implementing and operating the e-commerce application were found not to be influencing factors.

2.3 Causal link

Support for the causal link between perceptions of strategic value and adoption comes from different research studies that associate individual perceptions and behavior. The Theory of Planned Behavior (TPB) [3], for example, is an especially well established intention model that has been proven successful in predicting and explaining behavior across a wide variety of domains, including the use of IT [2]. In general terms, the TPB establishes that perceptions influence intentions which in turn influence the actual behavior of the individual. By considering the intention to adopt e-commerce as the target behavior in question, the use of intention models, such as the TPB, theoretically justify the causal link between perceptions and adoption of e-commerce. Similarly, this causal link has been studied in other research that have shown that managers' perception and attitudes toward IT are strongly associated with an organization's use of IT [7, 23].

3. Research model

Based on the literature review of the strategic value, adoption of e-commerce, and theory of planned behavior, we propose the following research model:
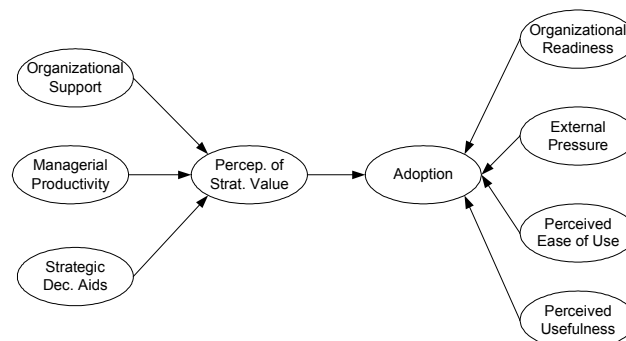

Figure 1. The proposed research model

3.1 Perception of strategic value of e-commerce

Based on Subramanian and Nosek [39] we considered three major variables as sources of strategic value of e-

commerce: *operational support, managerial productivity,* and *strategic decision aids*. Since the instrument utilized by Subramanian and Nosek [39] was found to have high reliability (Cronbach alpha= 0.82) and convergent and discriminant validity, we used the same items to measure the strategic value construct. Operational support is a variable that measures how e-commerce can reduce costs, improve customer services and distribution channels, provide effective support role to operations, support linkages with suppliers, and increase ability to compete. Managerial productivity refers to how e-commerce can enhance access to information, provide a means to use generic methods in decision-making, improve communication in the organization, and improve productivity of managers. Finally, strategic decision aids has to do with how e-commerce can support strategic decisions of managers, support cooperative partnerships in the industry, and provide information for strategic decisions.

3.2 Factors influencing adoption of e-commerce

We identified the factors that were found to be significant in prior research about technology adoption (see table 1). Based on similarity and face validity, we grouped these factors in four different variables: *organizational readiness, external pressure, perceived ease of use,* and *perceived usefulness*. Iacovo et al. [21], and Mirchandani and Motwani [29] identified organizational readiness as one of the factors that influence technology adoption. We assess this construct by including two items about the financial and technological resources the company may have available to adopt e-commerce. Factors assessing how compatible and consistent e-commerce is with firm's culture, values, and preferred work practices; existing technology infrastructure; and top management's enthusiasm to adopt e-commerce were also included in this category. These items were found relevant in previous research by Beatty et al. [6], Premkumar and Potter [33], Chin and Gopal [13], and Mirchandani and Motwani [29].

External pressure was assessed by incorporating five items that were found to be influential in previous research related to information technology adoption. The items considered were competition, social factors, dependency on other firms that were already using e-commerce, the industry, and the government [21, 11].

Davis [14] defined perceived ease of use as "the degree to which a person believes that using a particular system would be free of effort" (p. 320). We considered a subset of Davis' [14] instrument to measure this construct and modified them to make them specifically relevant to e-commerce. Similarly, he defined perceived usefulness as "the degree to which a person believes that using a particular system would enhance his or her job performance" (p. 320). We utilized the six items defined by Davis and modified them according to this research.

Table 1. Summary of adoption factors included in the current study

Factors in the current study	Factors in previous studies	Source
Organizational Readiness (OR)	Organizational compatibility	Beatty et al. (2001)
	Technical compatibility	Beatty et al. (2001)
	Organizational readiness	Iacovo et el. (1995)
	Organization facilitating conditions	Kuan & Chau (2001) Chang & Cheung (2001)
	Compatibility with company	Mirchandani & Motwani (2001)
External Pressure (EP)	External pressure	Iacovo et el. (1995)
	Environment Social factors	Kuan & Chau (2001) Chang & Cheung (2001)
Perceived Ease of Use (PEU)	Perceived ease of use	Davis (1989)
Perceived Usefulness (PU)	Perceived usefulness	Davis (1989)

The questions we explored in this research were related to the validation of the proposed model and the relationship between perceptions and adoption of e-commerce:

1. What are the determinant factors of the perceived strategic value of e-commerce in SME?
2. How do the perceptions of strategic value, as viewed by top managers/owners, influence their decision to adopt e-commerce?
3. What are the factors involved in the decision to adopt e-commerce by top managers/owners?

4. Methodology

4.1 Subjects

We targeted top managers of small and medium size business in the Midwest region of the U.S. Different criteria have been utilized to determine a small or medium size business. In our study, we considered the number of employees as the principal criterion since other categorizations such of those involving revenue, total capital and/or other types are more difficult to obtain and can result in misleading classifications of organizations. The number of employees considered in a SME varies according to the agency providing the definition. For the purpose of this study, we have used the cutoff for small and medium size businesses suggested by the U. S. Small Business Administration (less than 500 employees).

4.2 Data collection

The data for this study were gathered by means of an electronic survey administered during Spring 2002. The data gathering process was carried out in three steps. First, a sample of 1069 small and medium size businesses were identified from various sources that focus on small and mid-sized business organizations. From these sources, we identified the company name, a contact person, an e-mail address for that person, address and telephone number. The contact person identified was typically the owner of the business or a top-level manager in the organization. Second, an initial mailing, which identified the purpose of the study, a request to participate and an opt-out feature, was sent to all 1069 potential respondents. One hundred thirty six of these electronic messages were returned due to an incorrect e-mail address or the organization no longer being in business. An additional one hundred one individuals indicated they were not able to or were unwilling to participate in this study.

Thirdly, approximately one week after the initial mailing, a second electronic mailing was sent to the remaining 832 potential respondents. This electronic message directed these individuals to the web site where the survey instrument was located. Seventy-one individuals completed the survey for a response rate of 8.41%. Possible explanations for this relatively low response rate could include the possible lack of relevance of the topic to the respondent, delivery method of the instrument (electronic) and finally, the time of the year (late Spring) at which the survey request took place.

4.3 Instrument development

Three top managers participated in a pilot of the survey instrument. One of the authors observed the pilot subjects as they completed the survey. Feedback from the subjects resulted in minor changes to survey instructions and questions. Respondents were required to complete the survey that had the following major sections:

- Thirteen questions about the organization, technology utilized in the organization, and demographics about respondent's gender, age, education, years of work in present position and years of work within present firm.
- Fifteen questions about the extent to which e-commerce is perceived as contributing to strategic value.
- Twenty-three questions to measure the factors involved in e-commerce adoption.

A seven-point Likert scale (from strongly disagree to strongly agree) was utilized to measure the questions regarding perceived strategic value and adoption of e-commerce. The survey included a brief definition of e-commerce in order to clarify the concept.

5. Results

5.1 Demographics and descriptive statistics

Using the data gathering process described in the Data Collection Section, a total of 71 surveys were returned over a 4-week period. The results indicate that the top managers are well educated with over 64% holding a 4-year college degree or Masters. The majority of them are male (62%) and 35% were between 41 and 50 years of age. They had an average of 8 years working in the firm. 96% of the firms had an Internet service provider already in place, 90% had a web site, and 70% had e-commerce capability.

5.2 Statistical analysis

In order to test the proposed model, a statistical analysis was conducted in two stages. The first step employed confirmatory factor analysis to measure whether the number of factors and loadings of items involved in the two main constructs of this study (perceived strategic value and adoption) conform to the proposed model. With this analysis, we found answers to research questions 1 and 3 as stated in Section 3.

Since we were also interested in exploring how the perceptions of strategic value influence the decision to adopt e-commerce (research question 2), canonical analysis was utilized in the second step. Canonical analysis involves developing a linear combination of independent variables (strategic value variables) and dependent variables (adoption variables) to maximize the correlation between the two sets [24]. MIS research has benefited from the use of this multivariate technique (see for example [25], [8]). Campbell and Taylor [9] demonstrated that canonical analysis subsumes other statistical procedures (t-test, Pearson correlation, multiple regression, ANOVA, MANOVA, and discriminant analysis).

Non-response is a potential source of bias in survey studies that needs to be properly addressed [15]. The potential bias in this study was evaluated by comparing responses between early and late respondents. Early respondents were defined as those who had completed the survey within the initial 2-weeks while late respondents were those who completed the survey after the specified response period. Around 70% of the responses were early respondents. Demographic data was utilized for this purpose: number of employees, number of years in the current position, number of years in the firm, and number of personal computers in the company. No significant differences were found between the early and late respondent groups suggesting no non-response bias.

Stage 1: Confirmatory factor analysis

a) Perceived strategic value construct

A confirmatory factor analysis was run using SPSS 10.1. All items measuring perception of strategic value of e-commerce were considered during the first run and resulted in one item not loading as expected on the intended factors. This item was dropped from the analysis and the construct was recalculated. The items considered in the final analysis for the perceived strategic value construct are shown in Appendix A.

The factor analysis used principal components in order to extract the maximum variance from the items. To minimize the number of items which have high loadings on any given factor, a varimax rotation was utilized. Using the Kaiser eigenvalues criterion, we extracted three factors (with eigenvalues 7.49, 1.88, and 1.19 respectively) that collectively explained 75.45% of the variance in all items. Hair et al. [17] provide guidelines for identifying significant factor loadings based on sample size. In order to obtain a power level of 80 percent at .05 significance level, a factor loading of .65 or higher should be considered as a cut-off value. Even though the results from the rotated factor matrix in Table 2 shows that most of the items had a loading greater than .65, the interpretation of the loadings in this current analysis was not without problems. Face validity was an important criterion to consider items that had a factor loading close to the cut-off value of .65 and similar loadings in more than one factor. For example, item OS5 (e-commerce provides effective support role to operations) seems to belong to the *organizational support* factor rather than to the m*anagerial productivity* factor. Similarly items DA1, DA3, and DA4 seem to belong to the *decision aids* factor rather than to the m*anagerial productivity* factor.

Convergent and discriminant validity was assessed using factor analysis. Convergent validity is demonstrated if the items load strongly (>0.50) on their associated factors. Discriminant validity is achieved if each item loads stronger on its associated factor than on any other factor [17]. Table 2 shows that all items have loading greater than 0.50 and load stronger on their associated factors than on other factors. Thus, convergent and discriminant validity are demonstrated.

Construct reliability or internal consistency was assessed using Cronbach's alpha. Table 2 shows that the values for alpha vary from .85 (decision aids) to .94 (managerial productivity). The scale reliabilities are unusually good compared to the acceptable 0.7 level for field research [31].

b) Adoption construct

The adoption construct was initially comprised of 23 items. In order to test how these items loaded, another factor analysis was run. As in the case of the perceived strategic value construct, the initial factor analysis resulted in items that did not load as expected on the intended factors. Thus, two items were dropped from the analysis and the construct was recalculated.

Table 2. Rotated component matrix

	Component		
	1	2	3
OS1	-4.133E-02	**.801**	.235
OS2	.281	**.720**	.377
OS3	4.807E-02	**.790**	.424
OS4	.476	**.719**	8.719E-02
OS5	.529	**.617**	7.553E-02
OS7	.239	**.727**	-.129
MP1	**.909**	.223	6.165E-02
MP2	**.891**	.123	.216
MP3	**.832**	.139	.352
MP4	**.794**	.209	.384
DA1	.532	.300	**.652**
DA2	.125	5.648E-02	**.835**
DA3	.508	.280	**.590**
DA4	.515	.272	**.608**
Alpha	**.94**	**.88**	**.85**

The results of this confirmatory factor analysis resulted in 5 factors loading cleanly with a total explained variance of 79.1%. Thus, we revised the proposed model and considered a fifth factor, which we named "compatibility", to better describe the items used (see Figure 2). The results from this factor analysis are quite interesting. Previous research has found compatibility to be an important factor that influences the adoption of information technologies [6, 29, 33, 13]. In our study, compatibility emerged freely as a significant independent factor. The items considered in the final instrument are shown in Appendix A.
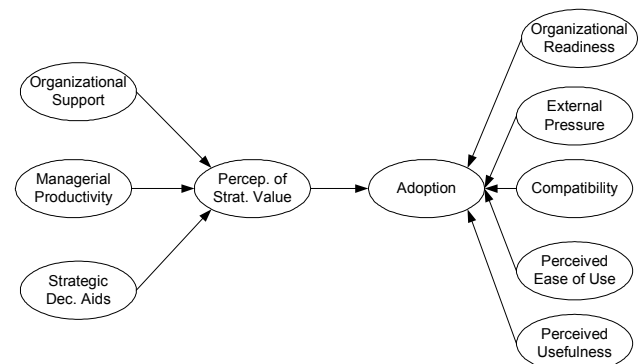

Figure 2. The revised research model

Convergent and discriminant validity was achieved as in the case of the perceived strategic value construct and the same considerations about the significance of the factor loadings were employed. Table 3 shows that all items have loading > 0.5. They also loaded stronger on their associated factors than on other factors. Thus, convergent and discriminant validity are demonstrated.

Table 3 also shows that alpha values range from .80 (external pressure) to .95 (perceived usefulness). As in the case of the strategic value construct, the reliability of the adoption construct turned out to be very high.

Table 3. Rotated component matrix

	Component				
	1	**2**	**3**	**4**	**5**
OR1	3.378E-02	.135	.163	.113	**.908**
OR2	.135	.170	-.158	.172	**.887**
C1	9.408E-02	7.384E-02	.421	**.743**	.265
C2	.133	6.885E-02	.381	**.833**	.116
C3	.340	.276	-8.970E-02	**.811**	5.296E-02
C4	.422	.411	-.216	**.518**	.137
EP1	.392	.145	**.565**	.263	.237
EP2	.402	.107	**.617**	.247	.122
EP3	.173	.186	**.777**	2.489E-02	-5.831E-02
EP4	.367	4.313E-02	**.673**	.104	-.106
EU1	.222	**.684**	.400	4.752E-03	.305
EU2	.376	**.800**	4.740E-02	.169	9.204E-02
EU3	.309	**.864**	.150	9.788E-02	.103
EU4	.233	**.913**	.107	.138	3.985E-02
EU5	.210	**.872**	8.842E-02	.194	.109
PU1	**.668**	.312	8.431E-02	.417	-4.296E-02
PU2	**.747**	.243	.239	.201	4.387E-02
PU3	**.769**	.346	.327	.203	.114
PU4	**.779**	.276	.338	.206	7.407E-02
PU5	**.776**	.325	.355	.116	.137
PU6	**.776**	.305	.298	3.077E-02	9.130E-02
Alpha	.95	.94	.80	.84	.85

Stage 2: Canonical analysis

Canonical analysis is a multivariate statistical model that studies the interrelationships among sets of multiple dependent variables and multiple independent variables [17, 36, 24]. By simultaneously considering both multiple dependent and independent variables, it is possible to control for moderator or suppressor effects that may exist among various dependent variables [28].

In canonical analysis there are *r* criterion variables (dependent variables) and *s* predictor variables (independent variables). The maximum number of canonical correlations (functions) between these two sets of variables is the number of variables in the smaller set [16, 24, 36]. In our case, the number of variables for the perception of strategic value is three while the number of variables in the adoption construct is five. Thus, the number of canonical functions extracted from the analysis is three which correspond to the smallest set of variables.

In order to test the significance of the canonical functions we followed the guidelines given by Hair et al. [17]. They suggest to use three different measures in order to interpret the canonical functions: a) the significance of the F value given by Wilk's lambda, Pillai's criterion, Hotteling's trace, and Roy's gcr, b) the measures of overall model fit given by the size of the canonical correlations, and c) the redundancy measure of shared variance. Table 4 shows the corresponding multivariate

test of significance with 15 degrees of freedom (3x5) while Table 5 shows the measures of overall model fit in the three canonical functions. Note that the strength of the relationship between the canonical covariates is given by the canonical correlation [17].

Table 4. Multivariate test of significance

Test Name	Value	Approx.F	Hypoth.DF	Error	Sig.
Pillais	.99561	6.15928	15.00	186.00	.000
Hotellings	2.72908	10.67374	15.00	176.00	.000
Wilks	.21427	8.27138	15.00	166.03	.000
Roys	.70204				

Table 5. Measures of overall model fit

Canonical Function	Canonical Correlation	Canonical R²	F Statistic	Probability
1	.838	.702	8.27138	.000
2	.491	.241	2.73334	.008
3	.230	.053	1.14925	.336

Even though the multivariate test of significance shows that all the tests are statistically significant at the .05 level (table 4), from the overall model fit we conclude that only the first and second canonical functions represent a significant value (p<.01). This conclusion is consistent with the canonical R^2 values showed in Table 5. For these data, in the first canonical function the independent variables explain 70% of the variance in the dependent variables; the second canonical function explains 24%, and the third one explains only 5.3%. This is not unusual since typically the first canonical function is far more important than the others [24, 9].

Although the first and second canonical functions are significant according to the above analysis, it is recommended that redundancy analysis be utilized to determine which functions should be used in the interpretation [37]. Redundancy is defined as the ability of a set of independent variables, taken as a set, to explain the variation in the dependent variables taken one at a time [17]. Table 6 summarizes the redundancy analysis for the dependent and independent variables for the two canonical functions that were found to be significant by using the measure of model fit. The results indicate that the first canonical function accounts for the highest proportion of total redundancy (93.41% including both dependent and independent variables) while the second one accounts only for 6.59%. In addition, the redundancy indexes are higher for the first canonical function than for the second one. Therefore, only the first canonical function is considered for interpretation.

Table 7 shows the summary of standardized canonical coefficients (canonical weights) and canonical loadings for the first canonical function considering both independent and dependent variables.

IEEE COMPUTER SOCIETY

Table 6. Canonical redundancy analysis

Canonical Function	Variable	Canonical R^2	Redundancy Index	Proportion of total redundancy
1	Dependent	.702	.486	46.42%
	Independent	.702	.492	46.99%
2	Dependent	.241	.017	1.62%
	Independent	.241	.052	4.97%

Table 7. Standardized canonical coeff. and canonical loadings for perceived strategic value and adoption

Construct	Variable	Canonical Weights	Canonical Loading
Perceived Strategic Value	OS	1.080	.998
	MP	.088	.729
	DA	.018	.759
Adoption	OR	.018	.591
	C	.447	.935
	EP	.011	.787
	EU	.270	.868
	PU	.345	.929

The canonical loadings measure the linear correlation between the independent variables and their respective canonical variates. These can be interpreted like factor loadings in a factor analysis [17]. Table 7 shows that all the canonical loadings are significant for both dependent and independent variables (cut off >.3 according to Green et al. [16], and Byrd and Turner [8]). The rank order of importance (determined by the absolute value of the canonical loadings) for the perceived strategic value of e-commerce is organizational support (OS), decision aids (DA), and managerial productivity (MP). Similarly, the rank of importance for the adoption construct contributing to the first canonical function is compatibility (C), perceived usefulness (PU), ease of use (EU), external pressure (EP), and organizational readiness (OR).

6. Conclusions

Throughout this study we have attempted to build a model that explains how perceived strategic value of e-commerce influences managers' attitude toward e-commerce adoption. Through studying two different streams of research, we have proposed and validated a predictive model that posit three factors as determinants of the perceived strategic value of e-commerce and five determinant factors for the e-commerce adoption in SMEs.

The canonical results of this study reveal a significant relationship between the perceived strategic value of e-commerce variables and the factors that influence e-commerce adoption in SMEs. This means that those top managers who perceived e-commerce as adding strategic value to the firm have a positive attitude toward its' adoption. This supports previous research done in the area of TPB [3,7,23]. From the canonical loadings we conclude

that the three factors proposed as determinants of perceived strategic value of e-commerce have significant impact on managers' attitudes toward e-commerce adoption with organizational support and decision aids as the most influential. In addition, the second order confirmatory analysis corroborated Subramanian and Nosek's [39] results in the sense that most of the variables considered in the perception of strategic value construct were found to be significant.

On the other hand, all the factors proposed as determinants of e-commerce adoption: compatibility, perceived usefulness, external pressure, perceived ease of use, and organizational readiness were found to be statistically significant as determinants of e-commerce adoption. Compatibility between e-commerce and firm's culture, values, and preferred work practices as well as consistency with the existing technology infrastructure turned out to be the most influential ones as perceived by top managers. Results from the second order factor analysis confirmed the studies of Mirchandani and Motwani [29], Chin an Gopal [13], and Premkumar and Potter [33] in which compatibility is considered an important factor that determines adoption. In our study, compatibility emerged freely as an independent factor that highly influences e-commerce adoption.

Regarding the findings on perceived usefulness, external pressure, and organizational readiness, our study validated previous research that have dealt with other information technology adoption issues [14, 21]. From the second order factor analysis, we concluded that all the variables that measured perceived usefulness, external pressure, perceived ease of use, and organizational readiness were found to be influential in e-commerce adoption. Finally, from the canonical analysis it can be concluded that managers who have positive attitude toward the adoption of e-commerce also perceive e-commerce as adding strategic value to the firm.

Generalizations from this research should be made with caution. The main limitation in our study corresponds to the number of employees considered in each company. Our sample is mainly comprised of companies whose number of employees varies between 10 and 200. Only 5 firms had more than 200 employees. This implies that the sample may be biased toward smaller firms and, therefore, the results may not be generalized to larger firms.

The uniqueness of this study gathering together two different streams of research generates many opportunities for future inquiries. First, in order to corroborate the results of this current study and to create a broader, cumulative knowledge of the relationship between perceived strategic value and adoption of e-commerce, it would be desirable to reproduce this research. As Adams et al. [1] pointed out "the tendency of IS researchers to become complacent or discouraged with progress in a specific area after conducting what would be considered a

limited number of studies in other domains should be challenged. We should begin to focus on replication, refinement, and development of models and measures" (p.245). Thus, by using the same proposed model, this research could be replicated by using a different sample in other regions of the U. S.

Second, a discriminatory analysis to identify the factors that differentiate between adopters from non-adopters of e-commerce in small and medium sized companies could also be conducted in the future. The results from this suggested analysis could be compared with previous research that have tried to determine discriminant factors between adopters and non-adopters in other information technologies.

Third, it would be also interesting to extend this study to determine the relationship between the total number of employees, budget allocated to information systems, and number of employees in the information systems department (if any) and the extent to which the firms have adopted e-commerce. Findings regarding this proposed study could help to determine the state-of-the-art in which SMEs are regarding e-commerce adoption according to these variables and determine what will be the tendency of e-commerce adoption in the future.

This study, by bringing together two distinct streams of research, can provide a foundation upon which future studies in e-commerce adoption can build upon. This is significant in the sense that it incorporates findings from research in other areas of IT into the e-commerce arena. We also expect that the results generated from our study will help managers of SMEs understand the relationship between their perceptions of the strategic value of e-commerce and its future adoption. In addition, we believe that this study will contribute to the knowledge that top managers and business owners should have in order to make better decisions when facing e-commerce adoption issues. By identifying and understanding which factors are critical in the integration of e-commerce into their organizations, business owners and top managers can take a proactive approach and the necessary steps to ensure success.

7. References

[1] D. A. Adams, R.R. Nelson, and P. A. Todd. "Perceived usefulness, ease of use, and usage of information technology: A replication," *MIS Quarterly*. June/1992. pp. 227-247.

[2] R. Agarwal. "Individual Acceptance of Information Technologies," in Framing the Domains of IT Management, R. W. Zmud (eds), Pinnaflex Education Resources, 2000, pp. 85-104.

[3] I. Ajzen. "The Theory of Planned Behavior," *Organizational Behavior and Human Decision Processes* (50), 1991, pp. 179-211.

[4] R. Amit and C. Zott. "Value creation in e-business," *Strategic Management Journal*. 22, 2001, pp. 493-520.

[5] A. Barua, C. H. Kriebel, and T. Mukhopadhyay. "Information technology and business value: An analysis and empirical investigation," *Information Systems Research* 6(1), 1995, pp. 3-23.

[6] R. C. Beatty, J. P. Shim, and M. C. Jones. "Factors influencing corporate web site adoption: A time-based assessment," *Information and Management*. 38, 2001, pp. 337-354.

[7] E. A. Bush, L. Jarvenpaa, N. Tractinsky, and W. H. Glick. "External versus internal perspectives in determining a firm's progressive use of information technology," in J. I. DeGross, I. Benbasat, G. DeSanctis and C. M. Beath (Editors), *Proceedings of the Twelve International Conference on Information Systems*, New York, NY, December 1991, pp. 239-250.

[8] T. A. Byrd and D. E. Turner. "An exploratory examination of the relationship between flexible IT infrastructure and competitive advantage," *Information and Management*, 39, 2001, pp. 41-52.

[9] K. T. Campbell and D. L. Taylor. "Canonical correlation analysis as a general linear model: A heuristic lesson for teachers and students," *The Journal of Experimental Education*, 64(2), 1996, pp. 157-171.

[10] Y. E. Chan. "IT value: The great divide between qualitative and quantitative and individual and organizational measures," *Journal of Management Information Systems*, 16(4), Spring 2000, pp. 225-261.

[11] M. K. Chang and W. Cheung. "Determinants of the intention to use Internet/WWW at work: a confirmatory study," *Information and Management* 39, 2001, pp. 1-14.

[12] A. Chaudhury, and J.P. Kuilboer, *E-Business and E-Commerce Infrastructure*, McGraw-Hill, Boston, MA, 2002.

[13] W. W. Chin and A. Gopal. "Adoption intention in GSS: Relative importance of beliefs," *DATA BASE*, May/August, 26(2-3), 1995, pp. 42-64.

[14] F. D. Davis. "Perceived usefulness, perceived ease of use, and user acceptance of information technology," *MIS Quarterly,* September 1989, pp. 319-340.

[15] F. J. Fowler. *Survey Research Methods*. 2nd Edition. Thousand Oaks, Sage, 1993.

[16] P. E. Green, M. H. Halbert, and P. J. Robinson. "Canonical analysis: An exposition and illustrative application," *Journal and Marketing Research*, 3, 1966, pp. 32-39.

[17] J. F. Hair, R. E. Anderson, R. L. Tatham, and W. C. Black. *Multivariate Data Analysis,* Prentice Hall, New Jersey, 1998.

[18] A. R. Hendrickson, P. D. Massey, and T. P. Cronan. "On the test-retest reliability of perceived usefulness and perceived ease of use scales," *MIS Quarterly*, June/1993, pp. 227-230.

[19] L. M. Hitt and E. Brynjolfsson. "Productivity, business profitability, and consumer surplus: Three different measures of information technology value," *MIS Quarterly*, June/1996, pp. 121-142.

[20] S. I. Huff, M. Wade, M. Parent, S. Schneberger, and P. Newson. *Cases in Electronic Commerce*. McGraw-Hill, Boston, 2000.

[21] A. L. Iacovou, I. Benbasat, and A. Dexter. "Electronic data interchange and small organizations: Adoption and impact

of technology," *MIS Quarterly,* December 1995, pp. 465-485.

[22] M. Igbaria, N. Zinatelli, P. Cragg, and A. Cavaye. "Personal computing acceptance factors in small firms: A structural equation model," *MIS Quarterly*. September/1997, pp. 279-302.

[23] S. L. Jarvenpaa and B. Ives. "Executive involvement and participation in the management of IT*," MIS Quarterly*, 15(2), 1991, pp. 205-227.

[24] R. A. Johnson and D. W. Wichern. *Applied Multivariate Statistical Analysis*. Prentice Hall, NJ, 1998.

[25] A. E. Koh and H. J. Watson. "Data management in executive in executive information systems," *Information and Management*, 33, 1998, pp. 301-312.

[26] K. Kuan and P. Chau. "A perception-based model of EDI adoption in small businesses using technology-organization-environment framework," *Information and Management,* 38, 2001, pp. 507-521.

[27] A. L. Lederer, D. J. Maupin, M. P. Sena, and Y. Zhuang. "The technology acceptance model and the World Wide Web," *Decision Support Systems,* 29, 2000, pp. 269-282.

[28] M. A. Mahmood and G. J. Mann. "Measuring the organizational impact of information technology investment: An exploratory study," *Journal of Management Information Systems*, 10(1), Summer 1993, pp. 97-122.

[29] A. A. Mirchandani and J. Motwani. "Understanding small business electronic commerce adoption: An empirical analysis," *Journal of Computer Information Systems*, Spring 2001, pp. 70-73.

[30] H. A. Napier, P. J. Judd, O. N. Rivers, and S. W. Wagner. *Creating a Winning E-business*. Course Technology, Boston, MA, 2001.

[31] J.C. Nunnally. *Psychometric Theory*. McGraw-Hill, New York,1978.

[32] OPEN Small Business Network 2002 Monitor. In URL: http://www.americanexpress.com/homepage/smallbusiness.shtml?mtpers_home=smbustab

[33] G. Premkumar and M. Potter. "Adoption of computer aided software engineering (CASE) technology: An innovation adoption perspective," *DATA BASE*. 26(2-3), 1995, pp. 105-123.

[34] G. Saloner and A. M. Spence. *Creating and Capturing Value, Perspectives and Cases on Electronic Commerce*, Wiley, NY, 2002.

[35] G. P. Schneider and J. T. Perry. *Electronic Commerce*. Course Technology, Cambridge, MA, 2000.

[36] J. P. Stevens. *Applied Multivariate Statistics for the Social Sciences*. Lawrence Erlbaum Associates Publishers, NJ, 2002.

[37] D. Steward and W. A. Love. "A general canonical correlation index," *Psychological Bulletin*, 70(3), 1968, pp. 160-163.

[38] G. H. Subramanian. "A replication of perceived usefulness and perceived ease of use measurement," *Decision Science,* 25(5-6), 1998, pp. 863-874.

[39] G. H. Subramanian and J. T. Nosek. "An empirical study of the measurement and instrument validation of perceived strategy value of information systems*," Journal of Computer Information Systems*, Spring 2001, pp. 64-69.

[40] B. Szajna. "Software evaluation and choice: Predictive validation of the technology acceptance instrument," *MIS Quarterly,* September 1994, pp. 319-324.

[41] P. P. Tallon, K. L. Kraemer, and V. Gurbaxani. "Executives' perceptions of the business value of information technology: A process-oriented approach," *Journal of Management Information Systems*, Spring 2000, pp. 145-173.

[42] V. Venkatesh and F. D. Davis. "A model of the antecedents of perceived ease of use: Development and test," *Decision Sciences*, 27(3), Summer 1996, pp. 451-481.

Appendix A: Final items considered in the study

		Perceived Strategic Value
Organizational Support	OS1	Reduce costs of business operations
	OS2	Improve customer service
	OS3	Improve distribution channels
	OS4	Reap operational benefits
	OS5	Provide effective support role to operations
	OS7	Increase ability to compete
Managerial Productivity	MP1	Provide managers better access to information
	MP2	Provide managers access to methods and models in making functional area decisions
	MP3	Improve communication in the organization
	MP4	Improve productivity of managers
Decision Aids	DA1	Support strategic decisions for managers
	DA2	Help make decisions for managers
	DA3	Support cooperative partnerships in the industry
	DA4	Provide information for strategic decision
		Adoption
Org. Readiness	OR1	Financial resources to adopt e-commerce
	OR2	Technological resources to adopt e-commerce
Compatibility	C1	With culture
	C2	With values
	C3	With preferred work practices
	C4	E-commerce would be consistent with our existing technology infrastructure
External Pressure	EP1	Competition is a factor in our decision to adopt e-commerce
	EP2	Social factors are important in our decision to adopt e-commerce
	EP3	We depend on other firms that are already using e-commerce
	EP4	Our industry is pressuring us to adopt e-commerce
Ease of Use	EU1	Learning to operate e-commerce would be ease for me
	EU2	I would find e-commerce to be flexible to interact with
	EU3	My interaction with e-commerce would be clear and understandable
	EU4	It would be ease for me to become skillful at using e-commerce
	EU5	I would find e-commerce easy to use
Perceived Usefulness	PU1	Using e-commerce would enable my company to accomplish specific task more quickly
	PU2	Using e-commerce would improve my job performance
	PU3	Using e-commerce in my job would increase my productivity
	PU4	Using e-commerce would enhance my effectiveness on the job
	PU5	Using e-commerce would make it easier to do my job
	PU6	I would find e-commerce useful in my job

IEEE
COMPUTER
SOCIETY