

# Technology Competence in the Function of Greater Extent of E-Business Use

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**Abstract** — Key research questions that motivated our work are: (1) What factors can be identified as key antecedents of e-business use and value? (2) How would these factors vary across different economic environments in Vojvodina [1]? In this paper we analyzed e-business value creation, from a resource-based perspective, that stems from the unique characteristics of the Internet.

**Keywords** — e-business; information system success; measurement model

## I. INTRODUCTION

There is a need for a theoretically and empirically relevant framework for examining the use and value of e-business in organizations.

Prior research argued that theories developed in the context of mature markets and industrialized economies need to be reexamined in the context of developing countries, because these countries may have very different economic and regulatory environments challenges the presumption of conceptual equivalence across cultural and economic barriers in management science research. We study e-business experience of organizations in developed and developing regions that might represent different stages of e-business transformation, for results in Vojvodina.

A host of variables, indicators and measures to assess the success of an IS:

- user (information) satisfaction of system acceptance,
- user engagement, user participation or user involvement,
- (perceived) information quality or system quality,
- perceived service quality: user satisfaction,
- usage of IS, usage to support specific tasks,

- task-technology fit,
- success of specialized information system (IS): impact on individual, group or organizational performance, such as decision support systems, group (decision) support systems and group communication support systems, office systems, Creativity Support Systems, computer-mediated communication or End-User Computing.

DeLone and McLean went to the trouble of a comprehensive analysis of all the different streams of research about IS success and proposed an integrated model for information system success [2].

## II. ELEMENTS FOR DIFFUSION OF E-BUSINESS

On the basis of a thorough literature review, Kwon and Zmud asserted the importance of technology resources (e.g., infrastructure and technical skills) for successful IS diffusion. This theoretical assertion was strengthened by a number of empirical studies. Hence, we include technology competence.

E-business is also influenced by organizational factors because these variables may constrain or facilitate the implementation and usage of e-business. Based on prior innovation studies, size scope, and financial commitment are identified as three critical organizational factors that would influence the extent of e-business use in an organization [3].

(1) Firm size is one of the most commonly cited factors in the innovation literature. As size represents several important aspects of the organization, including resource availability, decision agility, and prior technology experience, it should be included in the model [4].

(2) International scope is an antecedent new to this study, which refers to a firm's geographical spread or its extent of multicountry operations in the global market. Firms with activities dispersed geographically may benefit more from e-business use as a means of coordinating their value chains. The public, open nature of the Internet makes doing so easier than earlier technologies such as EDI [5]. The global reach of the Internet makes it potentially more beneficial as well. As a consequence, firms with greater international scope are likely to use e-business to a greater extent than those with less international scope. Given the international dimension of our research design and our geographical, multicountry emphasis on globalization of e-business, it is important to include international scope.

(3) Financial resources have been a popular antecedent to IS diffusion. To capture financial resources specifically committed to e-business rather than the overall financial resources of the organization, we use the construct financial commitment and define it as the commitment of financial resources to e-business as a proportion of total firm resources. This is felt to be a more appropriate antecedent of e-business use because it reflects committed rather than merely available resources. It also reflects the strategic importance that the senior management puts on e-business. One would expect that greater resource commitments would lead to more e-business applications that are both more useable and used [6].

As the environment presents both constraints and opportunities for technological innovation, e-business is influenced by environmental factors related to competition and regulation. Competitive pressure has long been recognized in the innovation diffusion literature as an important driver for technology diffusion. These studies have shown that innovation diffusion is accelerated by the competitive pressure in the environment. In contrast to competitive pressure, regulatory support is a unique feature of e-business that has not been included in prior studies on technology diffusion [7]. The open-standard nature of the Internet brings unique issues regarding business law, security, credit card use, and online transactions with parties that have no prior relationship, which in turn poses unique demands on regulatory support (again different from EDI). In addition, governments' embrace of e-business brings direct (government incentives) and indirect (required for government incentives) stimulus for its use. Thus, regulatory support is another critical environmental factor that tends to affect e-business use [8].

As explained above, we have selected these six antecedents based on prior research and particular linkages to the nature of Internet-based e-business. We incorporated these six factors within the technological, organizational, and environmental contexts of the technology-organization-environment (TOE) framework [9]. Further justification for each of these factors is provided below, together with hypothesis development.

#### A. Technology Context

Technology competence is conceptualized as an integrative construct that is reflected not only by physical

assets, but also by human resources that are complementary to physical assets. It refers to a firm's technical capability as a result of having distributed computing power within the organization and having implemented specific technologies such as EDI and EFT [10]. Technology infrastructure establishes a platform on which e-business can be built; information technology (IT) human resources provide knowledge and skills to develop e-business applications. Therefore, firms with a higher degree of technology competence tend to enjoy greater readiness to use e-business in their value chain processes. As a result, they would be more likely to achieve a greater extent of e-business usage [11]. This leads to the following hypothesis:

H1. Firms with greater technology competence are more likely to achieve a greater extent of e-business use.

#### B. Organization Context

Large firms generally possess slack resources that can facilitate implementation and usage. Firm size is often associated with inertia; that is, large firms tend to be less agile and flexible than small firms. The possible structural inertia associated with large firms may slow down organizational usage and may therefore retard e-business value creation. By contrast, smaller firm size is expected to facilitate innovation usage, as small firms "require less communication, less coordination, and less influence to gather support". The actual use of e-business may entail radical change in firms' business processes and organization structure, which might be retarded by the structural inertia of large firms [12]. In our study, firm size is defined by the number of employees in the organization. This leads to the following hypothesis:

H2. Controlling for resource availability effects, larger firms tend to achieve a lesser extent of e-business use.

Proposed that the greater the business scope, the greater the demand for IT. The effect of international scope on e-business use can be explained from a resource-based perspective. When companies expand into heterogeneous market segments, they need to develop resources and capabilities including a flexible IT infrastructure and IT management skills that enable them to deal with that heterogeneity as well as or better than their competitors. Retail companies that expand globally would have a greater incentive to use e-business to leverage their existing IT capabilities for a competitive advantage. This leads to the following hypothesis:

H3. Firms with greater international scope are more likely to achieve a greater extent of e-business use.

Implementing e-business requires investment in hardware, software, system integration, and employee training. Sufficient financial resources dedicated to e-business helps companies to obtain these necessary resources and develop them into superior e-business functionalities. Thus, firms with greater financial commitment are more likely to achieve successful e-business implementation and thus tend to achieve a greater

extent of usage [13]. Hence, we have the following hypothesis:

H4. Firms with greater financial commitment are more likely to achieve a greater extent of e-business use.

### C. Differences between Developed and Developing regions

Given that the Internet is an open platform with global connectivity, developed and developing regions differ in terms of the level of IT use and the factors shaping that use. At the general level, technology diffusion studies have found that diffusion occurs unevenly across countries with different environments. Moreover, the extent of diffusion depends on a variety of economic, social, and political factors, including income, education, technology policies, cultural norms, and access to formal and informal communication networks. Looking specifically at the use of IT, wealth has been identified as the single most important factor accounting for differences between developed and developing regions, but other factors have also been found to be important [14]. These include inadequacy and access costs of the basic information infrastructure, education levels, scarcity of managerial, technical, and financial resources at the firm level, and culture and politics, including the rule of law, political openness, and property rights protection.

H5. The strength of the antecedents of e-business use and value will differ for developed and developing regions.

## III. RESEARCH METHODOLOGY

To test the associated hypotheses proposed above, we need data, but no secondary databases contain specific data on the required variables. Hence, we designed a questionnaire and conducted a multicountry survey. The questionnaire was designed on the basis of a comprehensive literature review and interviews with e-business managers and was refined via several runs of pretests, revision, and pilot tests. Each of the items on the questionnaire was reviewed by an expert panel for its content, scope, and purpose (content validity).

To have a representation of both developed and developing economies, the survey was conducted in Serbia and its developed region Vojvodina during the period of February-April 2011. The sample was stratified by firm size and region, with sites selected randomly within each size cell.

Table I. shows the characteristics of the establishment sample. All of them have adopted e-business, as this was a selection criterion for inclusion in the sample. The distribution of firm size, measured by number of employees, reflects a balance of large and small businesses. Eligible respondents were the individuals in each firm best qualified to speak about the firm's overall e-business activities.

TABLE I. SAMPLE CHARACTERISTICS (N=624)

Region	Obs.	(%)
Banat	64	10,3
Srem	64	10,3
Istocna Srbija	47	7,5
Sumadija	61	9,8
Juzna Srbija	60	9,6
Zapadna Srbija	53	8,5
Backa	69	11,1
Sevarna Srbija	57	9,1
Novi Sad	63	10,1
Beograd	86	13,8
<b>Total</b>	<b>624</b>	<b>100</b>
<b>No. of Employees</b>		
<50	134	21,5
50~100	107	17,1
100~250	151	24,2
250~400	111	17,8
>400	121	19,4

The development of the measurement model included successive stages of theoretical modeling, statistical testing, and refinement [15]. Measurement items were developed on the basis of a comprehensive review of the literature as well as expert opinion. We then tested multi-indicator constructs using confirmatory factor analysis (CFA).<sup>1</sup> Based on the assessment of CFA, the measurement model was further refined and then fitted again (Table II).

TABLE II. MEASURES

Constructs		Indicators
Technology competence	TC1	Number of PCs per employee (≠)
	TC2	IT professionals, as percent of total employees (≠)
	TC3	Number of items the establishment has in the following list (≠): Use of e-mail, website accessible by public, use of intranet, use of extranet, use of EDI, use of EFT, use of call center
Size	SZ1	Number of employees at establishment
International scope	FS1	Multiestablishments (Y/N)
	FS2	Establishments outside of country (Y/N)
	FS3	Headquarters located outside of

<sup>1</sup> For the purpose of testing the robustness of our measurement model, we also ran exploratory factor analysis on all indicators. Principal component analysis with equamax rotation yielded a consistent grouping with CFA.

		country (Y/N)
	FS4	Percent of sales from outside country (≠)
	FS5	Percent of procurement spending from outside country (≠)
Financial commitment	FR1	IS operating budget, as percent of total revenue (≠)
	FR2	Web-based spending, as percent of total revenue (≠)
Competitive pressure	CP1	Degree affected by competitors in the local market (1~5)
	CP2	Degree affected by competitors in the national market (1~5)
Regulatory support	RE1	Government provided incentive (1~5)
	RE2	Required by government purchase (1~5)
	RE3	Business laws support electronic business (1~5)
	RE4	Legal protection for consumer purchase on the Internet (1~5)
Front-end functionality	FF1	Website supports product catalog (Y/N)
	FF2	Website supports product reviews (Y/N)
	FF3	Website supports consumer customization (Y/N)
	FF4	Website supports account management (Y/N)
	FF5	Website supports registry of online community (Y/N)
Back-end integration	BI1	Web applications electronically integrated with back-office systems and databases (1~5)
	BI2	Company databases electronically integrated with suppliers and partners (1~5)
Extent of e-business use	EU1	Number of items in the following list (≠): Providing information online, making sales online, providing service online, joining electronic intermediaries for online sales, making purchases online, joining electronic intermediaries for online purchase
	EU2	Percent of consumer sales conducted online (≠)
	EU3	Percent of business-to-business sales conducted online (≠)
	EU4	Percent of goods for resale ordered online (≠)
	EU5	Percent of supplies and equipment for doing business ordered online (≠)
Impact on sales	IS1	Sales increased (1~5)
	IS2	Sales are widened (1~5)
	IS3	Customer service improved (1~5)

Impact on internal operations	IIO1	Internal processes more efficient (1~5)
	IIO2	Staff productivity increased (1~5)
Impact on procurement	IP1	Procurement costs decreased (1~5)
	IP2	Inventory costs decreased (1~5)
	IP3	Coordination with suppliers improved (1~5)

Several constructs deserve further explanation. First, technology competence is instrumented not only by physical technologies, but also by IT human resources that possess the knowledge and skills to implement e-business. Such a design is consistent with the theoretical rationale discussed. Our study used the major items in the first three dimensions to instrument front-end functionality, and the fourth dimension corresponded to our back-end integration.

To empirically assess the constructs theorized above, we conducted CFA using structural equation modeling as implemented in partial least squares. We assessed construct reliability, convergent validity, discriminant validity, and validity of the second-order construct. The measurement properties are reported in Table III.

(1) *Construct Reliability*: Construct reliability measures the degree to which items are free from random error and therefore yield consistent results. In our measurement model (Table III), all constructs have a composite reliability over the cutoff of 0.70.

(2) *Convergent Validity and Discriminant Validity*: Convergent validity assesses the consistency across multiple operation. As shown in Table III, all estimated standard loading are significant ( $p < 0.01$ ), suggesting good convergent validity.

TABLE III. MEASUREMENT MODEL FACTOR LOADINGS, RELIABILITY, AND CONVERGENT VALIDITY

Constructs (reliability)	Indicators	Loadings	Convergent validity ( <i>t</i> -start)
Technology competence (0.81)	TC1	0.79***	46.76
	TC2	0.79***	37.10
	TC3	0.71***	24.90
International scope (0.81)	FS1	0.64***	36.65
	FS2	0.86***	160.80
	FS3	0.78***	52.66
Financial commitment to e-business (0.83)	FR1	0.86***	29.07
	FR2	0.82***	15.84
Competitive pressure (0.86)	CP1	0.87***	74.04
	CP2	0.87***	73.89
Regulatory support (0.80)	RE1	0.68***	21.30
	RE2	0.69***	24.87
	RE3	0.71***	22.91

Back-end integration (0.86)	RE4	0.74***	30.76
	BI1	0.87***	80.53
	BI2	0.86***	79.54
E-business use (0.78)	EU1	0.64***	18.44
	EU2	0.50***	6.67
	EU3	0.46***	4.85
	EU4	0.83***	35.95
	EU5	0.75***	13.55
Front-end functionality (0.80)	FF1	0.63***	15.92
	FF2	0.65***	25.76
	FF3	0.67***	26.00
	FF4	0.72***	24.31
	FF5	0.68***	20.46
Impact on sales (0.88)	IS1	0.86***	76.46
	IS2	0.84***	51.62
	IS3	0.81***	41.92
Impact on internal operations (0.90)	IIO1	0.89***	81.85
	IIO2	0.91***	123.42
Impact on procurement (0.87)	IP1	0.85***	50.11
	IP2	0.85***	74.50
	IP3	0.79***	37.90
* $p < 0.10$ ; ** $p < 0.05$ ; *** $p < 0.01$ .			
Insignificant factors are dropped (FS4 and FS5)			

To assess the discriminant validity-the extent to which different constructs diverge from one another-we used Fornell and Larcker's criteria: average variance extracted for each construct should be greater than the squared correlation between constructs [16]. Such results suggest that the items share more common variance with their respective constructs than with other constructs. All constructs meet this criterion.

(3) *Validity of the Second-Order Construct*: Table IV. shows the estimation of the second-order construct, e-business *value*. The paths from the second-order construct to the three first-order factors are significant and of high magnitude, greater than the suggested cutoff of 0.7.

TABLE IV. MEASUREMENT MODEL: SECOND-ORDER CONSTRUCT

Second-order construct	First-order construct	Loading	<i>t</i> -stat	Composite reliability
E-business value	Impact on sales	0.865***	77.68	0.88
	Impact on internal operation	0.805***	44.08	
	Impact on procurement	0.844***	55.52	
* $p < 0.10$ ; ** $p < 0.05$ ; *** $p < 0.01$				

#### IV. ANALYSIS AND INTERPRETATIONS

For e-business use, five of six TOE factors-technology competence, size, financial commitment, competitive pressure, and regulatory support- have significant paths leading to the dependent construct. Size has a negative path, while the other factors have positive paths. The path associated with international scope is positive but statistically insignificant ( $p > 0.10$ ).

E-business value is also shown to have significantly positive associations with front-end functionality and back-end integration. We compared the standardized path from front-end functionality to e-business value with standardized path from back-end integration to e-business value. Back-end integration is found to have much higher magnitude than front-end functionality (0.239\*\*\* versus 0.141\*\*\*).

Within the TOE framework, technology competence, financial commitment, competitive pressure, and regulatory support are found to have significant influence on the extent of e-business use. Among these, technology competence appears to be strongest factor.

Among all the TOE factors, technology competence is the most significant factor, as indicated by its path loadings and significance levels ( $p < 0.01$ ), followed by regulatory support. Within the organizational context, our study reveals a negative effect of firm size on e-business use. While it has been commonly believed that large firms have more slack resources for committing required investments, our results show that large firms are also burdened by structural inertia, possibly due to fragmented legacy systems and entrenched organizational structures.

Competitive pressure is statistically significant for developed but not for developing part of the country. Such a difference could be explained by the distinct market environments of developed and developing part of the country. Prior research has shown that information asymmetry exists in less-developed markets, and market imperfections and inefficiencies may weaken the pressure from competitors [17]. In developed area of the country, however, markets have evolved into mature stages over time, characterized by more transparent information flow and more stable legal frameworks and government policies.

These findings could serve as useful guidelines for firms to develop their e-business capabilities. This is especially important in the retail industry, where firms have been building various legacy systems and using multiple IT platform over the years.

Effective e-business programs rely on necessary organizational reconfiguration and business processes reengineering. As Internet technologies diffuse and become necessities, these organizational capabilities and structural differences will be even more critical. In particular, managers in retail firms with a wider scope should pursue e-business usage more proactively, given the greater potential to achieve benefits from e-business. This

implication should be of special interest for retailers seeking global expansion into different regions and market segments. Such expansion means that retailers would face greater coordination tasks and could leverage e-business initiatives to facilitate coordination and achieve resource integration.

This framework could be applied by researchers to study other complex information systems in different setting. We see this research as a first step toward understanding the complex relationships among technology, environments, and organizational performance. We hope that these initial results will motivate others to engage in future research to refine the theory and measurement.

## V. REFERENCES

- [1] S. Adžić, O. Sedlak, Z. Čirić, "Micro-Industrial Clusters and Rural Development the Case Study of Vojvodina," AVA-2009, 'International congress on the aspects and visions of applied economics and informatics', Book of abstracts, Debrecen, Hungary, 27-29, march, 2009. pp.114.
- [2] W. H. DeLone, E. R. McLean, "Information systems success: The quest for the dependant variable," *Inform. Systems Res.* 3(1), 1992, pp. 60-95.
- [3] R. G. Fichman, "The diffusion and assimilation of information technology innovations," R.Zmud, ed. *Framing the Domains of IT Management: Projecting the Future through the Past*. Pinnaflex Publishing, Cincinnati, OH, 2000.
- [4] R. G. Fichman, C. Kemerer, "The assimilation of software process innovation: An organizational learning perspective," *Management Sci.* 43(10), 1997, pp. 1345-1363.
- [5] M. Porter, "Strategy and the Internet," *Harvard Buss. Rev.* 79, 2001, pp. 63-78.
- [6] A. Bharadway, "A resource-based perspective on IT capability and firm performance: An empirical investigation," *MIS Quart.* 24(1), 2000, pp. 169-196.
- [7] S. Dewan, K. L. Kraemer, "Information technology and productivity: Evidence from country-level data," *Management Sci.* 46(4), 2000, pp. 548-562.
- [8] S. Xu, K. Zhu, J. Gibbs, "Global technology, local adoption: A cross-country investigation of Internet adoption by companies in the United States and China," *Electronic Markets* 14(1), 2004, pp. 13-24.
- [9] R. Amit, C. Zott, "Value creation in e-business," *Strategic Management J.* 22(6-7), 2011, pp.493-520.
- [10] V. Sethi, W. R. King, "Development of measures to assess the extent to which an information technology applications provides competitive advantage," *Management Sci.* 40(12), 1994, 1601-1627.
- [11] B. Welty, I. Becerra-Fernandez, "Managing trust and commitment in collaborative supply chain relationships," *Comm. ACM* 44(6), 2001, pp. 67-73.
- [12] E. Shih, J. Dedrick, K. L. Kraemer, "International diffusion of e-commerce: Impact of rule of law and access cost," *Comm. ACM*. Forthcoming, 2005.
- [13] J. V. Dedrick, K. L. Gurbaxani, K. L. Kraemer, "Information technology and economic performance: A critical review of the empirical evidence," *ACM Comput. Surveys* 35(1), 2003, pp. 1-28.
- [14] F. Caselli, W. J. Coleman, "Cross-country technology diffusion : The case of computers," *The Amer. Econom. Rev.* 91(2), 2001, pp. 328-335.
- [15] D. Straub, B. Hoffmann, B. Weber, C. Steinfield, "Toward new metrics for Net-enhanced organizations," *Inform Systems Res.* 13(3), 2002, pp. 227-238.
- [16] K. A. Steward, A. H. Segars, "An empirical examination of the concern for information privacy instrument," *Inform Systems Res.* 13(1), 2002, pp. 36-49.
- [17] H. H. Teo, K. K. Wei, I. Benbasat, "Predicting intention to adopt interorganizational linkages: An institutional perspective," *MIS Quart.* 27(1), 2003, pp. 19-49.