

DOES ELECTRONIC BUSINESS CREATE VALUE FOR FIRMS? AN ORGANIZATIONAL INNOVATION PERSPECTIVE

Youlong Zhuang
College of Business
University of Missouri-Columbia
mzhuangy@missouri.edu

ABSTRACT

This study applies organizational innovation theory to one specific type of innovation—electronic business. It describes e-business innovation along seven dimensions: organizational focus, radicalness, centrality, adaptability, uncertainty, pervasiveness, and communicability. E-business is identified as both an administrative and technical innovation that is flexible, has median centrality, high levels of radicalness, uncertainty, pervasiveness, and communicability. The study also links innovative use of e-business to firm performance. By analyzing data from *InformationWeek* and the *Compustat* database, the study shows significant differences between the performance of e-business innovative firms versus the performance averages for their respective industries. The identification of e-business innovation attributes and the linkage between innovation and performance assists researchers in building e-business theories. The study also provides managers a basis for choosing the appropriate level of involvement in e-business.

Keywords: Innovation; electronic business; firm performance

1. Introduction

The purpose of this study is to understand the role of e-business innovation in firm performance. It follows the lead of previous researchers on organizational innovation who suggests that it's more important to understand how innovation theory can explain one particular innovation instead of searching for a single unifying theory that could explain all innovations in general [Wolfe, 1994; Swanson, 1994; Damsgaard and Lyytinen, 1997]. Accordingly, the current research applies organizational innovation theory to a specific type of innovation—electronic business—so that, first, the unique attributes of e-business innovation can be identified. This study then examines the attributes of e-business innovation and how they affect business success by linking early adoption and innovative use of e-business to firm performance.

The first research issue—understanding the important attributes of e-business innovation—is valuable for both researchers and managers. Researchers report that innovation in general is critical to firm competitiveness and effectiveness [Wolfe, 1994] and, yet, any systematic study of e-business as an innovation is absent. Because e-business has been one of the most, if not the single most pervasive innovations for businesses in recent years, researchers want to know where e-business fits into the overall innovation classification in terms of its attributes [Wolfe, 1994]. Such a classification provides guidance to future researchers by laying a common ground for comparing findings and organizing the accumulation of knowledge of e-business [Wolfe, 1994]. Managers want to understand e-business innovation attributes so that they can adjust their organizational process to facilitate e-business innovation and enhance firm performance [Zmud, 1984; Kettinger and Hackbarth, 2004].

The second issue of this study—understanding whether early adoption and innovative use of e-business contributes to firm performance—is also valuable for researchers and managers. However, two shortcomings of previous researches limit their value for e-business application. One drawback in studies of general innovation is the focus on antecedents of an organization's tendency to innovate (the dependent variable is typically organizational innovativeness), rather than studying the results of innovativeness [Wolfe, 1994]. Another shortcoming is a focus on e-commerce in general, rather than e-business, specifically [Lewis and Cockrill, 2002, Wang and Tsai, 2002].

E-business is defined in this study as “a broader definition of EC, not just the buying and selling of goods and services, but also servicing customers, collaborating with business partners, conducting e-learning, and conducting electronic transactions within an organization.” [Turban et al., 2004, p. 3]. Furthermore, while e-commerce studies address the factors that predict such adoptions, little is known about the effects of e-business adoption on firm performance. Managers want to know how some firms rather than others are able to establish leadership positions in the use of e-business.

As a step in overcoming the deficiencies described above, this study applies organizational innovation theory in the context of e-business. It first identifies seven e-business innovation attributes based on past research on organizational innovation [Wolfe, 1994; Downs and Mohr, 1976]. It then applies Schumpeterian [1934] innovation theory to link a firm's e-business innovativeness—early adoption and innovative use—to its performance.

The next section discusses organizational innovation theory in an e-business context. It includes a definition of innovation for e-business research and a review of e-business innovation attributes. Thereafter, the linkage between e-business innovation and firm performance is described and statistically tested. Finally, the concluding section provides discussion and implications.

2. Organizational Innovation Theory

Organizational innovation theory encompasses a broad range of research on innovation adoption and assimilation in organizations. It includes studies ranging from definitional issues to how innovation affects firm performance. Within this spectrum the current study focuses specifically on e-business innovation and how it affects firm performance.

Concepts from two previous organizational innovation studies are especially relevant for the current study. First, Damanpour's [1991] general definition of innovation is adopted for the e-business domain. Second, we argue that Wolfe's [1994] suggestions for specifying the attributes of innovation can be beneficially applied for understanding e-business performance.

2.1. Definition of Innovation for E-Business Research

Damanpour's [1991] general definition summarizes an innovation as "adoption of an internally generated or purchased device, system, policy, program, process, product, or service that is new to the adopting organization (p.556)." The elements of this definition are embedded in e-business technologies and, as such, e-business is an organizational innovation. It can be internally generated or purchased, either whole or in part. When it is introduced into a firm, e-business requires new devices such as computer hardware, software programs, and policies for using the computer networks and safeguarding confidential information. It stimulates changes in the business process such as customer order-fulfillment to fit the new ways business is conducted. Thus, e-business innovation demonstrates the important characteristics of organization innovations.

2.2. Attributes of E-Business Innovation

The current study follows one of the five research strategies suggested by Wolfe [1994]. He suggests that, "the attributes of the focal innovation be well specified (p. 422)" because attributes affect the firm's adoption pattern, rate of innovation, and the antecedents and processes of the adoption. Other innovation researchers [Henderson and Clark, 1990; Meyer and Goes, 1988], too, assert that ignoring the classification of attributes is a major obstacle to generalizability of innovation research. Accordingly, we next elaborate those attributes for e-business.

Seven attributes for innovation derive from research by others in various innovation settings [Wolfe, 1994; Daft, 1978; Nord and Tucker, 1987; Downs and Mohr, 1976]: Organizational focus (technical vs. administrative), radicalness (radical vs. incremental), centrality (central vs. peripheral), adaptability (flexible vs. inflexible), uncertainty (high vs. low), pervasiveness (high vs. low), and communicability (high vs. low). The question for guiding e-business research is, "Where, along each bipolar scale, do we expect e-business innovation to be positioned?"

Organizational focus reflects the areas of the firm to which innovation is most relevant [Wolfe, 1994]. Its original bipolar values—technical vs. administrative [Daft, 1978; Nord and Tucker, 1987; Kimberly and Evanisko, 1981] were later expanded by IS researchers to include IS innovations involving business partners that are strategically important for the innovating firms [Swanson, 1994]. Because the line between technical and administrative is easily blurred [Zmud, 1983], e-business often cannot be identified simply as either a technical or an administrative innovation. In some instances, however, e-business appears to be an administrative innovation because it arises from management needs. For example, managers seeking closer interaction with external business partners are more likely to adopt extranet and e-business. They scrutinize the environment, judge the fit of e-business to their own organization, and initiate innovations [Mehrtens, et al. 2001; Tan and Teo, 1998]. The adoption of intranet technologies for internal collaboration among geographically dispersed employees is a further example of administratively driven e-business innovation [Damanpour et al., 1989]. At the same time, e-business is a technical-driven innovation arising from technological advantage residing within the firm's IS unit. For example, business transactions through public networks are feasible only after implementation of encryption technology.

Swanson [1994] extended the two-core (technical vs. administrative) concept of organizational focus into a three-category construct to better classify IS innovations, which may enhance our understanding of the adoption and use of e-business technology. Type I is process innovation that enhances the efficiency or effectiveness of IS in a firm. Some examples are Computer Aided Software Engineering (CASE), relational database, and object-oriented

technologies. Type I innovations may also support other business innovations more broadly in a “weak-order effects” (p. 1077). Software maintenance, for example, is a Type I innovation that is likely to have effects beyond the boundaries of the IS unit. Type II is innovations that enhance the administrative work processes of firms. Examples include automated financial accounting systems, payroll and personnel record systems, groupware, office productivity software, and decision support systems. This type is close to the administrative focus discussed above. Type III innovations are information technologies that have strategic relevance for enabling firms to gain competitive advantages. Enterprise resource planning systems, airline reservation systems, and computer integrated manufacturing solutions are examples. Type III innovations focus on a firm’s major business process, extend to its products and services, or facilitate the integration or coordination among business partners, particularly between suppliers and customers.

It should be noted that e-business innovation is a Type III innovation [Chatterjee et al., 2002] that introduces a new way of doing business. It centers on a firm’s major business processes and replaces traditional paper and physically-based business activities with digital information flows. Business activities such as order entry, order confirmation, shipping documentations, and others are conducted digitally with minimal human intervention. In fact, e-business introduces a new way of doing business.

Radicalness of an innovation is the degree of change it brings to the firms’ systems and behaviors [Gopasakrishnan and Damanpour, 1997]. While technical innovation causes changes mainly within an IS unit, administrative innovation requires much broader changes [Zmud, 1982]. E-business innovation has high radicalness because it is both a technical and administrative innovation. It significantly changes the way business is conducted by requiring greater integration of the firm’s front end to its back-end systems [Sairamesh, et al. 2002]. It requires competing in real time instead of cycle time and often causes conflicts between new Internet-based distribution channels and the traditional supply chain when a firm uses both [Kalakota and Robinson, 2001]. It challenges the adopting firm on how to realize synergies in terms of inventory, transportation, and distribution [Swaminathan and Tayur, 2003].

Centrality indicates by how much e-business affects the major routine work of a firm. A central innovation dislodges and replaces major activities [Gatignon, et al., 2002], while a peripheral innovation has no direct impact on its major day-to-day activities [Nord and Tucker, 1987]. To most firms, such impact of e-business is medium. A retailer with a grand opening of its Web store, for example, is unlikely to experience the severe disruptions in major routine that would accompany the closing of all its physical stores. On the other hand, the impact is not minor. The use of new media affects, among other activities, the adopter’s supply chain and distribution channels, as when a supplier requires customers to place orders through its Website. Work skills required for employees may change, including more knowledge workers, because of new business processes introduced by e-business and physically-based work may be replaced with information flow and customer self-services [Straub, 2004; Rotchanakitumnuai and Speece, 2004].

Adaptability is about how much the adopter can refine, elaborate, and modify e-business innovation to fit its goals and objectives [Wolfe, 1994]. The fit, or compatibility, is a major factor in explaining technology innovation adoption behaviors [Cooper and Zmud, 1990]. An innovation may start with a simple prototype to which new features are added later to accommodate related innovations [Swanson, 1994]. In this view, e-business innovation is highly flexible, with uses in all major business activities or simply in a few. In many cases, the innovation begins with just a Web site, adding new features to its front-end and gradually integrating to its back-end inventory and supply chain management systems to accommodate the diffusion of e-business [Wang, et al., 2004]. In fact, firms often create new services or products to render new e-business technologies to be even more useful. E-business innovations may be tailored to the operations of a specific firm and be enhanced and extended to meet the demand of business functionality [Yang and Papazoglou, 2000].

Uncertainty is about the risk associated with e-business [Wolfe, 1994]. The risk is high for e-business as a new technology. For example, computer networks are less reliable than traditional phone lines, the investment of the first movers may be high compared to that of the followers, it is relatively easy for others to imitate a competitor’s innovation, and protection of e-business innovation is hard, even with patent laws. For example, Amazon.com uses patented one-click checkout technology on its Website. But many other retailing sites have express checkout or similar functions. An additional source of higher risk is the falling price of computer and networking devices and increasing computing powers, following Moore’s law -- doubling of transistors every couple of years. High risks also stem from dependence on the network effects [Oliva, et al. 2003; Rajgopal, et al. 2003]. For example, if only a few companies use the technology in business-to-business e-commerce, the benefits are limited. Further risk comes from firms’ networks to its stakeholders which make them transparent to the outside world. As a result, e-business brings more risks to its adopters than many other technologies do.

Pervasiveness is about the involvement of the organization’s employees in the innovation [Wolfe, 1994;

Lyytinen and Rose, 2003]. This is high for e-business. Almost everyone in the firm could be affected. Each unit plays at least a supporting role of e-business. E-business is not the sole responsibility of one unit within an organization. The success of e-business depends on the endeavor of every employee. For example, if a firm decided to replace paper memos with intranet for its internal communications, every employee, from CEO to janitor, need to learn how to retrieve electronic information with some computer-type devices [Jacoby and Luai, 2005].

Finally, *Communicability* reflects the likelihood of communicating the aspects of an innovation to others [Rothman, 1974]. Communications promote innovative behaviors [Lind and Zmud, 1991]. Variations in the communicability of an innovation and cosmopolitan may affect the adoption of the innovation [Downs and Mohr, 1976]. E-business is a complex innovation. It requires coordination of several units within the firm and collaboration of many firms in the supply chain. The word of mouth effects are much different in the e-business environment [Singh and Kundu, 2002]. In traditional business, a consumer can spread his or her experiences with a company to a limited number of people. In e-business, the same person can easily tell thousands or even millions of people with online forum. Thus, communicability is high for e-business.

In summary, e-business is both an administrative and technical innovation that is flexible, has median centrality, high levels of radicalness, uncertainty, pervasiveness, and communicability. Table 1 summarizes the attributes of e-business innovations. It shows where e-business innovation stands at each bipolar dimension.

Table 1. Attributes of E-Business Innovation

Dimension	Classification		
	Technical	In-Between	Administrative
Organizational focus	√		√
Radicalness	Incremental		Radical
Centrality	Peripheral	√	Central
Adaptability	Inflexible		Flexible
Uncertainty	Low		High
Pervasiveness	Low		High
Communicability	Low		High

3. E-Business Innovation and Firm Performance

The influential work of Joseph Schumpeter [1934] underscores the importance of innovation as the source of value creation. Schumpeterian innovation not only can change how an industry operates, but has even been called “creative destruction” because of its radical nature. Performance is, in effect, innovation-based [Mahoney and Pandian, 1992].

Schumpeterian innovation theory emphasizes the importance of technology and considers innovative use of technology as the foundation of new products and production methods. Examples include the introduction of a new good or of a new method of production, the opening of a new market, or the development of a new source of supply of raw materials or partly manufactured goods [Schumpeter, 1934].

With the attributes discussed in the previous section, e-business innovation is an example of Schumpeterian innovation. Its organizational-focus attribute suggests that such innovation crosses both technical and administrative boundaries, affects major business processes, and facilitates coordination among business partners. Such innovation has strategic impacts on innovating firms [Mustonen-Ollila and Lyytinen, 2004].

The high radicalness attribute implies that e-business innovation brings profound changes to the adopting firm and its partners [Akkermans and Helden, 2002]. By moving one of its business processes to e-business, for example, the design and logistics of the adopter’s remaining processes become much different. Its suppliers and customers, too, may be affected by those same innovations.

The high uncertainty attribute of e-business challenges the managers of e-business. It is the innovative use of the technology that differentiates a superior performer from a poor one. Such innovative use often accompanies introduction of a new good or of a new method of production as in Schumpeterian innovation.

Due to its high pervasiveness, e-business affects everything throughout the organizations. Employees need to be retrained to assume new responsibilities brought about by e-business. Firms reorganize its structure to fit e-business innovation which emphasizes the flow of information both within their boundary and among partners along the supply chain.

Typical of Schumpeterian innovation's creative destruction, e-business has been changing entire organizations and industries. Its diffusion often stimulates reconfiguration of the adopter's technology, strategy, and structure, and, for early adopters, sometimes provides a "dominant design" that gains initial competitive advantage [Mason, et al., 1997]. Dell, for example, as one of the first firms to use the Internet to sell directly to businesses, governments, and consumers, gained significant advantages over its competitors [Metz, 1998; Menn, 1999].

Widespread adoption of e-business technology affects firm performance by redefining the way firms compete. Among the most powerful sources of creative destruction in the last century is the introduction of the Internet for connecting millions of computers and other devices worldwide. Its commercial use, combined with the graphical user interface based World Wide Web browser, is more than deployment of equipment and devices—it is also a social force. It has changed the way firms do business, including their product offerings, organizational boundaries and structures, value chains, and marketing channels.

E-business also affects firm performance by intensifying the competition. Towards the last few decades of the twentieth century, the competition among businesses is going global and becoming more severe. This global marketplace is characterized by intense social, economic, and technological changes. Innovation plays an important role in enhancing and sustaining the performance of firms to adapt to the change. [Gopalaskrishnan and Damanpour, 1997]. E-business emerged as a critical business innovation. Managers become Schumpeterian entrepreneurs and adopt e-business to destroy the current organizational arrangements. This process resulted in some cannibalization of the firm's existing markets as the industry was launched on a new course [Mason et al. 1997]. Manufacturers often find e-business cannibalizing their existing distribution channels [Boyd and Bilegan, 2003]. E-business thus affects firm performance.

E-business influences firm performance by enabling organizational learning and knowledge management [Parker, 2003]. E-business innovation has provided new capabilities that produce values by creating more efficient markets, enabling easier access, making value and supply chains more efficient, disrupting current pricing power, enabling mass customization, and extending reach. Firms that adopt e-business early will cumulate more knowledge and thus can compete better in the new economy [Mustonen-Ollila and Lyytinen, 2004].

E-business also influences firm performance by changing business process [Wu, et al, 2003]. It changes business communications, order taking, and procurement processes. Better communications within and across corporate boundary enhances collaborative commerce and create values [Gibson and Edwards, 2004]. Online ordering and payment make transaction more accurate, timeliness, less expensive, and result in happier customers and more revenues for the firm [Laudon and Traver, 2004]. Automatic procurement allows a firm to search and locate potential suppliers in a larger pool and thus can find high quality suppliers [Rayport and Jaworski, 2004]

This leads us to two main hypotheses of this study:

H1: Superior e-business innovativeness will be associated with significantly higher profit ratios.

H2: Superior e-business innovativeness will be associated with significantly lower cost ratios.

4. Methodology

4.1 Sample Selection

Each year since 1989, *InformationWeek* has ranked companies on the basis of how they use IT innovatively. It awarded 500 firms that demonstrated a pattern of technological, procedural, and organizational innovation. During the period of 1998 through 2001, it also awarded gold citations to one third of the 500 firms for their early adoption and creative use of electronic commerce technologies. To identify firms with superior e-business innovativeness, this study uses the rankings provided by *InformationWeek* in its annual special issue during the period of 1998 through 2001. *InformationWeek* uses a rigor survey instrument. It has more than 10 years of experience in designing the instrument and collecting the data. The instrument is field-tested and the survey is not biased to company's prior financial performance [Shin, 2003]. Editors of *InformationWeek* prescreen the sample to examine if a firm demonstrates a pattern of technological, procedural, and organizational innovation and select firms with at least one billion dollar annual revenue. They then contact these firms through mail, phone, and fax. The subjects are IT executives of the firms [Weston, et al., 2000].

According to these citations, a total of 417 companies are awarded gold citation for at least one of the four years, 163 companies are awarded gold for two or more years, and 62 are awarded gold for three or four years. The final sample of 62 firms contains companies with three or more gold awards. This provides a more robust sample of e-business technology innovators [Bharadwaj, 2000].

Our procedure next creates a matching set of control firms drawn from the *Compustat* database. The selection process utilizes the North American Industry Classification System (NAICS), a six-digit classification that identifies a firm based on its business activities. For each e-business technology innovator, instead of just one matching firm for each innovating firm, we select as matching firms all other having the same NAICS code. The average performance of same-code firms is used as the control group [Santhanam and Hartono, 2003]. The 62 innovator firms and the matching set of control firms are utilized to conduct the tests.

Data from sources such as *InformationWeek* and *Compustat* have been used in several researches [c.f. Bharadwaj 2000; Bharadwaj et al. 1999; Brynjolfsson and Hitt 1996; Hitt and Brynjolfsson 1996; Lichtenberg 1995; Santhanam and Hartono, 2003]. This research uses the method appeared in at least one of the above researches.

4.2. Dependent Variables

The dependent variables include two sets of measures. First, the profit ratios are five profit-based measures of net and operating income. The second set of the measures are three cost ratios. These same measures were used by Bharadwaj [2000] and Santhanam and Hartono [2003].

The profit ratios are measures related to return and net income. The return on assets (ROA) is the ratio of a firm's net income to its assets. The return on sales is the ratio of net income to sales. The operating income to assets (OI/A) is the ratio of operating income to assets. The operating income to sales (OI/S) is the ratio of operating income to sales. The operating income to employee (OI/E) is the ratio of operating income to number of employees. The second set of the measures are related to cost and expense. They are cost of goods sold to sales (COG/S), selling and general administrative expenses to sales (SGA/S), and total operating expenses to sales (OEXP/S). The OEXP is calculated as the sum of COG and SGA.

5. Results

The results of statistical test for all four years (1998 through 2001) are provided in Table 2. The performance data on some measures for a few innovator and control firms are not available in the *Compustat* database and hence have to be excluded. The actual sample size on each test is displayed in the table. The t-statistic from the t-test and the Z-statistic from the Wilcoxon test are reported. A significant negative test statistic for profit ratios and a significant positive test statistic for cost ratios indicate superior e-business performance for the innovative firms. Tests for financial performance halo effects and qualitative evidence of e-business innovativeness are provided as Appendix A and B respectively.

The findings strongly support the hypotheses with profit ratios significantly higher for the innovator sample and cost ratios significantly higher for the control sample in all tests except two. The two non-significant t-test statistics are for Return on Sales (ROS) in 1999 and Cost of Goods Sold to Sales (COG/S) in 2001. However, their corresponding Wilcoxon tests do support the hypotheses. Considering that a total of 64 tests are performed, it is not unreasonable to observe a few inconsistencies by chance.

Table 2. Results

		1998				
		N	Mean	Median	t	Z
ROA	Innovator	62	0.046	0.042	-4.940***	-5.154***
	Control	62	-0.107	-0.062		
ROS	Innovator	62	0.054	0.050	-3.374***	-5.369***
	Control	62	-1.266	-0.084		
OI/A	Innovator	62	0.111	0.105	-5.258***	-6.037***
	Control	62	-0.036	0.014		
OI/S	Innovator	62	0.131	0.108	-3.487***	-6.533***
	Control	62	-1.190	-0.010		
OI/E	Innovator	62	43.422	27.557	-4.037***	-4.884***
	Control	62	12.885	10.487		
COG/S	Innovator	62	0.638	0.687	2.976**	4.134***
	Control	62	1.551	0.788		
SGA/S	Innovator	53	0.213	0.203	3.572***	5.157***
	Control	61	0.705	.301		
OPEXP/S	Innovator	53	0.826	0.844	3.308**	5.892***
	Control	61	1.511	0.955		
		1999				

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		N	Mean	Median	t	Z
ROA	Innovator	62	0.049	0.054	-4.903***	-6.047***
	Control	62	-1.879	-0.053		
ROS	Innovator	62	0.064	0.056	-0.273	-4.827***
	Control	62	-2.596	-0.041		
OI/A	Innovator	62	0.104	0.090	-5.111***	-5.928***
	Control	62	-0.128	-0.017		
OI/S	Innovator	62	0.134	0.100	-3.188**	-6.412***
	Control	62	-3.932	0.009		
OI/E	Innovator	62	47.959	29.020	-3.664***	-5.218***
	Control	62	10.920	10.716		
COG/S	Innovator	62	0.637	0.682	2.753**	4.147***
	Control	62	3.967	0.789		
SGA/S	Innovator	53	0.210	0.197	3.674***	4.927***
	Control	61	0.869	0.278		
OPEXP/S	Innovator	53	0.821	0.841	3.603**	5.812***
	Control	61	1.526	0.960		
2000						
		N	Mean	Median	t	Z
ROA	Innovator	62	0.037	0.042	-2.708**	-5.847***
	Control	62	-0.458	-0.096		
ROS	Innovator	62	0.057	0.056	-3.269**	-5.360***
	Control	62	-1.896	-0.059		
OI/A	Innovator	62	0.108	0.098	-4.059***	-6.313***
	Control	62	-0.232	-0.022		
OI/S	Innovator	62	0.135	0.103	-3.407***	-6.222***
	Control	62	-1.472	-0.004		
OI/E	Innovator	61	54.342	34.993	-4.993***	-5.565***
	Control	62	-3.621	5.146		
COG/S	Innovator	62	0.641	0.695	2.636*	4.042***
	Control	62	2.060	0.785		
SGA/S	Innovator	53	0.208	0.183	3.691***	5.104***
	Control	61	0.707	0.293		
OPEXP/S	Innovator	53	0.823	0.848	3.796***	6.139***
	Control	61	1.365	0.959		
2001						
		N	Mean	Median	t	Z
ROA	Innovator	58	0.014	0.019	-2.556*	-5.264***
	Control	62	-0.496	-0.062		
ROS	Innovator	58	0.018	0.028	-2.468*	-5.017***
	Control	62	-3.930	-0.061		
OI/A	Innovator	58	0.077	0.075	-2.639*	-5.311***
	Control	62	-0.283	0.017		
OI/S	Innovator	58	0.103	0.070	-3.003**	-5.462***
	Control	62	-1.738	-0.017		
OI/E	Innovator	57	33.963	21.598	-3.705***	-4.495***
	Control	62	-5.349	2.895		
COG/S	Innovator	58	0.639	0.699	1.764	-3.055***
	Control	62	1.215	0.722		
SGA/S	Innovator	50	0.228	0.220	2.506*	-4.107***
	Control	61	1.790	0.312		
OPEXP/S	Innovator	50	0.844	0.873	2.620*	-5.111***
	Control	61	2.466	0.960		

*p<0.05, **p<0.01, ***p<0.001

6. Discussion

This study first explores the seven attributes of e-business innovation. It then tests the linkage between innovative use of e-business and firm performance by following Schumpeterian innovation theory. The statistical results strongly support the theory.

E-business innovation is characterized as both administrative and technical innovation in terms of organizational focus. This attribute indicates that the success of e-business depends on more than the effort of a single business unit within the firm. Factors both inside and outside of the organization can impact e-business performance.

E-business innovation brings high radical changes to the way firms conduct business. The radical changes favor organizations that adopt e-business early. One example is the changes occurred in the stock trading. No stock exchange firms today ignore online trading. However, early adopters claim large customer base.

The medium centrality suggests that firms could not change everything to e-business overnight because of the continuity of business and the involvement of many parties. The business continuity requires a thorough testing of a new system before widespread adoption of it. A firm may want all of its business processes to be electronic. Yet, other firms may not be ready to do so, or the corresponding laws and regulations may not be in place. Firms that carefully plan their migration to e-business without impair their overall business would win.

The flexibility of e-business allows a firm to adopt the technology to the extent it desires. Firms can start using e-business to conduct their non strategic activities and later extends it to more critical business processes. For example, a firm can begin with a simple content dominated Web site providing information about the company and its products and services to publicize the firm and promote its products before a full version of online business transaction is carried out. Or a firm can start with an intranet to test how it works before extending it to the business partners.

The high uncertainty of e-business gives rise to the need of a well planned flexible e-business strategy. A flexible strategy allows a firm to adjust its e-business investment according to the environmental and technological changes and become more agile in competition. New technologies in e-business come and go faster than any other technologies preceding it. As a result, business purposes dominate the use of e-business.

The high pervasiveness implies that e-business affects everyone in the organization. Education and training are important for e-business organizations. For example, if a firm decides to distribute its internal announcement through e-mail, the firm should train its employees not only how to use e-mail but also how to use it correctly following an e-mail usage policy. The effectiveness of the system depends on how employees utilize it.

The high communicability of e-business innovation requires team up of individual unit within a firm and collaboration of firms along the supply chain. Powerful firms may demand their business partners conduct business electronically. It is to the benefit of the firm to participate actively in e-business.

This study supports the hypotheses that e-business innovativeness enhances firm performance by increasing profit ratios and lowering cost ratios. E-business innovativeness is based on a panel of experts' judgment of early and innovative use of e-business. The results confirm that e-business as Schumpeterian innovation affects firm performance. E-business provides more efficient sales channels than the traditional ones. It reaches more customers with less cost. It allows collaboration among business partners adding values to consumers.

The support of the hypotheses encourages firms to make more innovative use of e-business. The technology has provided equal opportunities for all firms. However, only organizations that can learn from their own and others' experiences and use the technology innovatively will gain competitive advantages.

7. Implications for Managers

Managers can benefit from the findings of the attributes of e-business innovation and the relationship between innovative uses of e-business and firm performance. The findings can assist them choosing appropriate level of participation in e-business that match their own organization's infrastructure and business objectives. They can thus better plan their e-business strategy.

The finding of linkage between e-business innovation and firm performance is interesting to managers. It helps them understand the importance of e-business. Early adoption and creative use of e-business enhance firm performance. Early adopters can establish brand images and gain large customer base. Early adopters will also be able to accumulate knowledge on e-business and reap more benefits. Innovative use of e-business makes a firm one step ahead of the competition.

In order to use e-business innovatively, managers need to understand the attributes of e-business. Organizational focus, for example, is important when assigning the responsibility of e-business. E-business is more than a technical issue. Delivering all responsibilities to one single unit within the firm will not bring the success of e-business. E-business is more than an administrative issue. It is a business issue. It is related to a firm's everyday business

activities and future development. Thus, suppliers and customers can all play important roles in the forming and implementing of e-business strategy. The success requires the coordination of many partners. Firms will collaborate while competing with rivals.

8. Limitations

The study uses external rankings of e-business innovators and thus could have some inherent potential biases. The rankings may be based on subjective evaluations of a firm's innovativeness. The criteria used in the selection process are determined by *InformationWeek* editors and may thus lack academic rigor. For example, to be selected, a firm must have at least one billion dollar annual revenue. Thus the result may be biased with only large firms in the sample. Future research should focus on developing more objective metrics for evaluating e-business innovativeness. Another limitation of the study is the sample size of only 62 firms. Future research may include larger samples and have more robust statistical tests.

The study applied Schumpeterian innovation theory to explain the differences between the performance of e-business innovative firms versus the performance averages for their respective industries. However, the underlying mechanisms of how e-business affects firm performance are by no means clear. Additional systematic research is needed to identify the full chain of variables linking e-business innovativeness to firm performance.

9. Conclusion

This study helps both researchers and practitioners better understand e-business. It identifies the attributes of e-business innovation and examines its value in firm performance. It provides researchers with attributes of e-business and enables them to compare findings of e-business performance. It helps managers decide to what extent their organizations should invest in e-business by matching the e-business attributes to their own organization's characteristics.

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Appendix A: Testing for Financial Performance Halo

The gold citations of *InformationWeek* 500 firms were selected by a panel of experts who did “an extensive mail, phone, and fax study” (Ricadela, 2001, p. 32). These types of ratings are often influenced by the past performance of the firm. It is called “halo effect” by Brown and Perry (1994). In this appendix, we test whether such an effect exists. We also test the effects of e-business innovation. We use the method of Santhanam and Hartono (2003). The method is similar to those of Brown and Perry (1994), Neter et al.(1996), and Bharadwaj (2000).

The test uses two sets of regression analysis. The first set of analysis regress prior year’s performance (profit or cost ratios) on current year’s performance. The second set extends the first one with a dummy variable added. The dummy variable is a binary indicator coded as 1 for innovative firms and 0 for firms in the control group. The formulas of the two models are:

$$FP_t = \beta_0 + \beta_1 FP_{(t-1)}$$

$$FP_t = \alpha_0 + \alpha_1 FP_{(t-1)} + \alpha_2 D$$

Where FP_t is performance measure at year t , β_0 and α_0 are intercepts, β_1 , α_1 , and α_2 are regression coefficients, and D is the (0,1) binary variable.

The results of the regression analysis are shown on Table A1. It includes the R-square changes by adding the dummy variable and respective regression coefficients. Model 1 indicates that 21 of the 24 performance measures were significantly predicted by prior year’s measures.

What is more interesting is that the significance of coefficient of dummy demonstrates the e-business innovation effect on firm performance. The coefficients of profit measures are expected to be positive while the coefficients of cost measures are expected to be negative. Model 2 indicates eighteen of the 24 coefficients are significant with the right sign. Thus, the halo effects may not be a major concern in this study because of the significant e-business innovativeness effect on firm performance.

Table A1: Regression Analysis of Financial Performance Halo Effects

	Model	N	1999		
			R-Square Change	1998 Financial Performance	Dummy
ROA	1	124	0.196***	0.443***	
	2		0.057***	0.326***	0.265***
ROS	1	124	0.010	0.099	
	2		0.000	0.100	-0.005
OI/A	1	124	0.280***	0.529***	
	2		0.037**	0.419***	0.222**
OI/S	1	124	0.174***	0.417***	
	2		0.025*	0.367***	0.166*
OI/E	1	124	0.710***	0.843***	
	2		0.002	0.830***	0.041
COG/S	1	124	0.130***	0.360***	
	2		0.023*	0.319***	-0.157*
SGA/S	1	114	0.385***	0.620***	
	2		0.020*	0.575***	-0.147*
OPEXP/S	1	114	0.101***	0.318***	
	2		0.50***	0.243***	-0.235***

			2000		
	Model	N	R-Square Change	1999 Financial Performance	Dummy
ROA	1	124	0.034***	0.185***	
	2		0.066***	0.105	0.196**
ROS	1	124	0.111***	0.333***	
	2		0.077***	0.326***	0.278***
OI/A	1	124	0.097***	0.311***	
	2		1.453***	0.196**	0.267***
OI/S	1	124	0.111***	0.334***	
	2		0.045**	0.273***	0.221**
OI/E	1	122	0.656***	0.810***	
	2		0.024***	0.763***	0.161***
COG/S	1	124	0.056***	0.236***	
	2		0.034**	0.190**	-0.191**
SGA/S	1	114	0.389***	0.624***	
	2		0.016*	0.581***	-0.133*
OPEXP/S	1	114	0.648***	0.805***	
	2		0.005	0.782***	-0.072
			2001		
	Model	N	R-Square Change	2000 Financial Performance	Dummy
ROA	1	120	0.025*	0.158*	
	2		0.040**	0.109	0.206**
ROS	1	120	0.021	0.145	
	2		0.034**	0.090	0.194**
OI/A	1	120	0.117***	0.343***	
	2		0.016	0.294***	0.137
OI/S	1	120	0.160***	0.400***	
	2		0.025*	0.351***	0.165*
OI/E	1	118	0.612***	0.782***	
	2		0.000	0.792***	-0.024
COG/S	1	120	0.191***	0.437***	
	2		0.005	0.420***	-0.071
SGA/S	1	111	0.041***	0.202**	
	2		0.030*	0.144	-0.184*
OPEXP/S	1	111	0.014***	0.119	
	2		0.050**	0.044	-0.235**

*p<0.10, **p<0.05, ***p<0.01

Appendix B: Qualitative Evidence of E-Business Innovativeness

To further validate the sample of e-business innovators and to understand the nature of their innovation capabilities, a search of the Dow Jones business database (Factiva.com) is conducted for articles describing the e-business innovations undertaken by the sample of innovators in this study during the period 1998 through 2001 [Bharadwaj, 2000].

Specifically, we search the Dow Jones business database to understand how some firms are able to establish leadership positions in the use of e-business while others are not. We study those firms that are identified by experts as innovative adopters of e-business and look for explanations to the results of their uses of e-business and the managerial processes they use [Mason et al., 1997].

Evidences from five innovative firms are collected and summarized in Table B1 [Bharadwaj, 2000]. Evidences of strategic investment rationale for e-business are collected. Firms and articles about their e-business innovation are listed in Column One of Table B1. Column Two shows the innovative use of e-business of the exemplar firms. Column Three demonstrates the advantages of such innovative use of e-business. The impact on competition is illustrated in Column Four.

Table B1: Case Exemplars of E-Business Innovators

Case Exemplars	Innovative Use of E-Business	Advantages	Effects on Competition
Dell Computer's online direct sales model [Metz, 1998; Menn, 1999]	Early and innovative use of Web as a sales medium. Collect information that would otherwise be difficult to get.	Benefits includes cost reduction, product development improvement, supply chain efficiencies enhancement. Information about customer preferences and demand is accurate and instantaneous. Dell uses the information of consumers' click stream to guide intensive multi-year planning with key vendors. Its mass-customization delivers products that address the specific requirements of individual customers.	Dell's competitors have to pay an 8% to 10% distribution premium for their value added reseller channel. They have to hold larger inventory because of lacking accurate and instantaneous customer information. They have to carry 80 days' worth of inventory vs. Dell's 11 days. A conventional firm would be difficult to sell online without alienating an existing network of dealers and re-sellers.
3M Co. [Gilbert, 2000]	DealerHut – An extranet to manage relationships with unauthorized distribution channels.	It helps small unauthorized distributors order directly from 3M. It gathers valuable customer data through online showrooms. It provides electronic communications, a means of collaborative product development via the Internet to lower inventory and reduce the production cycle.	3M connected all its business partners, large and small, into a very efficient virtual organization. Competitors would be hard to establish similar relationships with these same firms.
Office Depot [Anonymous, 2000]	Early and innovative use of Website	The Website has an innovative "Office Solutions" section. It has thousands of pages of information and services for business and linked to leading technology solutions providers. The Contract Business Unit is dedicated to creating innovative solutions for its larger customers that enable employees to conveniently purchase from their desktop.	Office Depot was ranked above both the Officemax and Staples Internet sites in terms of shopping convenience, usability, performance, technology innovation, value, and next day service.
FedEx Corp. [McDermott, 2001]	Customer Relationship Management (CRM)	FedEx Corp. is one of the first firms in the industry deploying an innovative CRM strategy. It developed a multimillion-dollar CRM program to cut costs and optimize its existing customer data in efforts to cross-sell and up-sell services to existing and new customers. It provides its sales force a comprehensive view of every customer.	Knowing the customers is the prerequisite for serving the customers better. Only innovating firms that know customers well will survive the e-business competition.
Mellon Financial Corporation [Anonymous, 1998; Anonymous, 2001]	Global Cash Management's Automated Payments (AP) RemEDI(SM) service	It is a knowledge-based system that totally automates the receipt, analysis, payment and reporting of gas and electric utility bills. It reviews and validates the invoices and pays the bills based on a number of user preset "rules." It also helps users manage utility usage more effective by having a digital format of usage in a database. It enables users to focus on issues that need their attention. It can reduce bill payment processing costs by at least 50 percent. It lowers costs for processing bill payments, and using EDI capabilities without the cost of employing EDI.	Mellon Bank Corporation is one of the nation's largest bank holding companies in market capitalization. Mellon Global Cash Management is an industry leader. It designs complete solutions through its comprehensive line of cash management services. The innovation made it one step ahead of its competitors.