Small Bus Econ (2009) 32:241–257
DOI 10.1007/s11187-007-9095-5

Effects of IT knowledge and media selection on operational performance of small firms

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Accepted: 11 December 2007 / Published online: 8 February 2008

Abstract This study examines the effects of information technology (IT) knowledge and media selection on operational performance, measured by balanced scorecard, in small firms. Small firms generally lag behind medium and large companies in adopting and implementing computerization. This study is based on a survey of 698 small firms. The results show that: (1) individual IT knowledge and both traditional and electronic communication methods significantly contribute to the internal process performance of small firms; (2) internal process performance, organizational IT knowledge, and electronic communication methods affect customer performance; and (3) financial performance is affected by process and customer performance. The findings imply that it is imperative for small firms to adopt computerization to achieve improvements in business performance.

Keywords Communication media · Information technology · IT knowledge · Small firms

JEL Classifications L26

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1 Introduction

Competition drives change and innovation as companies constantly strive to gain competitive advantage. Globalization has led to total competition, which in turn has induced firms to adopt digitization to survive and beat competition in the borderless global economy.

Technical changes, such as the information and telecommunication evolution, have changed the nature of business and competition. Product services have become commoditized because of digitalization, while service contents increased substantially. The service content of products has increased substantially. Increasingly, products are more customized and follow-up services became an integral part of the value-added bundle.

Information technology (IT) is no longer the domain of only medium or large firms but also for small firms in

various ways. Small firms are defined as those with less than 50 employees in this article. Small firms generally lag behind their large counterparts in computerization and digitization. The digital divide is getting even wider between small and large firms. This is mainly attributable to the inability or unwillingness of small firms in making the necessary IT investment. The phenomenon leads to the vicious cycle of low product and service quality, lack of investment in technology and technical training, low digitization, and subsequently low competitiveness of small firms.

Recently, computerization of small firms is accelerating even though the level is still not at par with that of medium and large firms. While large firms are typically capital and equipment intensive, labor-intensive small firms may be able to increase productivity and provide value added services through increased computerization and digitization (Munoz and Welsh 2006). However, there is a little research indicating whether small firms can actually increase performance through computerization, nor what aspects of IT applications contribute to their performance. The purpose of this study is to investigate whether or not the level of IT applications and IT knowledge contribute to the performance of small firms.

2 Literature review

In this section, relevant literature for this study will be reviewed. More specifically, recent studies dealing with the relationship between organizational performance and IT knowledge and IT communication will be discussed.

2.1 IT knowledge

IT knowledge means "knowledge about various information technologies." This includes hardware, software, IT infrastructure, and operating systems. Munro et al. (1997) divided knowledge about end user computing (EUC) into hardware, software, and concepts and practices. They found that those three knowledge levels are the appropriate means for measuring computing ability of end users, and that the perceived knowledge level has a strong relationship with actual test scores. Torkzadeh and Lee (2003) proposed a method that can be used to measure the perceived EUC skill. Based on the assumption that EUC knowledge plays an important role in the introduction and diffusion of IT, they developed a measure for EUC knowledge. In this study, IT knowledge encompasses such knowledge and hardware skills.

IT knowledge can be examined at the personal or organizational level (Ruiz-Mercader 2006). Broadly, it can be divided into the introduction and diffusion of a new IT, and performance maximization of the adopted IT.

First, IT knowledge promotes the introduction and diffusion of a new IT. Through an analysis of 166 small-medium firms in Singapore, Thong and Yap (1995) showed that one of the main factors contributing to the adoption of IT was IT knowledge of the CEO. Specifically, the CEO's IT knowledge level is more important in small firms because the CEO has the absolute power in important investment decisions. Winston and Dologite (1999) summarized the factors affecting extensive diffusion of IT in small firms. In their study, IT experience of organizations, experience of end users, and IT knowledge of company owners were included as important factors. That is, IT knowledge of all staff affects the adoption and diffusion of new IT. King and Xia (1997) asserted that prior knowledge of users affects the selection of a communication method. Premkumar and Roberts (1999) include IT specialty as a main factor when small firms adopt a new IT.

Second, IT knowledge enables effective applications of the introduced IT. High levels of IT knowledge mean that firms not only have the IT capability, but also have advantage in terms of potential applications and efficient management of IT.

According to Guimaraes and Igbaria (1996), management and control capability of end users, the relationship between information systems (IS) and end users, support and unification, and IS management control are important success factors of EUC. This kind of management and control capability is engendered by the accumulation of IT-related knowledge. Hong (2001) examined the factors of EUC performance of 255 people in 60 companies. He found that the knowledge level of end users about IT raises EUC performance. Blili et al. (1998) also showed that the higher the usage capability of an end user, such as computer education, usage experience, and computer knowledge, the higher the usage of and

satisfaction with IT. Deeter-Schmelz and Kennedy (2002) classified two groups: in one group the supplier's website significantly affects the purchasing decision; and in the other group the supplier's website did not have an impact on the purchasing decision making. They then compared the knowledge of two groups about Internet. The result showed that the former group had a higher level of knowledge about Internet than the latter. The finding indicates that IT knowledge contributes to the performance of a firm.

2.2 IT communication

2.2.1 IT communication and its benefits

IT communication can be defined as "communication by the means of IT." It is different from traditional communication methods such as face-to-face meetings, documentation, fax, and telephone calls in that communications are made through IT tools that have developed rapidly. In a study of British firms, Leek et al. (2003) found the usage and usefulness of e-mail, intranet, extranet and Internet are increasing dramatically.

Mustaffa and Beaumont (2002) found an evidence that utilization of various e-commerce tools, such as web-site, frequently asked questions (FAQ) pages, web advertising, the use of Internet and electronic data interchange (EDI), e-mail, etc. shortened the time and distance, made the supply chain network efficient, and sped up and automated various internal processes. They also claim that utilization of e-commerce tools enable firms to strengthen the marketing and sales activities and make customer relationship management more efficient. Thus, IT communication contributes in two ways: internal efficiency improvement, and improvement in the connection and reaction to external factors (Dewett and Jones 2001).

According to Andersen and Segars (2001) and Dewett and Jones (2001), IT communications promote internal efficiency and innovation of an organization. Andersen and Segars (2001) presented an evidence that the more companies use IT communication technology in the textiles/clothing industry, the higher the performance of those firms. They also showed that the higher the usage level of IT communication, the more the decision structure was decentralized, which led to the improvement of the firm's financial performance. Dewett and Jones (2001) believe that the utilization of IT communication gives a rise to efficiency and synergy of information, connect workforces, reinforce capability, and then promote efficiency and innovation.

IT communications contribute to external connection and improvement in coping capability with external factors (Dewett and Jones 2001; Souitaris 2001; Barba-Sánchez et al. 2007). Dewett and Jones (2001) suggest that the application of IT increases coping ability with external partners, customers, and stakeholders through active boundary-spanning activities of the organization. Souitaris (2001) provided an evidence that external communications are important in renovating a firm. He showed that the investigation of product information is more important than general information about the market and technology; and that collaboration with external partners is more important than collaboration with supporting organizations. Through IT communications, small firms can increase the accessibility and quality of services to established and new customers, and have smooth communications with customers (Barba-Sánchez et al. 2007).

IT communications promote internal efficiency and innovation, external connectivity, and the ability to cope with external factors. Generally, such IT communications can be divided into e-mail, intranet, Internet, EDI, etc. (Larson and Kulchitsky 2000; Walczuch et al. 2000; Stefansson 2002).

2.2.2 IT communication methods

E-mail is not only the most widely used, but also the most important IT communication tool. It has several favorable properties, first it is asynchronous. This means that people can send and received email at any time regardless of the status of the other party (sender or receiver). As well, e-mail can facilitate one-to-one or one-to-many relationships, meaning a sender can send and receive a message from/to one person, or to many people simultaneously. These favorable properties have led to a rapid increase in the number of e-mail users. E-mail has improved the cost, speed and productivity of business when compared with traditional communication methods.

Kettinger and Grover (1997) showed that e-mail was used as a communication method among

organizations for various purposes including task achievement, social activity and broadcasting. They studied what factors affect the use of e-mail for each purpose. They found that: (1) e-mail usage for task achievement is determined by the experience of e-mail users, number of associates, uncertainty of tasks, inter-dependence of tasks, necessity of communication with outsiders, cost efficiency, and timeliness; (2) e-mail usage for social activity is determined by the number of the associates, prediction possibility of task, necessity of communication with the outside, cost efficiency, importance of presence, and importance of privacy; and (3) e-mail usage for broadcasting is determined by the number of associates, uncertainty of tasks, inter-dependence of tasks, and a distance communication capability.

The development and diffusion of the Internet brought a new means of IT communication. Dandridge and Levenburg (2000) analyzed data from 195 micro firms. They found that in companies with more than four employees, the degree and frequency of Internet usage remarkably increased to search products and information. Particularly, the degree and frequency of Internet usage for searching products and information were very high in firms expecting growth such as exports. Walsh and Godfrey (2000) identified the Internet's role in customer service. They described how the Internet helps with good customer management, which leads to added value and increased loyalty of the customer. Walczuch et al. (2000) showed that with implementation of the Internet, small firms gain many benefits such as reducing the distance barrier, improving a firm's image, continuous global advertisement, increased sales, effective information collection, extension of customer service, increased customer satisfaction, and enhanced access to international markets.

As the Internet becomes ever popular, web-EDI is more widely used. Recently, even small–medium sized enterprises (SMEs) are adopting web-EDI. EDI is defined as "sending from computer to computer standardized business documents" (Walton and Marucheck 1997). The method of EDI is generally divided into traditional VAN-EDI and web-EDI accessed through the Internet.

Traditional EDI is considered more suitable for transactions between large scale organizations (Stefansson 2002). On the other hand, web-EDI is more suitable to send standardized messages in SMEs (Stefansson 2002). It is expected that traditional VAN-EDI and new web-EDI may coexist, sharing their roles as the Internet is more widely used. Roberts and Mackay (1998) classified the role of VAN-EDI, as supporting strategic long-term relationships and web-EDI as supporting operational activities such as order processing.

2.2.3 *IT communication channel mix*

Although it is certain that IT communication methods, such as e-mail, Internet, and EDI are very innovative methods, it is reasonable to say that IT communications will be complementary rather than a complete substitute for traditional communication methods such as mail, telephone and face-to-face meetings (Larson and Kulchitsky 2000). According to the 'media richness theory' concept developed by Lengel and Daft (1988), the level of information richness varies depending on the communication medium. Therefore, it is important to communicate with the appropriate method for the given circumstance.

Some studies (Deeter-Schmelz and Kennedy 2002; Lichtenthal and Eliaz 2003) indicate discriminative or exclusive use of each communication method. These studies consider the importance of IT communication and the application possibility when constructing the marketing communication channel mix. E-mail can be an effective communication method in dealing with customers in the early stage. It can replace or substitute for traditional public relations, advertising, fax, etc. in establishing perception, knowledge, and connection. The Internet can be used at all stages of the customer service experience: perception, knowledge, connection, preference, assurance, and purchasing. The Internet can replace or substitute for the traditional catalog, exhibition, tele-marketing, and direct sales.

The usefulness of a communication method varies depending on the internal or external use by an organization. Drew (2003) studied strategic use of e-commerce for SMEs in England. He showed that SMEs had the potential to improve their performance by appropriately using electronic commerce in sales and sales promotion activities. He found that Internet and IT knowledge of SMEs is one of the success factors of Internet applications. Drew showed that e-mail and Intranet support internal efficiency and innovation, and web-site and Internet are good for

marketing and customer response. E-mail plays an important role in either internal or external activities of the organization.

Effective IT communication methods vary depending on the relationship with suppliers or customers. Roberts and Mackay (1998) suggest that, in response to the recent IT development trend, a new communication method that can handle image, audio, video, etc. should be combined with traditional EDI which cannot handle those elements. Furthermore, these media should be connected with IT such as e-mail, image processing, file transmission, fax, electronic catalog, video conferencing, etc. They contend that the relationship with suppliers should be classified from the buyer's perspective as a strategic relationship, supplier relationship, or expendable product relationship. An appropriate communication medium should be employed for each type. For example, it would be more appropriate to use e-mail and EDI for the strategic relationship, and electronic catalog for expendable product relationship.

Regarding internal communication among departments of an organization, effective communication media will vary depending on the internal organizational relationship. Maltz (2000) classified communication methods into memo, report, e-mail, electronic documents, planned telephoning, unplanned telephoning, planned conference, hallway talks, etc., and then analyzed the perceived information quality of each method among various departments. The results show that electronic documents, planned telephoning, planned conference, and hallway talks are effective for communication between marketing and manufacturing departments. Planned phone calls, planned conference, and hallway talks are effective for communications between marketing and R&D departments.

2.3 Operational performance

The IT-induced operational performance of a firm can be evaluated in three different ways. One way is to simply focus on IT performance. DeLone and McLean (1992) classified performance of IS into six categories: (1) quality of IS, (2) quality of information, (3) user satisfaction, (4) degree of system usage, (5) personal influence, and (6) organizational influence. Similarly, Saarinen (1996) suggested a model to estimate performance of a firm's IS using four categories: development process, usage process, quality of the information system, and the influence of the information system on the organization. Quality of IS was described by user interface, flexibility, quality of information, content, and format. Influence of IS on an organization was measured by application and change, efficiency and profitability, decision making and control, communication, and reorganization.

The traditional method of evaluating operational performance is to use financial indicators. Andersen and Segars (2001) used return on asset (ROA), operating margin, and net profit margin as the indicator of financial performance. However, Premkumar and Roberts (1999) suggested that small firms are often reluctant to divulge financial information such as asset size, sales volume, net profit margin, etc. This may lead to distorted information and questionable validity of information used in the study of small firms.

A more balanced approach to evaluating firm performance is to combine financial information and intangible performance indicators. Tallon et al. (2000) categorized IT business value into six major areas and then measured the increase/decrease in each area. The six areas include customer relationship, supplier relationship, sales/marketing, production/operation, product/service, and organization process. Customer relationship improvement was found to be the most important factor. Cragg et al. (2002) investigated the relationship between IT alignment of small-medium manufacturers and firm performance. They evaluated elements, such as long-term profitability, increase in sales volume, financial resources, brand and customer loyalty, cost savings, image improvements, and more, and then evaluated IT impact as an additional performance indicator. Based on the third method, this study uses the Balanced Scorecard (BSC) approach to determine firm performance. In the model shown in Fig. 1, operational performance is derived through process performance, customer performance, and financial performance.

3 Research model and hypotheses

3.1 Research model

The objective of this study is to investigate two major categories of relationships: (1) the relationship

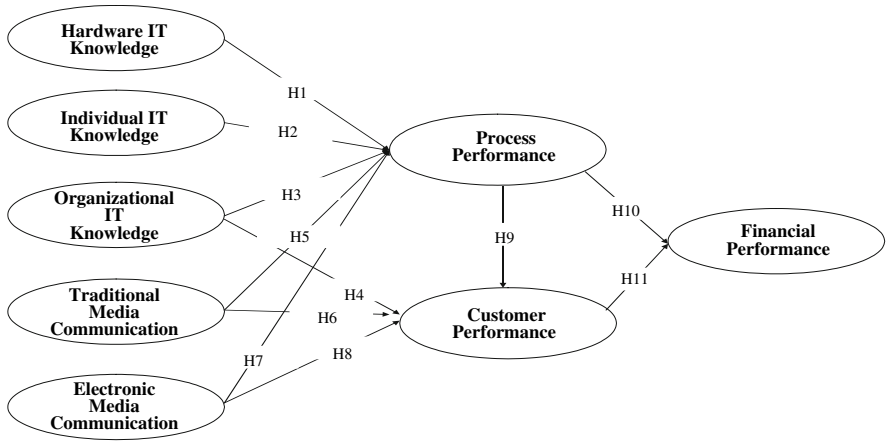

Fig. 1 Research model

between IT knowledge and operational performance of small firms and (2) the relationship between communication media selection and operational performance in small firms. The research model is shown in Fig. 1.

3.2 Variables and hypotheses

3.2.1 IT knowledge and operational performance

High levels of IT knowledge and continuous training in small firms enable introduction and diffusion of IT (King and Xia 1997; Premkumar and Roberts 1999; Winston and Dologite 1999; Barba-Sánchez et al. 2007) and also contribute to successful application of introduced IT (Blili et al. 1998; Guimaraes and Igbaria 1996; Deeter-Schmelz and Kenndy 2002). Based on this premise, the following hypotheses are presented.

Hypothesis 1 The level of organizational IT hardware knowledge has a positive relationship with process performance.

Hypothesis 2 The level of individual IT knowledge has a positive relationship with process performance.

Hypothesis 3 The level of organizational IT knowledge has a positive relationship with process performance.

Hypothesis 4 The level of organizational IT knowledge has a positive relationship with customer performance.

3.2.2 Communication method and operational performance

Adapting Kydd and Ferry's (1991) and Daft and Lengel's (1986) continuum of communication media, we propose the choice of communication media will vary in the organization's relative capability to build reliability, empathy, assurance, tangibility, and responsiveness with customers (see Fig. 2). More specifically, electronic media, such as e-mail and Internet (e.g., FAQs) are more effective in establishing assurance, tangibility, and responsiveness (within bandwidth) than traditional media such as face-to-face or telephone. On the other hand, traditional media such as face-to-face and telephone are more effective in establishing reliability, empathy and responsiveness than electronic media.

As shown in Fig. 2, we are suggesting that traditional media provide end users with a higher level of reliability and empathy, because they allow the exchange of verbal and non-verbal information (Chidambaram and Jones 1993). Specifically, the face-to-face medium allows a broad range of communication stimuli and responses which leads to the perception of personal interest, politeness and attention.

On the other hand, electronic media have properties that are different from traditional communication methods. Electronic media, such as e-mail and Internet increase efficiency and promote innovation from an internal perspective (Andersen and Segars 2001), and thus more effectively enable boundary spanning activities from an external perspective (Dewett and Jones 2001). Particularly, small firms

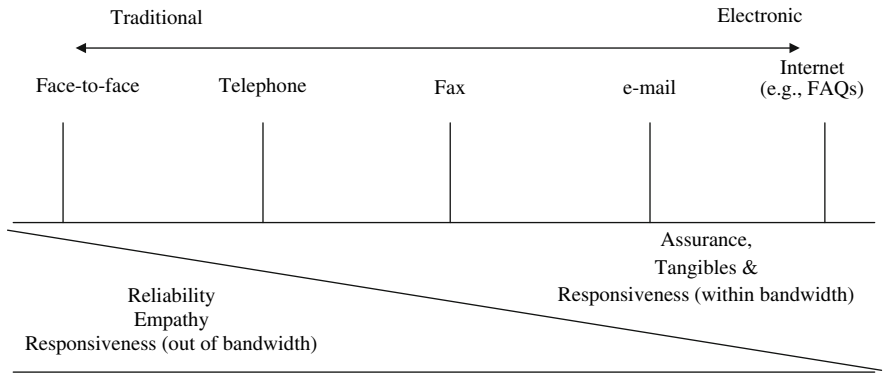

Fig. 2 Continuum of communication media

Note: Adapted from Kydd and Ferry (1991), who adapted their framework from Daft and Lengel (1986)

are able to reach potential customers that they could not before and can manage customer relationship more effectively through IT communication media (Mustaffa and Beaumont 2002). Consequently, it is expected that electronic media create performance improvements such as reducing the time required for internal processes, increased accuracy, and increased productivity. It is also expected that electronic media enhance development of new customers, improve effective advertising/promotion, and improve supplier management (Deeter-Schmelz and Kennedy 2002; Drew 2003; Lichtenthal and Eliaz 2003). This leads to the following hypotheses.

Hypothesis 5 The greater the use of traditional communication methods, the better will be process performance.

Hypothesis 6 The greater the use of traditional communication methods, the better will be customer performance.

Hypothesis 7 The greater the use of electronic communication methods, the better will be process performance.

Hypothesis 8 The greater the use of electronic communication methods, the better will be customer performance.

3.2.3 Operational performance relationships

This study derives the idea of operational performance from previous studies which considered the performance of knowledge management, such as Gooijer (2000) and Arora (2002). Generally, organizations seek performance objectives such as efficiency, survival, improvement, and innovation. These performance measures can be achieved through effective knowledge management activities (Franzoni 2007).

Therefore, the improvement of knowledge management for internal process activities can enhance organizational performance (Shani et al. 2000). This study investigates the relationship between process activities and organizational performance, and the relationship between customer performance and financial performance.

Previous studies that suggested the BSC approach in measuring the performance of knowledge management used a strategic map showing the process in which growing and learning performance lead to improvement of internal business processes, customer performance, and finally financial performance (Gooijer 2000; Kaplan and Norton 2000; Arora 2002). Reflecting these perspectives, this study proposes additional relationships among process performance, customer performance, and financial performance.

Hypothesis 9 The better the process performance, the higher will be customer performance.

Hypothesis 10 The better the process performance, the higher will be financial performance.

Hypothesis 11 The better the customer performance, the higher will be financial performance.

4 Research methodology

4.1 Research method

This study used a sample of small firms in Korea. Korean industries are classified into 17 categories by the Korean National Statistical Office (KNSO) and Small and Medium Business Administration (SMBA). According to SMBA, the total number of small firms in Korea is about 2.7 million. Among those, wholesalers, retailers, lodging, and food service businesses make up the majority.

In the pilot test, 50 small Korean firms were randomly selected from a directory published by KNSO. In order to increase reliability of our survey, we performed pilot tests three times and refined the questionnaires, accordingly. Then, we contacted companies with fewer than 50 employees by e-mail and via online websites. A total of 710 firms were contacted and 698 valid responses were used to test the proposed hypotheses. Table 1 shows the demographic breakdown of the respondents from 28 industries using the Bank of Korea industry classification standard.

4.2 Manipulation of variables

Manipulation of measured variables is shown in Table 2. The IT knowledge and communication methods were measured by 12 and 16 items, respectively. Operational performance of small firms was measured by 10 items. All items used a 7-point Likert scale with responses ranging from "not at all" to "always."

5 Results

5.1 Analysis of reliability and validity

It is important to verify that questionnaire items do indeed explain or appropriately measure the intended constructs. Such reliability and validity were examined with Cronbach's α and exploratory factor analysis (EFA) as shown in Table 3.

The 12 questionnaire items regarding the level of IT knowledge were intended to identify three factors: hardware IT knowledge, individual IT knowledge, and organizational IT knowledge. Hardware IT knowledge refers to knowledge about computer hardware items such as the operating system, printer, scanner, digital camera/camcorder, and PDA. Individual IT knowledge refers to knowledge about personally used IT, such as e-mail, Internet, business office application software, and advanced software packages. Organizational IT knowledge refers to knowledge of IT items that are managed on an organizational scale, such as a business website, intranet, programming or enterprise tools, such as JAVA, Visual Basic, XML, and ERP.

The 10 questionnaire items regarding communication media were designed to tap two factors: traditional communication media which include face-to-face meetings and telephone, and electronic communication media which include e-mail and internet/EDI.

The 10 items regarding operational performance were intended to measure three factors: process performance, customer performance, and financial performance. Nunnally (1978) recommended that all of the primary factor loadings should be greater than .5 in order to assess the fit between the items and their construct. In this test, all factor loadings were higher than .5, demonstrating a good fit between each factor and its related items.

The EFA conducted to verify conceptual validity of hardware IT knowledge, individual IT knowledge, organizational IT knowledge, process performance, customer performance, and financial performance showed the factor loading of each factor higher than .5.

According to Kline (1998), confirmatory factor analysis (CFA) is a better method than EFA when testing a hypothesis related to observed variables and their underlying latent construct. Thus, in this study CFA was performed to investigate construct validity.

Based on the covariance matrix, the standardized factor loadings (Lambda) and t-values ($p < .05$) were obtained. Table 4 shows the overall significant loading (close to 1) for each item on its hypothesized construct, which represents the construct validity (Lapierre et al. 1999). Moreover, most of the squared multiple correlations were above .50, which indicate a moderate level of reliability.

5.2 Goodness of fit for the research model

A path analysis was performed to test the hypotheses. The analysis results with LISREL 8.52 show a

Table 1 Demographic characteristics of respondent firms

Bank of Korea Classification Standard	Korea Statistical National Office Classification Standard	Total number of small firms	Number of respondents
1. Farming, forestry and fishery	Farming, forestry–fishery	1,738	9
2. Mining	Mining	2,028	1
3. Food and beverage manufacturing	Manufacturing and gas distribution	304,234	13
4. Textile leather product manufacturing			45
5. Wood and paper manufacturing			8
6. Printing, publishing and copying			32
7. Petroleum and coal product manufacturing			5
8. Compound and chemistry product manufacturing			15
9. Non metal and mineral product manufacturing			8
10. The first metal industry			5
11. Metal product manufacturing			29
12. Instrument and equipment manufacturing			29
13. Electricity and electronic machine manufacturing			55
14. Precision machine manufacturing			16
15. Conveyance equipment manufacturing			6
16. Furniture and some manufacturing			7
17. Electric power business			4
18. Construction business	Construction	65,287	74
19. Wholesale and retail	Wholesale and retail	890,412	112
20. Restaurant and accommodation business	Accommodation and restaurant	598,465	5
21. Transportation and charge business	Transportation	262,921	18
22. Communication and broadcasting	Communication	2,839	29
23. Finance and insurance business	Finance	2,989	6
24. Estate and business service	Estate and lease business–business service	88,870	36
25. Administration and national defense	NA	NA	3
26. Education and health	Education service	130,492	19
	Health and social welfare		
27. Culture, recreation and services	Recreation, culture and athletics	338,635	78
28. The others	Repair, personal service and others		28
Total		2,686,160	698

Table 2 Summary of manipulated definition of variables

Factor	Construct	Detail items
IT knowledge	Hardware IT knowledge	A1. POS(PC POS/Web POS)
		A2. Scanner
		A3. Digital camera/camcorder
		A4. PDA
	Individual IT knowledge	A5. E-mail usage
		A6. Internet usage
		A7. Basic OA S/W (word, MS-Office)
		A8. Advanced S/W (SPSS, LISREL, Mini tab)
	Organizational IT knowledge	A9. Operation of homepage
		A10. Operation of intranet
		A11. Programming tool (JAVA, Visual Basic, XML etc.)
		A12. ERP used for small firms
Communication	Traditional communication media	B1. Face-to-face-communication with customer (firms)
		B2. Face-to-face-communication with suppliers
		B3. Face-to-face-communication with collaborating firms
		B4. Face-to-face-communication with external information people
		B5. Telephone-communication with customer (firms)
		B6. Telephone-communication with suppliers
		B7. Telephone-communication with cooperation firms
		B8. Telephone-communication with external information people
	Electronic communication media	B9. E-mail-communication with customer (firms)
		B10. E-mail-communication with suppliers
		B11. E-mail-communication with collaborating firms
		B12. E-mail-communication with external information people
		B13. Internet/EDI-communication with customer (firms)
		B14. Internet/EDI-communication with suppliers
		B15. Internet/EDI-communication with cooperation firms
		B16. Internet/EDI-communication with external information people
Operational performance	Process performance	C1. Deduction of duplicated process
		C2. Improvement of processing speed
		C3. Improvement customer demand process
	Customer performance	C4. Swift handling for customer's complain
		C5. Increase of new customer
		C6. Keep existing customer
		C7. Easiness of customer date management
		C8. Offering differentiated service through customer analysis
	Financial performance	C9. Increase of sale amount
		C10. Increase of sales benefit
	Each item measured on a 7-point Likert scale with responses ranging from "not at all" to "always"	

Table 3 The results of reliability and validity

Variable	# of factor	Name of factor	# of question	Question	Factor loading	Eigen value	Cronbach's α
IT knowledge	3	Hardware IT knowledge	8	A1. POS(PC POS/Web POS)	.492	1.78	.8443
				A2. Scanner	.539		
				A3. Digital camera/camcorder	.634		
				A4. PDA	.527		
		Individual IT knowledge		A5. E-mail usage	.876	3.60	.8869
				A6. Internet usage	.885		
				A7. Basic OA S/W (word, MS-Office)	.785		
				A8. Advanced S/W (SPSS, LISREL, Mini tab)	.600		
		Organization IT knowledge	6	A9. Operation of homepage	.604	4.08	.8665
				A10. Operation of intranet	.731		
				A11. Programming tool (JAVA, Visual Basic, XML, etc.)	.824		
				A12. ERP used for small firms	.826		
Communication method	2	Traditional media	8	B1. Face-to-face-communication with customer (firms)	.798	5.60	.9268
				B2. Face-to-face-communication with suppliers	.759		
				B3. Face-to-face-communication with collaborating firms	.804		
				B4. Face-to-face-communication with external information people	.795		
				B5. Telephone-communication with customer (firms)	.834		
				B6. Telephone-communication with suppliers	.804		
				B7. Telephone-communication with cooperation firms	.747		
				B8. Telephone-communication with external information people	.766		
		Electronic media	8	B9. E-mail-communication with customer (firms)	.713	4.83	.9159
				B10. E-mail-communication with suppliers	.741		
				B11. E-mail-communication with collaborating firms	.723		
				B12. E-mail-communication with external information people	.753		
				B13. Internet/EDI-communication with customer (firms)	.731		
				B14. Internet/EDI-communication with suppliers	.763		
				B15. Internet/EDI-communication with cooperation firms	.663		
				B16. Internet/EDI-communication with external information people	.717		

Table 3 continued

Variable	# of factor	Name of factor	# of question	Question	Factor loading	Eigen value	Cronbach's α
Operational performance	3	Process performance		C1. Deduction of duplicated process	.896	2.280	.8604
				C2. Improvement of processing speed	.883		
				C3. Improvement customer demand process	.561		
		Customer performance		C4. Swift handling for customer's complain	.747	3.750	.9110
				C5. Increase of new customer	.835		
				C6. Keep existing customer	.811		
				C7. Easiness of customer date management	.768		
				C8. Offering differenciated service through customer analysis	.844		
		Financial performance		C9. Increase of sale amount	.930	1.970	.9267
				C10. Increase of sales benefit	.920		

Table 4 Results of confirmatory factor analysis for the construct items

Constructs and indicator	Lambda	*t*-Value	Squared multiple correlation
Organizational IT hardware knowledge			
A1. POS(PC POS/Web POS)	.85	17.94	.41
A2. Scanner	1.15	27.31	.74
A3. Digital camera/camcorder	1.14	26.32	.71
A4. PDA	.98	20.43	.50
Individual IT knowledge			
A5. E-mail usage	1.36	34.13	.93
A6. Internet usage	1.36	33.17	.90
A7. Basic OA S/W (word, MS-Office)	1.03	22.55	.55
A8. Advanced S/W (SPSS, LISREL, Mini tab)	.76	15.22	.29
Organizational IT knowledge			
A9. Operation of homepage	1.06	20.20	.49
A10. Operation of intranet	1.21	24.82	.66
A11. Programming tool (JAVA, Visual Basic, XML)	1.23	25.42	.68
A12. ERP used for small firms	1.22	24.82	.66
Traditional media communication			
B1. Face-to-face-communication with customer (firms)	1.10	23.79	.60
B2. Face-to-face-communication with suppliers	1.15	25.44	.65
B3. Face-to-face-communication with collaborating firms	1.12	23.84	.60
B4. Face-to-face-communication with external information people	1.17	27.25	.71

Table 4 continued

Constructs and indicator	Lambda	*t*-Value	Squared multiple correlation
B5. Telephone-communication with customer (firms)	1.14	25.54	.66
B6. Telephone-communication with suppliers	1.21	27.25	.72
B7. Telephone-communication with collaborating firms	.91	18.87	.43
B8. Telephone-communication with external information people	.99	22.02	.54
Electronic media communication			
B9. E-mail-communication with customer (firms)	1.03	20.97	.50
B10. E-mail-communication with suppliers	1.20	24.91	.64
B11. E-mail-communication with cooperation firms	1.03	21.83	.53
B12. E-mail-communication with external information people	1.20	25.29	.65
B13. Internet/EDI-communication with customer (firms)	1.07	22.59	.56
B14. Internet/EDI-communication with suppliers	1.27	27.05	.71
B15. Internet/EDI-communication with cooperation firms	.99	20.02	.47
B16. Internet/EDI-communication with external information people	1.14	22.37	.55
Process performance			
C1. Deduction of duplicated process	1.04	26.59	.76
C2. Improvement of processing speed	1.15	28.68	.88
C3. Improvement customer demand process	.84	19.66	.48
Customer performance			
C4. Swift handling for customer's complain	.97	21.11	.58
C5. Increase of new customer	1.05	23.52	.69
C6. Keep existing customer	1.00	24.61	.75
C7. Easiness of customer date management	1.05	22.47	.64
C8. Offering differentiated service through customer analysis	1.02	23.89	.71
Financial performance			
C9. Increase of sale amount	1.07	27.12	.82
C10. Increase of sales benefit	1.14	26.98	.91

goodness of fit for the research model ($\chi^2 = 5508.20$, $p = .000$, degrees of freedom = 644, $\chi^2/df = 8.295$, GFI = .71, AGFI = .66, NFI = .79, NNFI = .80 RMSEA = .10).

When a model is correct, but its conditions may not be correct, the χ^2 value is likely to appear larger than it should be. This indicates a problem with χ^2 as an indicator of a goodness of fit since the χ^2 value

Table 5 Results of goodness of fit test

Research model	Values	Recommended values
χ^2	5508.20 (.000)	Significant ($p < .001$)
χ^2/df	8.295 (5508.20/644)	<10 Interpreted, 2–5 good, <2 overfitting (Medsker et al. 1994)
PGFI	.61	0 to 1 Higher values, more parsimonious. (Mulaik et al. 1989)
GFI	.71	>.90 (Jöreskog and Sörbom 1989)
AGFI	.66	>.80 (Gefen et al. 2000)
NFI	.79	>.90 (Jöreskog and Sörbom 1989)
NNFI	.80	>.90 (Jöreskog and Sörbom 1989)
PNFI	.72	Higher is better (James et al. 1982)
RMSEA	.10	<.08 good, <.05 excellent (Browne and Cudesk 1992)
ECVI	8.19	Smaller values, better fitting (Kelloway 1998)

decreases as the sample size becomes bigger. From this perspective, it is advisable to use the χ^2 value in conjunction with other fitness indices (Jöreskog and Sörbom 1989). Medsker et al. (1994) suggested that χ^2/df ratios of less than 10 can be interpreted as indicating a good fit to the data with ratios less than 2 indicating over-fitting. The current model is deemed reasonable since the ratio of χ^2/df is 8.295.

In this article, the fitness of the overall model is assumed appropriate on the grounds of high fitness indices including the goodness of fit index (GFI). As shown in Table 5, even though the other fitness statistics do not reach the recommended values, the model is acceptable because the analysis was conducted at the firm level and not at the individual level.

5.3 Results of path analysis

With an analysis of 698 small firms in the sample, we found that: (1) individual IT knowledge and traditional media have significant positive effects on process performance; (2) organizational IT knowledge has a significant positive effect on customer performance; and (3) only electronic communication media have positive effects on both process performance and customer performance. We also found that process performance has a significant effect on customer performance and financial performance, and customer performance, in turn, positively affects financial performance.

The results of the path analysis indicate some suggestive points. First, we compared the magnitude of each latent variable to process performance and customer performance. The results showed that individual IT knowledge is the strongest latent variable to process performance. In other words, as individual IT knowledge (such as e-mail, Internet, OA, S/W) is more frequently used, internal process performance is improved as well. However, customer performance is affected significantly by electronic communication media. That means customers' satisfaction is more enhanced by assurance and tangibles than reliability and empathy from the perspective of SERVQUAL (Parasuraman et al. 1985; 1988; 1991).

Second, organizational IT knowledge (such as operation of the business website, operation of intranet, use of programming tools, and use of ERP) significantly contributes to customer performance but not to process performance. We believe employees in small Korean firms reported a high level of operational IT knowledge because the 'Networking of Small Firms Project' of the Korean government was implemented very recently and its effects remain fresh. Many firms participated in free organizational IT training provided under this project. This training might be the reason why organizational IT knowledge was not related to process performance.

Third, traditional communication media do contribute to process performance but do not to customer performance. On the other hand, electronic communication media through e-mail and Internet/EDI contribute to both process and customer performances. This means that electronic communication media play an important role in raising organizational performance.

Fourth, we found that financial performance is affected more by customer performance than process

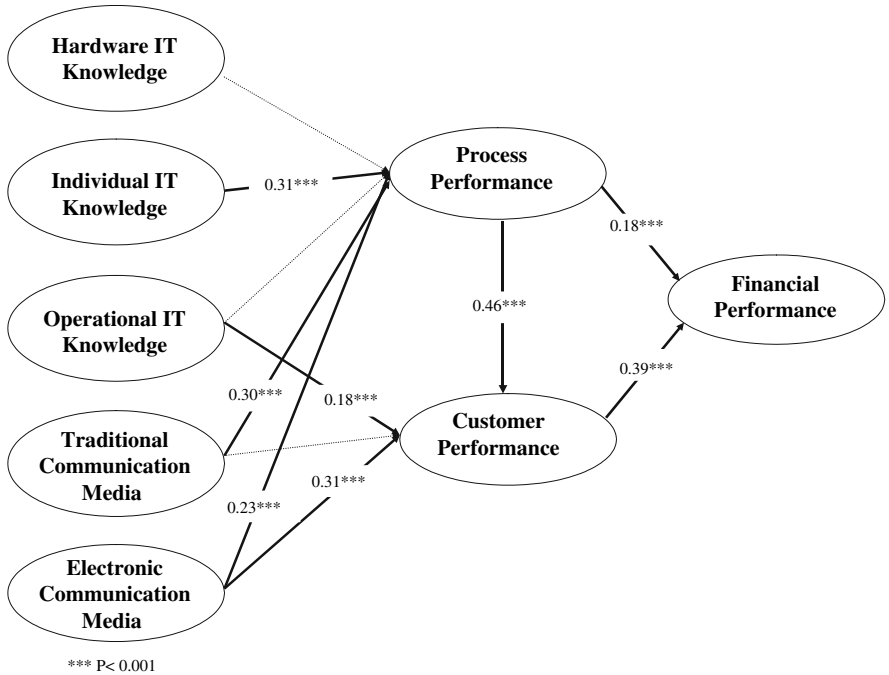

Fig. 3 Results of hypotheses test

performance, and process performance strongly influences customer performance. This means the BSC's strategic map is working as hypothesized. Ultimately, this result showed that financial performance is influenced by intangible assets such as process and customer performance.

6 Conclusion

The results of the path analyses are summarized in Fig. 3. First, electronic communication media have a statistically positive effect on the process and customer performance of small firms. However, traditional communication media have effect only on the process performance. This means IT-related communication media are becoming an important communication trend. Thus, small firms should focus on IT-related communication methods such as self-service, customer-center problem resolution**,** the instant help function, and desk automation. Remote on-line troubleshooting and Internet-based products are good examples of more advanced technologies that are currently being used to support customer centers. We believe small firms can apply the above findings in a positive way.

Second, individual IT knowledge has a statistically significant effect on the process performance of small firms. However, it is shown that organizational IT knowledge has no effect on the internal process performance. This result suggests that small firms should pay more attention to improving employees' individual IT knowledge. We recommend establishing a reward system for organizational IT application such as ERP or web master certification. These rewards will help motivate employees to improve organizational IT knowledge, which in turn will lead to improved organizational performance.

Third, small firms should make an effort to increase the application of IT communication methods (e-mail, Internet/EDI). E-mail is important for financial, internal process, and customer performance in general. Particularly, Internet/EDI does not have an effect on internal process performance, but has a positive effect on customer performance and financial performance.

This study has some limitations that should be considered for generalization. This study is based on the data collected from small firms in Korea. Korea is the world's most networked and advanced country in ICT-based e-business. Thus, the levels and applications of IT knowledge and electronic communication media are very high in Korea.

References

Andersen, T. J., & Segars, A. H. (2001). The impact of IT on decision structure and firm performance: Evidence from the textile and apparel industry. *Information & Management, 39*(2), 85–100.

Arora, R. (2002). Implementing knowledge management—A balanced scorecard approach. *Journal of Knowledge Management 6*(2), 240–249.

Barba-Sánchez, V., Martínez, M. P., & Jiménez-Zarco, AI (2007). Drivers, benefits and challenges of ict adoption by small and medium sized enterprises (SMEs): A literature review. *Problems and Perspectives in Management, 5*(1), 103–147.

Blili, S., Raymond, L., & Rivard, S. (1998). Impact of task uncertainty, end-user involvement, and competence on the success of end-user computing. *Information & Management, 33*(3), 137–153.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods and Research, 21*, 230–258.

Chidambaram, L., & Jones, B. (1993). Impact of communication medium and computer support on group. *MIS Quarterly, 17*(4), 465–492.

Cragg, P., King, M., & Hussin, H. (2002). IT alignment and firm performance in small manufacturing firms. *Journal of Strategic Information Systems, 11*(2), 109–132.

Daft, R. L., & Lengel, R. H. (1986). Organization information requirements, media richness and structural design. *Management Science, 32*(5), 554–571.

Dandridge, T., & Levenburg, N. M. (2000). High-tech potential? An exploratory study of very small firms usage of the internet. *International Small Business Journal, 18*(2), 81–91.

Deeter-Schmelz, D. R., & Kennedy, K. N. (2002). An exploratory study of the internet as an industrial communication tool: Examining buyers perceptions. *Industrial Marketing Management, 31*(2), 145–154.

Delone, W. H., & McLean, E. R. (1992). Information system success: the quest for the dependent variable. *Information Systems Research, 3*(1), 60–95.

Dewett, T., & Jones, G. R. (2001). The role of information technology in the organization: A review, model, and assessment. *Journal of Management, 27*(3), 313–346.

Drew, S. (2003). Strategic uses of e-commerce by SMEs in the east of England. *European Management Journal, 21*(1), 79–88.

Franzoni, C. (2007). Opportunity recognition in technology transfer organizations. *International Entrepreneurship and Management Journal, 3*(1), 51–67.

Gooijer, J. (2000). Designing a knowledge management performance framework. *Journal of Knowledge Management, 4*(4), 303–310.

Guimaraes, T., & Igbaria, M. (1996). Exploring the relationship between EUC problems and success. *Information Resources Management Journal, 9*(2), 5–15.

Hong, K. (2001). Impact of end-user knowledge and finesse of end-user technologies on the success of end-user computing in small firms. *Journal of Korean Small Business Studies, 23*(2), 161–185.

James, L. S., Mulaik, S. A., & Brett, J. M. (1982). *Causal analysis: Assumptions, models, and data*. Beverly Hills, CA: SAGE.

Jöreskog, K. G., & Sörbom, D. (1989). Model Search with TERRAD II and LISREL. *Sociological Methods and Research, 19*, 201–210.

Kaplan, R. S., & Norton, D. P. (2000). Having trouble with your strategy? Then map it. *Harvard Business Review, 78*(5), 167–176.

Kettinger, W. J., & Grover, V. (1997). The use of computer-mediated communication in an interorganizational context. *Decision Science, 28*(3), 513–555.

King, R. C., & Xia, W. (1997). Media appropriateness: Effects of experience on communication media choice. *Decision Science, 28*(4), 877–910.

Kline, R. K. (1998). *Principles and practice of structural equation modeling*. New York: The Guilford Press.

Kydd, C. T., & Ferry, D. L. (1991). Computer supported cooperative work tools and media richness: An integration of the literature. *Proceedings of the Twenty-Fourth Annual Hawaii International Conference on Systems Sciences* (3, pp. 324–332). Los Alamitos, CA: IEEE Society Press.

Lapierre, J., Filiatrault, P., & Chebet, J. (1999). Value strategy rather than quality strategy: A case of business to business professional service. *Journal of Business Research, 45*, 235–246.

Larson, P. D., & Kulchitsky, J. D. (2000). The use and impact of communication media in purchasing and supply management. *The Journal of Supply Chain Management, 36*(1), 29–39.

Leek, S., Turnbull, P. W., & Naude, P. (2003). How is information technology affecting business relationships? Results from a UK survey. *Industrial Marketing Management, 32*(3), 119–126.

Lengel, R. H., & Daft, R. L. (1988). The selection of communication media as an executive skill. *Academy of Management Executive, 2*(3), 225–232.

Lichtenthal, J. D., & Eliaz, S. (2003). Internet integration in business marketing tactics. *Industrial Marketing Management, 32*(1), 3–13.

Maltz, E. (2000). Is all communication created equal?: An investigation into the effects of communication mode on perceived information quality. *Journal of Product Innovation Management, 17*(2), 110–127.

Medsker, G. J., Williams, L. J., & Holahan, P. J. (1994). A review of current practices for evaluating causal models in organizational behavior and human resources management research. *Journal of Management, 20*, 439–464.

Mulaik, S. A., James, L. R., Alstine, J. V., Brett, J. M., Lind, S., & Stilwell, X. D. (1989). Evaluation of goodness-of-fit indices for structural equation modeling. *Psychological Bulletin, 105*, 430–445.

Munoz, M. J., Welsh, D. H. B. (2006). Outsourcing in the IT industry: The case of the philippines. *International Entrepreneurship and Management Journal, 2*(1), 111–123.

Munro, M. C., Huff, S. L., & Martin, B. L. (1997). Understanding and measuring user competence. *Information & Management, 33*(1), 45–57.

Mustaffa, S., & Beaumont, N. (2002). The effects of electronic commerce on small australian enterprises. *Technovation, 24*(2), 85–95.

Nunnally, N. R. (1978). Stream renovation: An alternative to channelization. *Environmental Management, 2*, 403–411.

Parasuraman, A., Zenithal, V., & Berry, L. (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing, 49*, 41–50.

Parasuraman, A., Zenithal, V., & Berry, L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing, 64*(1), 12–37.

Parasuraman, A., Zenithal, V., & Berry, L. (1991). Refinement and reassess of the SERVQUAL scale. *Journal of Retailing, 67*(4), 420–450.

Premkumar, G., & Roberts, M. (1999). Adoption of new information technologies in rural small businesses. *OMEGA, 27*(4), 467–484.

Roberts, B., & Mackay, M. (1998). IT supporting supplier relationships: The role of electronic commerce. *European Journal of Purchasing & Supply Management, 4*(2–3), 175–184.

Ruiz-Mercader, J., Meroño-Cerdan, A. L., & Saberter-Sánchez, R. (2006). Information technology and learning: Their relationship and impact on organizational performance in small businesses. *International Journal of Information Management, 26*(1), 16–29.

Saarinen, T. (1996). An expanded instrument for evaluating information system success. *Information & Management, 31*(2), 103–118.

Shani, A. B., Sena, J. A., & Stebbins, M. W. (2000). Knowledge work teams and groupware technology: Learning from Seagate's experience. *Journal of Knowledge Management, 4*(2), 111–124.

Souitaris, V. (2001). External communication determinants of innovation in the context of a newly industrialized country: A comparison of objective and perceptual results from Greece. *Technovation, 21*(1), 25–34.

Stefansson, G. (2002). Business-to-business data sharing: A source for integration of supply chains. *International Journal of Production Economics, 75*(1–2), 135–146.

Tallon, P. P., Kraemer, K. L., & Gurbaxani, V. (2000). Executives' perceptions of the business value of information technology: A process-oriented approach. *Journal of Management Information Systems, 16*(4), 145–173.

Thong, J., & Yap, C. (1995). CEO characteristics, organizational characteristics and information technology adoption in small businesses. *OMEGA, 23*(4), 429–442.

Torkzadeh, G., & Lee, J. (2003). Measures of perceived end-user computing skills. *Information & Management, 49*(7), 607–615.

Walczuch, R., van Braven, G., & Lundgren, H. (2000). Internet adoption barriers for small firms in the Netherlands. *European Management Journal, 18*(5), 561–572.

Walsh, J., & Godfrey, S. (2000). The internet: A new era in customer service. *European Management Journal, 18*(1), 85–92.

Walton, S. V., & Marucheck, A. S. (1997). The relationship between EDI and supplier reliability. *International Journal of Purchasing and Materials Management, 33*(1), 30–35.

Winston, E. R., & Dologite, D. G. (1999). Achieving IT infusion: A conceptual model for small businesses. *Information Resources Management Journal, 12*(1), 26–38.