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請詳讀所附論文之節錄內容，並逐項回答下列各題:

論文: Teo, T., & Pian, Y. (2003). A contingency perspective on Internet adoption and competitive advantage. European Journal of Information System, 12(2), 78-92.

請用中文回答否則不予計分

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A contingency perspective on Internet adoption and competitive advantage

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Abstract
Firms adopt the Internet for different purposes, ranging from simple Internet presence to using the Internet to transform business operations. This paper examines the contingency factors that affect levels of Internet adoption and their impact on competitive advantage. A questionnaire was used to gather data for this study; 159 usable responses were obtained from a sample of 566 firms in Singapore. Results indicate that most firms are still exploring the business use of the Internet. A proactive business technology strategy was found to be positively associated with the level of Internet adoption. Technology compatibility and top management support were found to have no significant relationships with the level of Internet adoption. Further, the level of Internet adoption had a significant positive relationship with competitive advantage. These results provide a better understanding of the contingency factors affecting the level of Internet adoption, as well as providing some evidence of the positive impact of Internet adoption on competitive advantage.
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Keywords: Internet; Web; adoption; contingency; competitive advantage

Introduction

The success of airline reservation systems in the 1980s in the United States has triggered an extensive examination of the impact of information technologies (IT) on markets and business transactions. Previous research focused on how IT can be used to transform industry and business structures, as well as to sustain firms' competitiveness (Malone *et al.*, 1987; Porter & Millar, 1996; Fruling & Digman, 2000). In recent years, research has increasingly examined the impact of the Internet.

Research has shown that the most useful effects of the Internet for small businesses are for information-gathering and time-savings rather than for advertising and sales (Poon & Swatman, 1999). Although business activities seek to generate revenues, research shows that financial & economic measures alone do not adequately capture the value of electronic commerce investment (Tiwana & Ramesh, 1999). Future expectations pertaining to positive impacts of the Internet on competitive advantage often serve as key motivations for the adoption of the Internet in firms. For example, research has shown that firms have used the Internet to enhance their competitive advantage in areas such as marketing and information distribution, research and development, sales and product distribution, and customer and product support services (Mathieu, 1996).

In order to examine the importance of the Internet in business activities, this study focuses on the commercial use of the Internet. We examine the contingency factors that are associated with a firm's level of Internet

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adoption and the impact of the level of Internet adoption on competitive advantage.

Background

Adoption of the Internet is not restricted to certain industries. There is an increasing trend for firms, regardless of industry, using Web sites to reach out to customers. However, firms that have higher market performances measured by revenues are more likely to use Web sites to reach their customers compared to other firms (Liu *et al.*, 1997).

Contingency factors affecting Internet adoption are likely to include both internal and external factors (Santos & Peffers, 1998; Vadapalli & Ramamurthy, 1998). Organisational factors, namely technology policy, top management support, and top management risk position; technological factors dealing with compatibility and relative advantage; and environmental factors involving competitive intensity, information intensity and government support have been examined. Results show that organisational factors have stronger relationships with Internet adoption compared to environmental factors (Teo *et al.*, 1997–1998).

In a similar vein, research on IS adoption has found that businesses with certain CEO characteristics (innovativeness and level of IS knowledge), innovation characteristics (relative advantage, compatibility and complexity of IS), and organisational characteristics (business size and level of employee's IS knowledge) are more likely to adopt IS. CEO and innovation characteristics affect the decision to adopt but not the extent of adoption while competition has no direct effect on adoption. The extent of adoption is mainly determined by organisational characteristics (Thong, 1999).

Other research has examined the issue of the impact of IT on competitiveness. For example, electronic linkages, such as inter-organisational systems and Internet-based commerce, are powerful ways for facilitating cost leadership, and differentiating products and services. Lederer *et al.* (1997) examined the relationship between a firm's electronic commerce strategy and business strategy, suggesting that firms perceive differentiation but not cost leadership as a benefit of electronic commerce.

Firms that make IS investments in response to pressure from customers or initiatives of competitors may gain strategic advantage over other competitors that fail to do so. Further, trading partner relationships and the balance of power are critical issues when firms participate in electronic commerce. Large firms often initiate electronic data exchanges due to competition and the need to introduce efficiency into day-to-day operations. On the other hand, these firms are also interested in boosting their size in order to influence the supply chain and sustain a dominant position. Thus, large firms are forcing smaller firms to adopt electronic data exchanges (Young *et al.*, 1999).

Imitation and communication among industry competitors are important factors for the adoption of new technology (Santos & Peffers, 1998). The value of the technology is dependent upon its adoption and acceptance by relevant parties. The benefits to early adopters are often affected by the adoption timing decisions of firms that follow. If other firms in an industry are slow to imitate an innovation, benefits to early adopters can be significant. In addition, adoption decisions determine whether technologies eventually become industry standards or are eclipsed by substitute technologies. In summary, the adoption of the Internet is influenced by various contingency factors and has wide ranging impact on firms. However, not all contingency factors are equally important. Similarly, the impact of adopting the Internet does differ among firms.

Research model and propositions

The research model shown in Figure. 1 comprises three parts. The first part is related to the middle of the model,

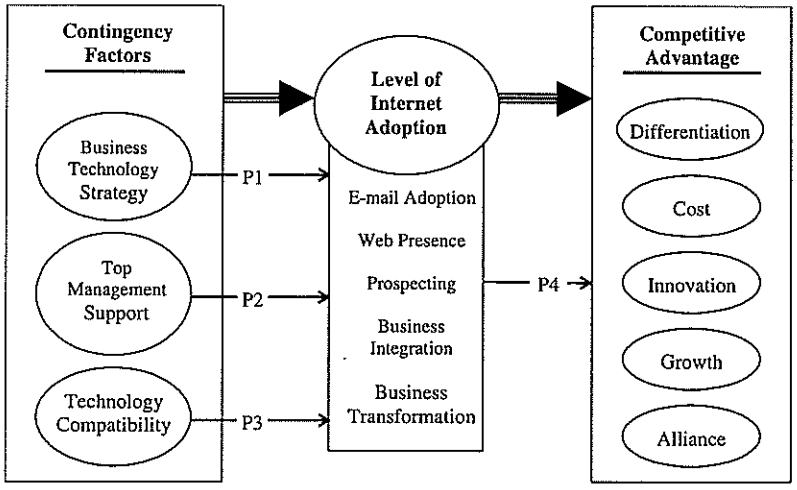

Figure 1 Research model.

the maturity of Internet adoption, which is referred to as the 'level of Internet adoption'. The levels of Internet adoption are classified as: level 0 – e-mail adoption, level 1 – Internet presence, level 2 – prospecting, level 3 – business integration; and level 4 – business transformation. The second part is related to the left portion of the model, which involves contingency factors influencing the level of Internet adoption. Here, we examine three factors, two of them relating to organisational factors – business technology strategy and top management support, and one to technological factor – technology compatibility. The third part is related to the right portion of the model that depicts the impact of Internet adoption on competitive advantage measured in terms of differentiation, cost reduction, innovation, growth, and alliance.

Levels of Internet adoption

Various researchers have proposed different types or levels of Internet adoption. One study proposed a three-level process model. Level 1 is 'visibility.' Companies in this level strive to represent the physical operations more effectively via information technology. Level 2 is referred to as 'mirroring capability'. In this level, companies substitute virtual activities for physical ones. Level 3 deals with 'new customer relationships', in which companies deliver values to customers in new ways (Rayport & Sviokla, 1996).

Another approach takes into account the types of business activities facilitated by Internet technology. Internet adoption can then be divided into three levels (Nambisan & Wang, 1999): level 1 – 'information access'; level 2 – 'work collaboration'; and level 3 – 'core business transactions'. Level 1 focuses on using Internet technology to disseminate information about products, services, and organisational policies, as well as to channel feedback from employees and customers. In the second level, Internet technology is used to facilitate real-time work collaboration and document flow during the business processes. The third level involves direct integration between Internet technology and core business processes/transactions.

In a similar vein, another approach classifies the level of adoption into four categories: non-adopters, planning to adopt, limited users, and sophisticated users (Sohn & Wang, 1998, 1999). A related approach conceptualises Internet adoption in terms of four levels of maturity. At level 1 (Static), only static information is provided on the Web. At level 2 (Interactive), some interaction is possible and the firm is basically exploring Internet usage. At level 3 (Transactive), additional features and transactions capability are present while at level 4 (Intelligent), the Internet is used to transform the business through new products and services enabled by Internet technology (AMS, 1999).

Yet another approach, rather than defining levels of Internet adoption, posits that Web sites can be classified by the different ways the Internet can be used (Hoffman *et al.*, 1995), namely 'on-line storefront', 'Internet presence', 'content sites', 'electronic malls', 'incentive sites', and 'search agents' or according to their business purposes, namely, 'promotion' of product and services; 'provision' of data and information; and 'processing' of business transactions (Ho, 1997). Thus, existing research suggests that researchers often model Internet adoption according to the functions of the Web sites. In other words, different levels of Internet adoption can facilitate different kinds of business activities. Web sites can be classified according to the complexity of their designs, which is believed to be strongly related to their efficiency and effectiveness (Wan & Chung, 1998). Taking into account an organisation's Internet strategy and its Web site's functional characteristics, we propose a model of Internet adoption ranging from levels 0 to 4. Note that this model was derived from the above research as well as literature describing the various uses of Web sites and the Internet. Our model is perhaps closest to the four categories of adopters (Sohn & Wang, 1998, 1999) and the maturity model (AMS, 1999).

Level 0 – e-mail adoption

A company in level 0 is one that has an e-mail account but does not have a Web site. The inclusion of level 0 is based on research (Teo *et al.*, 1997–98) which classified Internet adoption into three groups: non-adopters (those without Internet account), adopters without Web sites but with Internet account, and adopters with Web sites.

Level 1 – Internet presence

The first level of Internet adoption is Internet presence. At this level, companies have made the adoption decision but the implementation is still in process (similar to Category 2 (planning to adopt) by Sohn & Wang (1998, 1999) and level 1 (Static) by AMS (1999)). The purpose of adoption may be to occupy a domain name or simply to have Internet presence. Generally, Web sites at this level provide mainly company information and brochures, therefore tending to be non-strategic in nature.

Level 2 – prospecting

The second level of Internet adoption is called prospecting, which involves the limited use of the Internet (similar to Category 3 (limited users) by Sohn & Wang (1998, 1999) and level 2 (Interactive) by AMS (1999). Usually, Internet adoption initiatives at this level are spearheaded by individual departments and are not tied to business strategy. Most firms at this level establish Web sites to provide customers with company information, product information, news, events, interactive content, personalised content, e-mail support, and simple search. This strategy is helpful in providing potential customers with access to the firm's products with minimal information-distributing cost.

Level 3 – business integration
The third level, business integration, takes into account the integration of business processes marked by the incorporation of the Internet in to the business model. In other words, Internet strategy is integrated with firm's business strategy. At this level, the value proposition for a Web site is usually for cost reduction and business support, as well as cross-functional links between customers and suppliers. Note that compared to the first two levels, Web sites at this level are more complex with added features for interactive marketing/sales, online communities and secure transactions (similar to level 3 (Transactive) by AMS, 1999). Moreover, the features found in levels 1 and 2 are enhanced at this level, for example, the information provided is more comprehensive and the search function carries more advanced and powerful properties.

Level 4 – business transformation
The fourth level aims to transform the business and represents the highest level of Internet adoption. The Internet is seen to transform the overall business model throughout the organisation by focusing on building relationships and seeking new business opportunities (similar to level 4 (Intelligent) by AMS, 1999). Note that levels 3 and 4 are also similar to Category 4 (sophisticated users by Sohn & Wang, 1998, 1999) except that we split sophisticated users into two separate levels consistent with the maturity model (AMS, 1999).

Contingency factors affecting the level of Internet adoption

The level of Internet adoption varies among different firms. It is therefore interesting to examine some of the contingency variables that may affect the level of Internet adoption. In this study, we examine business technology strategy, top management support, and technology compatibility as contingency factors affecting the level of Internet adoption. These variables were chosen because prior research on Internet adoption (e.g., Teo & King, 1997) found them to be important. In addition, although there are other contingency variables, we decided to focus only on these three variables in order to limit the length of the questionnaire as well as confirm whether variables important in facilitating Internet adoption are also important in facilitating the extent of Internet adoption.

Business technology strategy
Business technology strategy refers to the degree to which a firm aggressively pursues technological changes in terms of process innovation (i.e. up-to-date production technologies and equipment), product innovation, technological forecasting activities, and recruitment of qualified human resources (Lefebvre *et al.*, 1997). There are two different business technology strategies: proactive (or aggressive) technology strategy and reactive technology strategy. A proactive technology strategy is a long-range strategy for the adoption of production process, product, and service innovations. Perceived environmental uncertainty promotes a proactive technology strategy and such strategy can be interpreted as a means to cope with an uncertain environment (Ettlie & Bridges, 1982). A firm implementing a proactive technology strategy is more likely to have a specialized group of people to evaluate new process innovations, which may lead to the adoption of major process innovations (Ettlie, 1983). In contrast, a firm operating with a reactive technology strategy will be more conservative in adopting innovations and thus more likely to adopt minor process innovations.

Firms with an aggressive and forward-looking technology strategy are more likely to innovate (Ettlie, 1983) and create new wealth (Hamel & Skarynski, 2001). Likewise, these firms are more likely to concentrate on improving existing practices through the adoption of computer-based information technologies (Lefebvre *et al.*, 1997). Similarly, these firms would also tend to leverage new technologies and the Internet in response to current technological trends and market demands (Teo *et al.*, 1997–98). Therefore, our first proposition is:

P1. The proactiveness of a firm's business technology strategy is positively related to the firm's level of Internet adoption.

Top management support
In order to make the most out of electronic commerce, it needs to be taken as a strategic business decision, not merely a technological one (Goldberg & Sifonis, 1998). Thus, top management support is most likely an important variable associated with the level of Internet adoption. With top management support, the role of IT will be elevated leading to greater business use of the Internet (Teo & Too, 2000).

In a similar vein, innovation studies confirm that top management support is related positively to innovation adoption in organisations (Meyer & Goes, 1988) and to the successful adoption and implementation of information systems (Premkumar & King, 1992; Grover, 1993). Top management support has also been found to play a prominent role, along with the variables of commitment in motivating and facilitating the organisational adoption of the Internet (Teo *et al.*, 1997–98). Similarly, top management support plays an important role in a firm's decision to adopt Internet technology (Sohn & Wang, 1998) and electronic data interchange (EDI). (Premkumar *et al.*, 1997). It follows that:

P2. Top management support is positively related to a firm's level of Internet adoption.

Technology compatibility

Previous research has found that the incompatibility of new technology with existing values and work practices greatly inhibits adopting innovations (Kwon & Zmud, 1987; Chung & Synder, 2000). Owing to the availability of the Internet, organisations may perceive that it is relatively easy to adopt Internet technology. However, adoption at higher levels may require closer integration of the technology with business context (Nambisan & Wang, 1999), which in turn stresses the importance of technology compatibility. Further, different levels of Internet adoption may need different combinations of Internet-related technologies. For example, a firm at level 0 may need no advanced in-house technology infrastructure whereas a firm at level 4 should possess not only an advanced technology infrastructure, but also database and secure payment systems. In other words, to support business activities such as inventory management, sales support, internal communication, and coordination, as well as accepting and processing data gathered from the firm's Web site, integration of the Internet with database management function is necessary (Butler, 2000). However, the feasibility of such integration is dependent on the compatibility of Internet technology with an organisation's existing technology and cultural values (relating to technology). Hence, we suggest that:

P3. The compatibility of Internet technology with a firm's existing technology and cultural values (relating to technology) is positively related to the firm's level of Internet adoption.

Impact of the level of internet adoption on competitive advantage

As discussed in the previous section, firms adopt the Internet for a variety of reasons. In some firms, it may be just simple Internet presence while in others it may be for the purpose of business integration or business transformation. Different levels of adoption are therefore likely to confer different degrees of competitive advantage. Based on an extensive review of academic and practitioner perspectives on competitive strategies and competitive advantage, there are five strategic thrusts to enhance a firm's competitive advantage. These are differentiation, cost reduction, innovation, growth, and alliance (Wiseman, 1988). The following sections describe how Internet adoption affects these five competitive advantages. Note that as we are using perceptual measures based on respondents' self-perceptions, we are actually examining the perceived impact of Internet adoption on competitive advantage.

Differentiation

Electronic commerce helps a firm to differentiate itself not only through price but also through product innovation, shorter-time to market, and customer service (Bloch *et al.*, 1996). Moreover, Internet adoption can help a firm provide customised products and services, thus enhancing its differentiation advantage. Aided by the Internet's interactivity feature – e-mail, registration form, discussion group, and customer communities – a firm can easily collect customer data, which include demographic data, product comments and potential demands for certain products/services. These data can provide a good foundation for the firm to customise existing products in innovative ways (Fruhling & Digman, 2000), which will help the firm distinguish its products and services from its competitors or focus on a particular customer group. The more extensive the data and the stronger the data-processing ability a firm possesses, the greater the competitive differentiation edge it will have. In addition, the Internet also provides an opportunity for a firm to establish its brand image. Firms can use Web sites to reinforce their identities, the differentiation of which can help build up customer loyalty, one of the most powerful competitive weapons in capturing market and customer share (Smith, 2000).

Cost reduction

Research on electronic commerce suggests that the adoption of an electronic marketplace can reduce transaction costs (Malone *et al.*, 1987, 1989). In addition, information technology and the Internet can dramatically reduce the costs of obtaining, processing, and transmitting information, thus changing the way firms do business (Porter & Millar, 1996; Porter, 2001). Internet adoption can reduce the cost of marketing, advertising, and business operations. Cost reductions induced by the Internet come from less expensive product promotion, cheaper distribution channels, and direct savings (Bloch *et al.*, 1996). Further, the inefficiencies associated with paper processing can be decreased and eliminated. The decrease in distribution costs can be expressed as a reduction in overhead expenses such as inventory, retail space, and personnel (Fruhling & Digman, 2000). In addition to reducing the costs of existing business activities, the Internet can help promote cost leadership by providing valuable new services inexpensively (Ghosh, 1998). For example, a firm is able to provide online customer service and technical support by putting frequently asked questions (FAQs) on its Web site. In addition, customers can obtain useful information from an online community by interacting with other customers regarding product queries.

Innovation

An innovation advantage may generate effects on one or more links of the product network (industry or value chain), which typically covers product and process R&D, purchase and transportation of raw materials, manufacturing of parts and components, assembly, testing, quality control, marketing, sales, wholesale distribution, and retailing. The impact of the Internet on innovation

can be categorised into three parts. First, information about customer needs collected from the Web site can assist the generation of new product ideas. Second, the cooperation network within the firm as well as between the firm and its business partners can facilitate R&D production process. Third, close relationship among business partners along the supply chain can provide opportunities to improve the product-distribution process. Internet adoption can offer firms an opportunity to experiment with new products, services, and processes. Moreover, the Internet not only reduces information-distribution time, but also reduces product cycle time (Bloch *et al.*, 1996).

Growth

Internet adoption can help a firm expand its market and customer share, thus facilitating a firm's growth strategy. Internet adoption affects a firm's growth ability by increasing its scope and extending its core business through market penetration and development, or product development (Fruhling & Digman, 2000). Based on Internet technology, a firm is able to quickly and effectively expand its geographical markets regionally and globally. In addition, an Internet presence can open new markets and new distribution channels. Further, an information-rich Web site can help a firm to develop relationships with customers by providing more effective marketing, new channels, shorter time to market, customised or personalised product, online 24-h technical support, and online interactive community. These relationships can increase the likelihood of sales and opportunities to introduce new products and services (Fruhling & Digman, 2000; Porter, 2001).

Alliance

IT and the Internet are creating many new inter-relationships among businesses and expanding the scope of industries in which a firm must compete to achieve competitive advantage (Porter & Millar, 1996; Porter, 2001). To maintain a successful alliance, communications between partners play a significant role (Monczka *et al.*, 1998). In addition, information sharing and delivering on promises are important in managing the relationship. Internet adoption in a firm can enhance its alliance advantage by providing an effective and cheaper communication channel among alliance partners. The Internet provides ubiquitous access to information and offers a platform-independent means for alliance partners to exchange information. Strong business-to-business alliances can be established in the procurement process and partnerships can be developed from linkages in the distribution channel using electronic commerce (Fruhling & Digman, 2000). The maturity of a firm's level of Internet adoption is likely to enhance the formation of linkages with business partners.

From the above discussion on the impact of Internet adoption on competitive advantage, we propose the following:

P4. The firm's level of Internet adoption is positively related to managers' perceptions of the competitive advantage obtained by such adoption.

Method

Sample and procedures

A questionnaire was used to collect data for this study. The sample was selected from the 'Singapore 1000' and 'Small and Medium Enterprises (SME) 500' published by the Data Processing (DP) Information Network Pte. Ltd. (2000). Only firms with Web sites and/or e-mail addresses were selected.

Before the formal survey, two rounds of pretests were conducted. The first round involved four Master's level and two doctoral students. Based on their feedback, certain items in the questionnaire were reworded. In addition, minor layout changes were made in order to improve clarity and readability. The second round of pretest included one doctoral student, one academic staff member, one Vice President in a consultancy firm, and one Business Analyst in an online firm. There were no major comments and the questionnaire was deemed ready for data collection. In the cover letter, we assured respondents that any information provided would be kept strictly confidential. Further, we made it clear that individuals and firms would not be identified in any reports pertaining to the study as only aggregated data would be reported.

The questionnaires were mailed to IT managers or top executives, namely Managing Directors and CEOs (for those firms that did not have IT managers) in 566 firms. The top executives were asked to fill in the questionnaire or forward it to the appropriate person in charge of IT/Internet applications. In some firms, the Finance department or other departments were in charge of IT/Internet applications. One hundred and one responses were received. Three weeks later, a second mailing was carried out to firms that had not responded. Five questionnaires were returned unanswered due to change of address and eight firms declined to participate. Four questionnaires were unusable due to missing responses. Final usable responses totalled 159, giving a response rate of 28.8%.

Instrument

The construct 'level of Internet adoption' was measured using paragraph descriptions of the five levels (see the Appendix). Organisations were asked to select the level that most closely fits their firm' level of Internet adoption. This method of collecting self-reported grouping data based on paragraph descriptions was commonly adopted by previous researchers (King & Teo, 1997; Shortell & Zajac, 1990). As a validation check, we

examined the firms' Web sites to verify their responses. Phone calls were made to respondents when necessary, to confirm the objective of Web sites as well as the presence and extent of certain features on Web sites.

In the instrument, the contingency factors, namely, business technology strategy, top management support and technology compatibility, were measured using four items each (Table 1a). Likert scales with values of 1–5 were adopted here with 1 – strongly disagree and 5 – strongly agree. Items developed by Lederer *et al.* (1997), who used Likert scales of 1–7, (with 1– extremely little, and 7 – extremely much) were adapted to measure the impact of Internet adoption on different facets of competitive advantage: differentiation, cost reduction, innovation, growth, and alliance. In addition, we also selected related items from other studies to supplement Lederer *et al.*'s measurement in order to capture the various dimensions more broadly (Table 1b).

Note that as an effort was made to keep the items and scale scores similar to that found in the original surveys, contingency variables were measured on a 5-point scale while competitive advantage was measured on a 7-point scale. This approach has been used in previous studies which also used different Likert scales in a questionnaire (e.g., Janz *et al.*, 1997). In addition, the questionnaire was arranged in sections with various items measuring a construct grouped together. The rationale is to make it easier for respondents to focus their attention on a particular topic.

Results

Respondents profile

Table 2 presents the demographic data of respondents. About 23% of respondents were from the manufacturing industry while 16% were from the retail/trading industry, followed by architecture/engineering industry (11.3%), travel/tourism/hotel (10.7%), finance/banking/insurance industry (10.1%), and business services industry (8.8%).

Over 90% of respondents held managerial positions. The average number of years served in the firm and industry were 6.6 and 11.1, respectively. The high hierarchical level of respondents coupled with the number of years of tenure in the firm and industry give some assurance as to the validity of the sample since management level respondents are more likely to be knowledgeable about their firms' Internet strategy and implementation. Note that we did not eliminate responses from non-managers because some firms may not have managers responsible for leveraging the Internet.

Table 1a Contingency factors

	Items	*Description of items*	*Sources*
Latent variables			
Instructions: Please indicate the extent to which you agree or disagree with the following factors relating to your organisation. (Scale: 1 'strongly disagree' to 7 'strongly agree')			
Business technology strategy	BStra1	Our organisation has a long tradition of being the first to try new methods and technologies.	Teo *et al.* (1997–1998)
	BStra2	Our organisation spends more resources than others in the industry in developing new products.	
	BStra3	Our organisation actively recruits the best technical personnel.	
	BStra4	Our organisation keeps abreast of the latest technological developments.	
Top management support	TopM1	Top management is interested in the adoption of the Internet.	Grover (1993) and Teo *et al.* (1997–1998)
	TopM2	Top management considers Internet adoption is important to the organisation.	
	TopM3	Top management has effectively communicated its support for Internet adoption.	
	TopM4	Top management is committed to the use of the Internet.	
Technology compatibility	Tech1	Internet adoption is compatible with our information technology infrastructure.	Rogers (1995) and Teo *et al.* (1997–1998)
	Tech2	Internet adoption is consistent with our organisational beliefs and values.	
	Tech3	Attitudes towards Internet adoption in our organisation have been favourable.	
	Tech4	Internet adoption is consistent with our business strategy.	

Table 1b Competitive advantage

	Items	*Descriptions of items*	*Sources*
Constructs			
Instructions: Please indicate the extent to which the following are derived from Internet adoption in your organisation (Scale: 1 'extremely little' to 7 'extremely much').			
The Internet enables our organisation to:			
Differentiation	Diff1	Provide new products/services to customers	Bloch *et al.* (1996), and Lederer *et al.* (1997), and Orli & Tom (1987)
	Diff2	Provide better products/services to customers	
	Diff3	Provide easier customer access to information	
	Diff4	Provide customised products/services	
	Diff5	Speed up transactions	
	Diff6	Enhance brand distinguishability	
	Diff7	Enhance the credibility and prestige of the organisation	
Cost reduction	Cost1	Save cost by reducing the workforce	Bloch *et al.* (1996), Lederer *et al.* (1997), and Orli & Tom (1987)
	Cost2	Save cost by reducing travel costs	
	Cost3	Reduce cost in information distribution	
	Cost4	Reduce cost in communication	
	Cost5	Reduce cost in marketing	
	Cost6	Reduce cost in advertisement	
	Cost7	Reduce R&D cost	
Innovation	Innov1	Allow previously infeasible applications to be implemented	Bloch *et al.* (1996), Lederer *et al.* (1997), and Orli & Tom (1987)
	Innov2	Allow other applications to be developed faster	
	Innov3	Change the way the organisation conducts business	
	Innov4	Respond more quickly to change	
	Innov5	Shorten the time period for product development (dropped)	
	Innov6	Better coordinate business operations (dropped)	
Growth	Growth1	Enhance business efficiency (dropped)	Lederer *et al.* (1997) and Premkumar & King (1992)
	Growth2	Increase return on financial assets	
	Growth3	Better achieve organisational goals	
	Growth4	Increase market share	
	Growth5	Increase ROI (Return on Investment)	
	Growth6	Increase annual sales revenue	
	Growth7	Increase customer satisfaction (dropped)	
Alliance	Allian1	Enable easier access to information by business partners	Bloch *et al.* (1996), Lederer *et al.* (1997), and Orli & Tom (1987)
	Allian2	Enable faster retrieval or delivery of information or reports by business partners	
	Allian3	Keep close contact with business partners	
	Allian4	Help establish useful linkages with other organisations	
	Allian5	Increase efficiency in supply chain	

More than 40% of the responding firms had average annual revenue of S$100 million to S$600 million (exchange rate: 1 S$ = 0.57 euros), and about one-third had average annual revenue of less than S$100 million. About 65% had less than 600 employees. The results also showed that establishing a Web site was relatively cheap with 44% of firms spending less than S$30,000 when they first created their Web sites. However, the maintenance of Web site was more expensive with about 45% of firms investing less than S$100,000 annually and another 18% investing S$100,000 to S$300,000 annually. 61.7% of participating firms had less than 10 IT/ IS employees. This could be due to outsourcing of Web site maintenance to specialized Internet service providers.

Level of Internet adoption

Among the 159 respondents, the distribution of levels of Internet adoption are shown in Table 3.

Structural equation modelling

Structural equation modeling (SEM) was applied to test the relationships among the theoretical constructs. The sample size of 159 respondents is considered adequate for SEM where the minimum sample size is 100 (Kline,

Table 2 Demographic profile

Demographic profile	*Percentage*
Industry	
Manufacturing	23.3
Retail/trading	15.7
Architecture/engineering	11.3
Travel/tourism/ hotel	10.7
Finance/banking/insurance	10.1
Business services	8.8
Computer/IT	4.4
Health/medical	3.8
Real estate/ property	3.8
Others	6.9
Missing	0.6
Hierarchical level	
CIO/IT Manager	35.8
Chairman/ Managing Director/ CEO	15.7
General Manager/ Vice President/ Director	12.6
Other managers	11.9
Finance/Accounting Manager	10.7
Marketing Manager	5.0
System Analyst/Engineer/Leader	4.4
Others	3.1
Missing	0.6
Number of employees	
0–100	23.9
101–300	27.7
301–600	13.8
601–1000	8.2
1001–2000	7.5
>2000	17.6
Missing	1.3
Number of IT/IS employees	
<10	60.4
10–30	17.6
31–60	5.0
61–100	2.5
101–200	3.8
>200	9.4
Missing	1.3
Average annual revenue	
<S100*million*	34.6
S100*million to*<S300 million	30.8
S300*million to*<S600 million	11.3
S600*million to*<S1 billion	2.5
S1*billion to*<S5 billion	9.4
>S5*billion*	8.2
Missing	3.1
Initial cost of establishing Web site	
<S10,000	28.9
S10,000 *to*<S30,000	15.1
S30,000 *to*<S60,000	9.4
S60,000 *to*<S100,000	7.5
S100,000 *to*<S500,000	10.1
>S500,000	5.7
Not applicable:	17.0
Missing	6.3
Annual investment in Internet technology	
<S100,000	44.7
S100,000 *to*<S300,000	18.2
S300,000 *to*<S600,000	9.4
S600,000 *to*<S1 million	6.3
S1*million to*<S5 million	8.2
>S5*million*	8.8
Missing	4.4

Note: *N*=159, exchange rate 1 $= 0.57*euros*.

Table 3 Levels of Internet adoption

Levels of Internet adoption	*Number*
Level 0 – E-mail adoption	27
Level 1 – Internet presence	48
Level 2 – Prospecting	52
Level 3 – Business integration	18
Level 4 – Business transformation	14

1998). In building structural equation models, the measurement models must be specified first (Joreskog & Sorbom, 1989; Schumacker & Lomax, 1996).

Measurement model

The measures for contingency factors and competitive advantage were subjected to confirmatory factor analyses using structural equation modelling. Table 4a and b shows the construct loadings while Table 4c shows the various fit indices. For contingency factors, the loadings range from 0.67 to 0.93 and are above the acceptable value of 0.50, commonly used as the cut-off value (Teo & King, 1996). The goodness-of-fit index (GFI), adjusted goodness-of-fit index (AGFI), normed-fit index (NFI), incremental-fit index (IFI), Tucker–Lewis index (TLI) and comparative-fit index (CFI) are above the threshold value of 0.90, thereby indicating that the measurement model for contingency variables has good fit with the data (Kline, 1998; Hair *et al.*, 1998). A root mean square error of approximation (RMSEA) value of 0.05 or less is an indicator of close fit, while values between 0.05 and 0.08 is an indicator of reasonable fit of the model to the data (Browne & Cudeck, 1993). Hence, our value of RMSEA = 0.04, supports the acceptability of the model (Bryne, 2001).

Similarly for competitive advantage, four items were dropped due to poor loadings (indicated in Table 1b). The loadings range from 0.62 to 0.91 and are above the acceptable value of 0.50 commonly used as the cut-off value (Teo & King, 1996). The fit indices (Table 4c) indicate a need to improve the measurement model (Table 4b). According to Hair *et al.* (1998), the number of indicators could affect the estimation results. In order to determine whether the five constructs can be combined

into a single construct called competitive advantage, a discriminant validity test was carried out. We basically reran the model several times; each time setting the correlation between two dimensions to be equal to 1 as recommended by Anderson & Gerbing (1988). We tested whether the increment in χ^2 value was significant compared to the original default model (Table 5). A non-significant χ^2 would imply that the models are similar and that we can combine the two constructs whose correlation is set to 1.

Results show that at the significance level of 0.05, differentiation and cost reduction, innovation and alliance, and differentiation and alliance are significantly different constructs, while the other pairs of constructs cannot be separated, suggesting there is a common secondary factor for these five constructs. Hence, a construct of competitive advantage is proposed using the mean values of differentiation, cost reduction, innovation, growth, and alliance to measure it. The fit indices (Table 4c) indicate that the model is acceptable.

Reliability

The composite reliability and variance extracted for a latent construct were computed separately (Table 6) for each multiple indicator construct in the model. The construct reliability values for all the latent variables in our study exceeded the commonly used threshold value for acceptance of 0.70 (Nunnally, 1978). Further, the variance extracted values all exceeded 0.50, which is the acceptable value (Hair *et al.*, 1998).

Structural model

The fit indices for the initial structural model indicated marginal fit as some of the indices were slightly below the required values. The improvement process was guided by theoretical considerations and modification indices. The final model had acceptable fit indices. Figure 2 presents the standardised estimation results for the final structural model.

Table 4a Measurement model for contingency factors

Indicators	*Exogenous constructs*		
	Business technology strategy	*Top management support*	*Technology compatibility*
BStra1	0.67		
BStra2	0.69		
BStra3	0.74		
BStra4	0.83		
TopM1		0.83	
TopM2		0.89	
TopM3		0.93	
TopM4		0.91	
Tech1			0.67
Tech2			0.90
Tech3			0.79
Tech4			0.80

Note: Only loadings greater than 0.50 are shown.

Table 4b Measurement model for competitive advantage

Indicators	*Exogenous constructs*				
	Differentiation	*Cost reduction*	*Innovation*	*Growth*	*Alliance*
Diff1	0.76				
Diff2	0.87				
Diff3	0.75				
Diff4	0.81				
Diff5	0.74				
Diff6	0.62				
Diff7	0.65				
Cost1		0.70			
Cost2		0.76			
Cost3		0.83			
Cost4		0.88			
Cost5		0.78			
Cost6		0.71			
Cost7		0.60			
Innov1			0.70		
Innov2			0.75		
Innov3			0.88		
Innov4			0.85		
Growth2				0.82	
Growth3				0.90	
Growth4				0.83	
Growth5				0.84	
Growth6				0.78	
Allian1					0.78
Allian2					0.86
Allian3					0.91
Allian4					0.93
Allian5					0.85

Note: Only loadings greater than 0.50 are shown.

Table 4c Fit indices for measurement model

Fit indices	*Contingency variables*	*Competitive advantage*	
		With 5 dimensions	*As 1 dimension*
GFI:	0.94	0.81	0.98
AGFI:	0.91	0.76	0.95
NFI:	0.96	0.89	0.98
IFI:	0.99	0.95	0.99
TLI:	0.99	0.94	0.99
CFI:	0.99	0.95	0.99
RMSEA	0.04	0.07	0.06

Proposition testing

Results show that one contingency factor, business technology strategy, is significantly and positively related to the level of Internet adoption; therefore, P1 is supported. Both technology compatibility and top management support have insignificant relationships with the level of Internet adoption. Hence P2 and P3 are not

Table 5 Discriminant validity testing for competitive advantage

	Chi-square	*DF*	*Increment in* χ^2
Default model	540.23	316	—
Model 1 (cov_dc=1)	544.10	317	3.87 (1df)*
Model 2 (cov_ci=1)	542.35	317	2.11 (1df)
Model 3 (cov_ig=1)	540.37	317	0.13 (1df)
Model 4 (cov_ga=1)	541.11	317	0.87 (1df)
Model 5 (cov_di=1)	542.10	317	1.87 (1df)
Model 6 (cov_cg=1)	540.74	317	0.50 (1df)
Model 7 (cov_ia=1)	544.20	317	3.97 (1df)*
Model 8 (cov_dg=1)	541.11	317	0.88 (1df)
Model 9 (cov_ca=1)	543.18	317	2.94 (1df)
Model 10 (cov_da=1)	544.17	317	3.93 (1df)*

Note: * $P < 0.05$.
Model 1 sets the correlation between differentiation and cost reduction as 1;
Model 2 sets the correlation between cost reduction and innovation as 1;
Model 3 sets the correlation between innovation and growth as 1;
Model 4 sets the correlation between growth and alliance as 1;
Model 5 sets the correlation between differentiation and innovation as 1;
Model 6 sets the correlation between cost reduction and growth as 1;
Model 7 sets the correlation between innovation and alliance as 1;
Model 8 sets the correlation between differentiation and growth as 1;
Model 9 sets the correlation between cost reduction and alliance as 1;
Model 10 sets the correlation between differentiation and alliance as 1.

Table 6 Composite reliability and variance extracted

	Construct reliability	*Variance extracted*
Business technology strategy	0.82	0.54
Top management support	0.94	0.79
Technology compatibility	0.87	0.63
Differentiation	0.90	0.56
Cost reduction	0.90	0.57
Innovation	0.87	0.64
Growth	0.92	0.69
Alliance	0.94	0.75

Note: Composite reliability=$(\Sigma\text{standardized loading})^2/(\Sigma\text{standardized loading})^2 + \Sigma\varepsilon_j$
Variance extracted measure=$\Sigma(\text{standardized loading}^2)/\Sigma(\text{standardized loading}^2) + \Sigma\varepsilon_j$.

supported. The R^2 value obtained is 0.72 for the effect of contingency variables on levels of Internet adoption. In addition, the results show that the path estimate from the level of Internet adoption to competitive advantage is positive and significant at $P<0.05$, suggesting that P4 is supported.

Model comparison

The final structural model was also compared with a series of nested models. The aim is to test whether the mediated model (i.e., with the level of Internet adoption as mediator) still holds when there is a direct relationship between the contingency variables and competitive advantage. A non-significant increment in χ^2 values would indicate that the final structural model is more parsimonious (Kline, 1998) since addition of paths showing direct relationship between contingency variables and competitive advantage does not result in significant increase in overall fit. The results are shown in Table 7.

The final model was compared to a structural null model. In the structural null model, paths relating the constructs to each other were set at zero, while factor loadings were included and the exogenous variables were correlated. The difference in χ^2 is significant, meaning that the final model is significantly improved in terms of fit. The final model was then compared to three unconstrained nested models (Table 7). The aim of the three unconstrained models is to examine the direct relationship between the contingency variables and competitive advantage. Note that an unconstrained nested model is one in which one or more of the parameters constrained (i.e., set to zero) in the final model are estimated instead. In other words, paths are added to the final model. If the difference in the χ^2's of the unconstrained model and the final model is not significant, the final model has a better fit because it is more parsimonious (Anderson & Gerbing, 1988). All the χ^2 differences of the unconstrained models were insignificant, thereby providing support for the final model.

Limitations and future research

Several limitations exist in this study. First, this study collected data from a single respondent per firm, and the data collected was self-reported. An attempt was made to mitigate this limitation by sending the survey to top management staff who tended to be more knowledgeable about the firm's business activities. Future research can collect data from more than one respondent per firm as well as use more objective measures to mitigate the problem of biases in self-reported data. Second, only a subset of contingency factors was examined in this study. Future research can examine other contingency factors that influence a firm's level of Internet adoption. Third, the measures for the level of Internet adoption were treated as continuous though they were really categorical. However, this might not be serious as there was some increase in the intensity of Internet adoption as we moved from one level to the next. This approach is similar to Teo & King's (1997) work where they treated their categorical measures of extent of integration as continuous as there was some increase in integration from one category of integration type to the next. Future research can refine the measures of levels of Internet adoption.

Fourth, the cross-sectional nature of this study also limits our ability to imply causality in the variable relationships. Future research can involve a longitudinal study to enable a more extensive investigation of Internet adoption and its impact over time. In addition, the

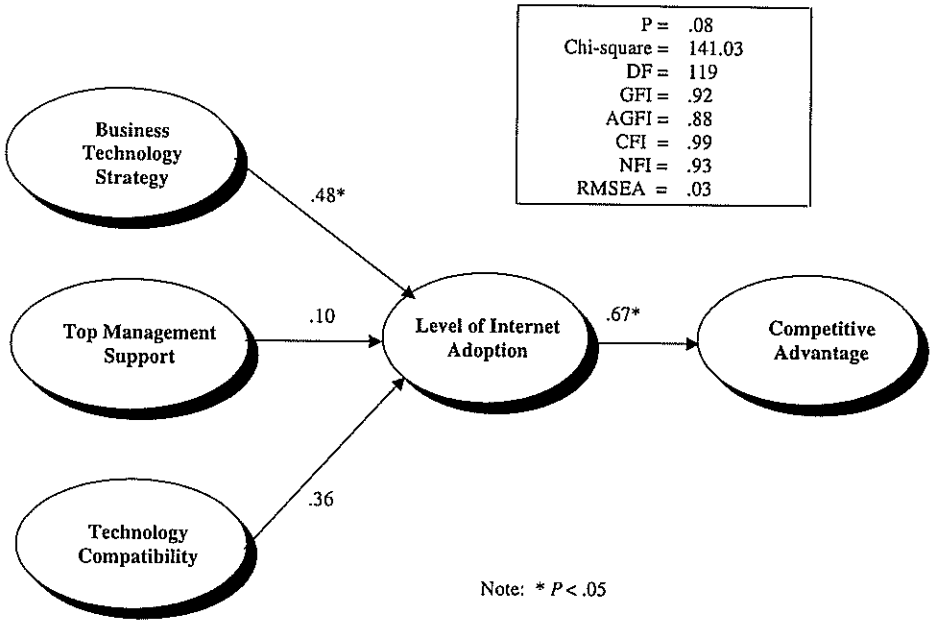

Figure 2 Standard estimation results for the structural model.

Table 7 Results of model comparisons

Models	*χ2*	*DF*	*GFI*	*NFI*	*CFI*
Structural null	297.89	131	0.84	0.86	0.92
Final model	141.03	119	0.92	0.93	0.99
Model 1	137.85	118	0.92	0.94	0.99
Model 2	139.83	118	0.91	0.94	0.99
Model 3	138.06	118	0.92	0.94	0.99

Note: Model 1 – add path from business technology strategy to competitive advantage.
Model 2 – add path from top management support to competitive advantage.
Model 3 – add path from technology compatibility to competitive advantage.

sustainability of different types of competitive advantage can also be investigated. Researchers can also examine other types of competitive advantages that are associated with Internet adoption. Fifth, the model was not tested in terms of different industry sectors. Future research can examine whether the distribution of levels of Internet adoption is identical among different industry sectors, thus identifying those Web site features that could be more important for firms in certain industries.

Sixth, as the study was conducted in Singapore, generalisability to Europe and the United States might be limited. However, since Singapore is well known for its excellent telecommunications infrastructure and is often considered as having amongst the highest Internet penetration rate in the world comparable to the United States and Europe (Business Times, 2001), this limitation is not serious. In line with this, it is important to note that good infrastructure for Internet adoption is not available everywhere in the world. Future research can examine factors influencing Internet adoption in countries with less favourable infrastructure.

Discussion

The findings of this study indicate that among the three contingency factors that are associated with the level of Internet adoption, business technology strategy is the most important as its effect on the level of Internet adoption is the strongest (significant at $P<0.05$). This is consistent with the proposition that the more proactive a firm's business strategy is, the higher its level of Internet adoption. The goal is for business strategy to be successful with the support of IS (Callon, 1996). IS can never be successful as a competitive resource, if they do not support the right business strategies.

The results also show that the impact of technology compatibility on the level of Internet adoption is not significant at $P<0.05$. The non-significant effect of technology compatibility on the level of Internet adoption could be attributed to the readily available Internet infrastructure in Singapore. As technological requirements of Internet adoption become less critical with ready Internet infrastructure, technology compatibility tends to be easily matched. In addition, the low cost of Internet connection could also act as an accelerator for a firm's Internet adoption activities.

Technical challenge of Internet adoption is mainly on managing access to an infrastructure rather than managing the Internet itself, thus resulting in relatively low

cost of Internet adoption as compared with other technology adoption processes (Vadapalli & Ramamurthy, 1998). Further, from the data, it was found that most of the respondents agree or strongly agree that Internet adoption is compatible with their technology infrastructures, organisation beliefs, and values. Hence, there are only minor differences in technology compatibility among the different levels of Internet adoption, leading to insignificant results.

The insignificant effect of top management support on the level of Internet adoption indicates that there is little difference in top management support among different levels of adoption. One possible reason is that top management is generally aware of the importance of the Internet due to much publicity about the Internet in Singapore and around the world. In his research on information systems adoption, Thong (1999) arrived at a similar result regarding the level of adoption of information systems. He suggested that although CEO and innovation characteristics are important determinants of the decision to adopt information systems, they do not affect the extent of adoption.

The impact of the level of Internet adoption on competitive advantage is significant. The R^2 obtained is 0.44 for the effect of the level of Internet adoption on competitive advantage. This result is in line with previous research (Lederer *et al.*, 1997), which reported that the most anticipated benefit from electronic commerce is competitiveness. Internet technology tends to be used and conceptualised as a technology applied with high potential impact in most sectors of a firm, so as to improve the firm's overall competitive ability (Griffiths *et al.*, 1997). This suggests that Internet technology has become an important competitive tool for firms.

Firms use the Internet for knowledge transfer and innovation rather than simply as a mechanism to lower transaction cost (Campbell and Mooney, 1997). In other words, they tend to use the Internet to facilitate product development and business process transformation, as well as facilitate increase in growth and financial performance. In addition, the adoption of electronic commerce is often motivated by the cost reduction obtained (Bakos, 1997). Moreover, the Internet offers an interactive channel for direct communication with customers, suppliers, financiers, manufacturers, retailers, and others involved in a business supply chain (Griffiths *et al.*, 1997). Internet technology also acts as a useful value-chain reshaping tool, and is taking an important role in business partnership establishment and management.

Implications

This study contributes to existing research by examining the competitive advantage obtained from Internet adoption. Several implications for practitioners can be drawn from the findings. First, this study shows that the level of Internet adoption has significant positive relationship with a firm's competitive advantage, suggesting positive support for Internet adoption. Firms hesitating to adopt Internet technologies need to examine their situations carefully as adopting the Internet is likely to be a necessity for most, if not all, businesses. Previous research (Poon and Swatman, 1999) has shown that the advantage generated by Internet adoption often takes some time to become obvious, which may discourage firms from adopting Internet technology at an earlier stage. While firms may hesitate investing in technology due to fears of rapid technological obsolescence, the same firms also risk losing their competitive edge by missing out the benefits of new technology.

Further, a firm adopting Internet technology can also enjoy innovation, growth, cost reduction, alliance, and differentiation advantages generated by the Internet. As the Internet has been increasingly used for commercial activities, more and more firms are connected to the Internet. The ready network advantages make it much easier for a firm to access trading partners and reduce the time to market via Internet-based commerce (Walsh, 1998).

Firms aiming to differentiate themselves via Web sites should switch their focus to internal productivity improvement and external partner relationship establishment. Productivity improvements through the use of a Web site to streamline business processes both internally and externally are less easily copied since they are less visible to competitors. Firms deciding to adopt higher-level Web sites should adjust their business and technology strategies accordingly. The results of this study show that a firm's technology strategy is the most important contingency factor that affects its level of Internet adoption. A successful high-level adopter may be a firm advocating proactive business and technology strategies, and identifying the potential of Internet technology at an earlier time than its competitors. Moreover, the successful integration of Internet strategy and business strategy may also be a significant factor for gaining competitive advantage. To maximise the benefits of Internet adoption, before making the decision, top management should carefully examine its business strategy and whether the Internet can be used to aid in achieving those business objectives.

Moreover, as revealed by the results, the compatibility of Internet technology and a firm's culture does not significantly influence its level of Internet adoption, which may mean that different levels of Internet adoption also need a supportive cultural environment. In order to make Internet adoption seamlessly integrated with its business activities, no matter what level of adoption a firm is at, it should always create a conducive organisational culture, which, in the long run, will facilitate the smooth upgrading to a higher level of adoption if needed, thus paving the way for long-term performance improvement.

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Appendix : Levels of Internet adoption

- Our firm has an e-mail account (Internet account), but does not have a Web site.
- Internet presence: Our firm has established its Web site, but only provides very simple firm information and brochures on it.
- Prospecting: Our firm has established its Web site, and the features provided on the Web site include extensive information of the firm and its products, feedback form, e-mail support, and simple search.
- Business integration: Our firm's Internet strategy pertains to using the Internet for business support and cost reduction. Our Web site includes advanced features such as interactive marketing and sales, online communities, and secure online ordering.
- Business transformation: Our firm's business strategy is transformed by Internet adoption. There is cross-enterprise involvement with the focus on building relationship and developing knowledge to create new business opportunities. We are electronically integrated with our key suppliers and customers for procurement and/or supply chain activities.