The Impact of Electronic Commerce on Procurement

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Internet technology has been increasingly used to enhance the global competitiveness of various business applications through the widespread electronic commerce (EC) functions. Many Internet-based systems have been designed and developed for supply chain management (SCM) in various areas such as computer, garment, and publishing industries, which mainly center on communication infrastructure, coordination between production and distribution, and procurement functions with security mechanisms. However, EC is not a panacea. On many occasions, participants (including buyers, sellers, and enablers) face various risks and overhead during the deployment of a new technology. In this article, we present the impact of EC on procurement processes in supply chains, highlighting the issues of buyers, sellers, and the transaction processes involved. The procurement processes are classified into preprocurement (sourcing), procurement (quotation, negotiation, order placement, and transaction), and postprocurement (delivery). Moreover, a four-phase migration model of procurement onto the Internet is introduced to illustrate the technical, security, and financial requirements in the deployment process of EC. The migration model not only gives a development guideline of procurement functions, but also provides an evaluation framework of e-procurement. An industrial example is used to illustrate the corresponding evolution as a result of EC deployment. The paper concludes with a summary of EC impact and future research directions.

electronic commerce, impact study, procurement, SWOT,
migration process, supply chain management

1. INTRODUCTION

The traditional market of electronic commerce (EC) was founded in the 1990s along with the rapid growth of the Internet. By 1991, EC was mainly supported by

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five basic facilities: electronic mail (e-mail), enhanced fax, electronic data interchange (EDI), transaction processing, and groupware; by 1995 EC began to mature with the emphasis of security with a variety of secure transaction processing services [1]. In the 21st century, EC has become a very hot topic in both the research and business areas, and, among the many definitions of EC, we can simply summarize EC as the buying and selling activities of information, products, and services via computer networks [2]. It has been an increasing trend for companies to migrate their businesses onto the Internet. What are the reasons for the individual companies to invest such a vast amount of time and money into this new business strategy? Is it because they want to sell on the Internet in order to increase sales, or are they just following it as a competitive business norm to establish their visibility in the electronic market? With whatever reasons they bear, companies are gradually moving their procurement functions such as sourcing, negotiating with suppliers, and coordination with research and development (R&D) onto the Internet. In other words, they are trading in an electronic fashion. Thus, the term electronic procurement (e-procurement) was recently invented to describe these activities that are taking place in the electronic market. E-procurement results in greater control and flexibility along with cost savings in the procurement operations and provides suppliers with the ability to become more proactive in the way they do business.

The degree to which different companies wanted to get involved with EC varies, therefore in this article we made the assumption that any company that migrates its procurement onto the Internet does not necessarily adopt EC completely. Our objective is to classify the impact of EC on procurement by migrating businesses onto the Internet with the justification of our ongoing Hong Kong Textile Apparel Industry Global Application (HKTAIGA) project. Such migration of a procurement process from the traditional trade to EC may reengineer the business processes, such as a direct information and material flow from one entity to another in the EC-based supply chain, for example, from manufacturer to retailers, whereas the intermediates, for example, distributors, are disintermediated from the traditional trade as shown in Figure 1.

The purpose of this study is to investigate any drawbacks as well as benefits within the procurement of EC in order to improve the current situation, and to minimize any uncertainties incurred during the migration. Moving procurement onto the Internet is not yet mature, although many researchers already paid attention to this area some years ago. When this idea becomes mature, the whole procurement process may be automated electronically, or some may be minimized, merged together, or even transformed into other processes.

This article is organized as follows: Section 2 reviews the literature of EC, procurement, e-procurement, and impact study. Section 3 describes the framework of EC impact on procurement with the four-phase of migration of business process and the classification of impact factors in the procurement of supply chain. A case study is described in Section 4, and finally the conclusion highlights the implications of the research result for general EC applications and future research directions.
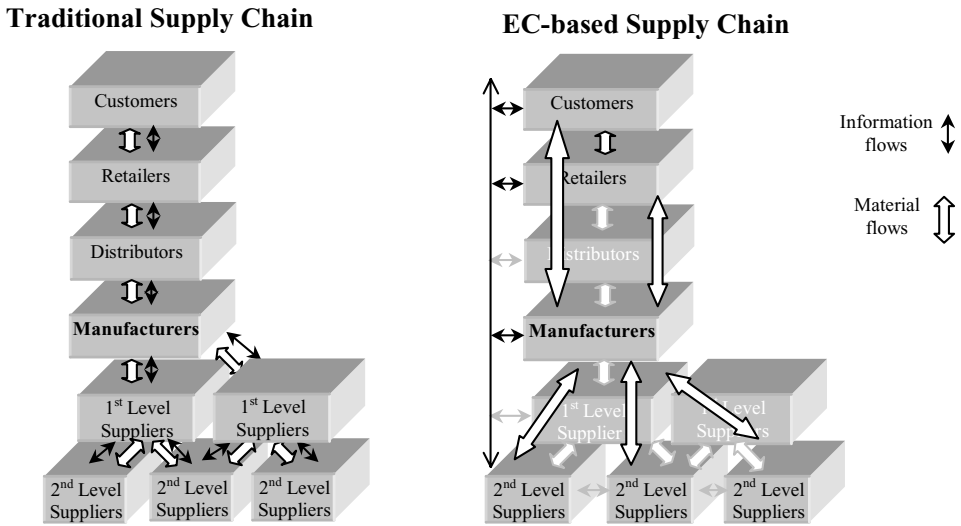
Figure 1.   The information/material flow processes of two types of B2B commerce.

2. LITERATURE REVIEW

Before companies launch EC by migrating their businesses onto the Internet, careful planning of the migration is necessary. With KLM, a Dutch cargo company, Christiaanse and Zimmerman [3] discussed the requirements needed and challenges faced when potential companies adopted use of electronic channels as well as how KLM applies electronic channels to reduce costs and improve responsiveness among several different parties. "The Swatch Group" migrated their supply chain onto the Internet, although their transaction functions can be facilitated with the automated information flow within the supply chain and efficient communications between buyers and sellers [4]. Srinivasan et al. [5] pointed out that by migrating the supply chain onto the Internet, both the key players and organizational activities would be adjusted, accompanied by both challenges and opportunities. Such challenges and opportunities include careful planning of the ways that people integrate changes, and the benefits that the Internet can bring to the business such as reduction in overall costs, respectively. Loebbecke et al. [6] illustrated how the largest academic bookseller, Co-op Bookshop, launched EC and the difficulties that they faced when competing globally. They suggested that a company should study the existing customers and markets before it deploys EC on the Internet. They also provided guidelines about the resources required for setting up and maintaining a Web site and ways to integrate the existing business into the Internet. Matsuda [7] investigated the barriers for the adoption of the Japanese electronic produce market system (EMS) by examining the current status of the produce market, and suggested a way to implement EMS under the current status around such market. Sadeh et al. [8] illustrated how the supply chain could launch EC with their proposed system, MASCOT (multi-agent supply chain coordination tool), which results in the enhancement of real-time planning and scheduling functions throughout the

whole supply chain in order to achieve a more effective and efficient way to coordinate production and transportation.

Procurement supports a delivery-relationship between buyers and sellers [9]. Being a broader scope than "purchasing," procurement involves strategic activities such as sourcing, negotiating with suppliers, and coordination with R&D [10]. Alt el al. [4] divided procurement into two phases; contracting and settlement. The contracting phase consists of sourcing and available to promise (ATP), and the settlement phase consists of transaction and delivery. Sourcing is the searching of requirement information of goods/services on the Internet, and ATP is the information flow with a supply chain, that is, the availability of goods and the shipping arrangement. Such information flow usually acts as an information exchange within the functions of quotation and negotiation. Transaction is the payment of goods/services, and delivery is the moving of goods/services from seller to buyer.

E-procurement is more than putting purchasing decisions online, its functions also include linking suppliers and buyers into the purchasing network and rethinking of business processes such as transactions [11]. With efficient information, such product information is structured by e-catalogs with which e-procurement can form a good basis in order to attract more buyers to the shopping site [12]. Shell Services International launched its e-procurement service as a cost-cutting driver in July 2000. Its e-catalogues contain a broad list of suppliers ranging from huge contract partners to small chemical producers with which Shell has prenegotiated discounts and service contracts. When a purchasing order is received, it will be automatically forwarded to the appropriate suppliers [13]. Avery [14] illustrated how e-procurement could reduce costs and cycle time by having a better relationship between buyers and sellers with a vertical supply chain. The introduction of an e-procurement system in Texas Instruments has reduced the number of transactions in which purchasing was involved and replaced the internally based catalog system, while saving a significant amount of cost [15]. The Texas-based Burlington Northern Santa Fe Railway, Fort Worth (BNSF) planned to apply e-procurement for strategic sourcing and SCM as they believed that collaboration with their suppliers could be facilitated in order to achieve full contract discount pricing [16]. The printing company, Lexmark, also took advantage of the strengths of e-procurement to enhance the relationship with both their customers and suppliers in order to deliver materials in their supply chain [17].

E-procurement could also result in negative cost impact incurred by manufacturers such as carrying excess inventory, poor transaction turnaround times, and uncertainties in supplier inventory and production schedules [18]. On the other hand, depending on the characteristics of product or service, e-procurement might not be suitable for some high-specification goods or services where tight relationships between buyers and suppliers are essentially required [11]. As a start, it is always critical for managers to ensure that their workers are motivated to use the e-procurement system when introducing it as well as the existing paper-based system [19].

In the literature, many researchers have studied the impact of EC on procurement. Croom [20] carried out a Delphi study to explore the impact of Web-based procurement systems on MRO purchasing and classified them as *operational* and *strategic* benefits. The operational benefits include the ability to reduce overall procurement costs and the improved audit of each transaction within the process. The strategic benefits refer to greater influence and control over procurement

expenditure. Gebauer et al. [21] studied the impact of the Internet on the procurement, in particular the transaction process of a purchasing department focusing on the impact of buyer–supplier relationships over the Internet. They introduced a scale of six measurements for the requirements of a purchasing function in the Internet, ranging from cost, time, satisfaction, quality, stock, and value. Rhodes and Carter [22] discussed the impact of EC on changing the product distribution in the textile apparel sector in the following aspects: globalization of production and retailing, evolution in retailing, evolving patterns of competition, pressures on small and medium-sized enterprises (SMEs), customization, and production of "batch of one." IBM and Micron achieved benefits by migrating their procurement onto the Internet [23]. IBM could reduce its total procurement cost and time by $240 million in 1999. Micron has gained a reduction in paper, cost, and inventory with its purchase order (PO) process, and moreover, its whole procurement was sped up. On the other hand, Philips [24] and Hill [25] investigated the impact of information technology (IT) on the supply chain of computer and apparel manufacturer's respectively. Philips [24] proposed that by shortening the supply chain (SSC), "favorable impact" can be achieved such as reduction in procurement time using EDI, better planning by collaborating effectively with suppliers and customers, increase in the flexibility of response to change, reduction in both time and cost by delivering goods directly from suppliers to customers, and enhanced communications with customers by electronic media. Similarly, Hill [25] recognized the impact as transport to change in the respects of information exchange in order to provide better decisions, better relationship between manufacturers and suppliers, better collaboration between retailers and manufacturers, and exchanging information in a paperless environment.

3.   THE FRAMEWORK OF THE EC IMPACT ON PROCUREMENT

EC focuses on the process improvement of interorganizational transactions unlike SCM which concerns the material and information flow coordination. An analysis of EC and SCM reveals a complementary relationship with some overlapping—EC concentrates on shaping information and contracting activities, and SCM primarily focuses on planning process and the organization of various flows [4]. From the two findings of Alt el al. [4] and Koppius [9], as described in Section 2, we have derived a classification of business processes of procurement: preprocurement, procurement, and postprocurement. Preprocurement mainly involves sourcing, procurement consists of quotation, negotiation, order placement and transaction, and delivery is the process of postprocurement.

Sourcing is the searching for required information of goods/services on the Internet with e-catalogs. A database system is required to store the product records of the e-catalogs and text- or image-based search engines are sometimes applied to facilitate the search results. A quotation is a request directed to the supplier of cost according to the product specification of buyers, and negotiation allows buyers to inquire about anything concerning with the deal. Both quotation and negotiation are supported by electronic communication infrastructures such as e-mails and message/discussion boards. Order placement allows buyers to specify the product

requirements, payment method, and delivery details in the electronic modifiable order form and such information will be stored in the database system. For transactions, there are traditional and electronic payments.

In general, there are three categories of traditional payments: cash, documents, and credit cards. Cash consists of notes and coins that are issued by some large authorized banks and is bulky to carry but retains user anonymity. Documents include personal checks and money orders written by an accepted authority such as banks and post offices. Credit cards range from Visa/Master Card to debit cards. They do not maintain user anonymity but identify both the payer and receiver, thus the transactions are traceable. An item could be paid before delivery using documents, or credit cards, or paid on delivery with cash (also called credit on delivery, COD), document, or credit cards depending on the terms and policy of sellers and agreement between buyers and sellers. With credit cards, a small charge such as an annual fee is paid to the issuing authority of cards. These are indeed convenient to use but bear many security problems such as forged signatures on stolen cards.

There are various forms of electronic payment in which some are widely accepted and used, but others are still in revolutionary stage. They include financial electronic data interchange (F-EDI), "home banking," and electronic cash (e-cash) [26]. F-EDI transmits payment transactions and associated remittance advice data from a payer's to a receiver's bank account. Like the Australian F-EDI system, it can avoid many of the costs, errors, and delays inherent in documentary-based payment mechanisms such as personal checks [27]. Home banking allows a payer to conduct a payment using an electronic payment device at home, which is very convenient. An example of home banking is CyberCash, which is a credit type of system where payment is guaranteed before an item is shipped to avoid credit card transaction fraud [28]. E-cash transforms cash into electronic form in which the payer connects to the Internet and pays for the item through the Internet such as Mondex, which can carry "value" up to five different currencies that can be transferred to a seller via a telephone line or the Internet [29].

Shipment is responsible for the logistic body in which collaboration between suppliers and the logistic body is required, for example, the exchange/flow of information is essential to ensure that the item is delivered to the customer. Such information includes time, location, and transportation mode of delivery. The information of demand can be used to forecast future demand and gain better inventory control. With EC, once the customer has submitted an order online with his or her preferred delivery date, a notification with confirmed date is returned back to the customer [30]. The delivery information is sent to the logistic body for delivery.

From what other researchers have done, we have summarized a two-dimensional table (as shown in Table 1) with a planning or brainstorming purpose, illustrating the impact of buyer and seller with respect to the business process of procurement, with the classification of impact as strengths, weaknesses, opportunities, and threats (SWOT). Strengths and weaknesses are for measuring the internal performance of the procurement prcess, for example, efficiency and effectiveness, and external opportunities and threats are identified in the electronic environment in which the procurement is operating [31]. For instance,

Table 1
The Categorization of EC Impact on the Procurement Functions

	Categories of Impact	
	Buyer	*Seller*
Business process		
Pre-		
Sourcing		
S	Reduce the use of heavy and thick paper catalog. Online e-catalogs provide *quick, flexible*, and *consolidated* sourcing policies.	E-catalog is a good way of structuring and categorizing product information, which provides *complete* information and *responsive* modification. Reduce the need for paper catalog printing, thus production cost is reduced.
W	Cannot touch or feel, or look at the real product. May interpret wrongly the descriptions of product.	Can at most provide a 3-D image of the product, also the quality of image may affect the interpretation of buyers. May not provide all the necessary information that buyer requires.
O	E-catalogs synthesize with procurement process and enhance online purchasing.	Online e-catalogs can enhance *economic* development.
T	Buyers are not usually loyal to an online shopping site as the shifting cost is low as they can always compare the price of other shopping sites.	Information and images of the products may get stolen by their competitors and reuse it in their e-catalogs.
Porcurement		
Quotation		
S	*Electronic* and *automated* forms for *quick* and *timely* inquiry.	*Electronic* and *customizable* responses directed *quickly* and *timely* to buyers.
W	Need to have basic computer skills to fill in the forms, so they may prefer to contact through telephone/fax.	Need to learn how to retrieve information from inquiry form and direct responses to buyer quickly.
O	Communication between buyer and seller is enhanced, as there is no physical meeting involved, so time is saved.	
T	Security issue: Buyers do not trust the Internet for providing personal information to the sellers, e.g., name and e-mail address.	
Negotiation		
S	*Transparent* and *timely* request directed *quickly* to seller.	*Transparent, timely*, and *customizable* responses directed *quickly* to seller.
W	Need to have basic computer skills to use the electronic communication media such as discussion board, so they may prefer to contact through telephone/fax.	Time constraint, may need to standby 24 hs for buyer's requests.
O	Communication between buyer and seller is enhanced, as there is no physical meeting involved, so time is saved.	
T	Security issue: Buyer and seller might not trust each other, as negotiation is not taken place in a face-to-face meeting.	

(continued)

Table 1 (*Continued*)

	Categories of Impact	
	Buyer	*Seller*
Order placement		
S	No need to prepare physical invoice manually, so time and paper are saved. *Automated, synthesized*, and *modifiable* placement. *Quick* and *timely* review of electronic purchase records.	No physical invoice needed to be dealt with—a paperless environment. *Automated* consolidation and *efficient* and *error-free* profiling management. Online electronic records of sales for individual buyer.
W	Cannot see or try out the physical product such as clothing before an order is placed.	Some time lag in verifying information before an order can be confirmed, e.g., availability of products and transaction information.
O	No geographical restrictions, international purchases are possible.	A more *accurate* demand forecasts, improve overall profitability.
T	Security issues: Do not trust suppliers as they may mis-use of buyers' personal information.	Security issues: Hackers may steal personal information of buyers from seller's database system.
Transaction		
S	*Electronic* transfer, ease of physical forms of payment.	*Electronic, secure*, and *real-time* collection, *fast* and *timely*.
W	Need to apply/register with electronic payments for electronic transactions.	Some forms of electronic payment may only limit to small amount of money.
O	No geographical restrictions and currency barrier, international purchases are possible.	Lower the risks of unsuccessful receipt of payment that results in the improvement of overall profitability.
T	Security issues: Do not trust suppliers as they may mis-use of buyers' personal information.	Security issues: Hackers may steal personal information of buyers from seller's database system.
Post-Delivery		
S	Once a transaction is completed, just-in-time delivery is used which saves time and decrease the uncertainty of receiving time.	Just-in-time (JIT) delivery is achieved leading to better control of logistic.
W	International delivery may still take a long time.	Time lag may occur when cooperating with overseas logistic third parities, so may not result in JIT delivery.
O	No geographical restrictions, international delivery is possible.	Information flow/communication between suppliers and logistic third parties is facilitated. *Separated* logistics and shipment and resulted in *JIT* inventory management, e.g., *make-to-stock.*
T	Security issue: Do not trust third parties as they may mis-use of their personal information.	Security issues: hackers may steal personal information of buyers from seller's database system.

during negotiation, buyers can benefit from a *quick* and *timely* enquiry in which communication between a buyer and a seller is enhanced, saving time with electronic and automated inquiry forms. However, both the buyers and sellers need to have basic computer skills to use the electronic inquiry forms, and buyers may not trust the Internet to provide personal information to the sellers. Therefore, in order to minimize such weaknesses and threats, as well as to maximize the benefits that can be gained from the migration, careful planning is essential. We have proposed Table 2, a four-phase migration model with technical, security, and financial requirements, as a plan for the migration of the procurement process onto the Internet.

3.1   The Four-Phase Migration Model of the Procurement Process onto the Internet

The first phase of migration is the digitization of data with database systems arranged in a local area network (LAN) to manage the information storage and retrieval within the company. In order to maintain such a system, security and financial issues such as login and password control and firewalls to protect the LAN, and costs for computer hardware/software and staff training should be treated as important as technical requirements. The next phase is the setup of communication infrastructures with other companies where information is transferred or exchanged within the interorganizational connections through e-mails and EDI. Costs for Internet access and building of EDI and e-mail systems, and a more sophisticated firewall to protect such systems are required. The third phase is the implementation of an EC front-end system for the procurement business processes where information processing can be facilitated with Web sites and search engines. Costs for staff training for the implementation and maintenance of the EC front-end system as well as technical and EC consultations, and a firewall to protect such systems are required. The last phase is the integration of a vertical portal where the EC front-end system is coordinated with third parties, such as transaction and logistic bodies. For security reasons, data are encrypted for information transaction as well as protecting such a complicated system with firewalls. There are also costs for maintaining such a system and transaction charges paid to the third parties, such as banks and logistic bodies. In addition, an authentication access model should be carefully implemented with each phase as different access rights are given to different functional staff or users to avoid the misuse of information.

   As we have made the assumption in the introduction that not every company would adopt EC fully while migrating their procurement functions onto the Internet, companies may not necessarily need to implement all four phases or start from the first phase, depending on the existing technical requirements of the companies. One should be aware that the degree of expertise, intangible costs, complexity of information, security, and uncertainties increase from phase one to phase four, therefore careful planning is necessary with the migration of a procurement process on to the Internet in order to achieve a positive impact as described in Table 3. Weaknesses and threats are neglected from this table as we

Table 2
The Four-Phase Migration Model of Procurement Process onto the Internet

Phase	Features	Technical	Requirements Security	Financial
1st phase Data digitization	*Information storage and retrieval* -Convert paper-based file information storage into digitized and automated information system. -Information content focused with LAN within the company.	• Basic computer hardware and software, e.g., word processing—automation • Database system—information storage and retrieval • LAN within the company • Training given to staffs for basic computer skills	• Basic authentication rights—login and password control • Firewalls to protect LAN	• Cost for computer hardware and software • Training course fees
2nd phase Communication infrastructures	*Information transfer/exchange* Interorganizational connections/inter-communications: connect and enhance communications with other companies through e-mails and EDI	• Software and hardware for Internet access and EDI • Network for e-mail system • Further training given to staffs if necessary	• A more sophisticated firewall to protect EDI and e-mail system as well as the LAN	• Start up and monthly subscription costs for • Internet access • Costs for building the • EDI and e-mail system
3rd phase EC front-end system	*Information processing* Implement the procurement business processes such as building Websites and search engines	• Software and hardware for implementation of EC front-end system • Technical staffs with EC knowledge for implementation of EC front-end system	• Membership schemes for readers—login and password control • Firewall to protect EC front-end system	• Costs for hiring both technical and EC consultants
4th phase Integration of vertical portal	*Information processing (with third party co-ordinations)* Form portal: integrate chain coordinations with third party for business functions, such as credit card company for transactions and logistic department for delivery	• Infrastructure for the coordinations with third party • Technical staffs with EC knowledge for implementation of further • EC front-end applications	• Data encryption for transaction information as well as firewall • A more complicated authentication model, i.e., only staffs who deal with transactions as well as the • Third party has the authentication to access credit cards information	• Setup and maintenance costs for such infrastructure • Transaction charge paid to third party

assume that they will be minimized with the four-phase migration-planning model.

3.2   The Categorization of Impact of EC in the Procurement Process

The impact of EC in the procurement process is classified into buyer and seller, which is further divided into individual and interorganizational categories as shown in Table 3. Individual and interorganization classifications represent the internal efficiency and external impact, respectively. With *sourcing*, buyers can search for quick and complete information of materials from suppliers' online electronic catalogs while purchasing is enhanced. During *quotation* and *negotiation*, sending inquiries with the electronic and automated inquiry forms to suppliers can save time, and in return suppliers would direct them with quick and customizable responses, while communication between buyers and sellers is facilitated. With automated, synthesized, and modifiable *order placement*, cost and time are saved while purchase records can be viewed in a quick and timely fashion. Suppliers can benefit from efficient and error-free profiling management and more accurate demand forecasts in order to improve overall profitability. Again, communications between buyers and sellers can be enhanced while time is saved. Electronic *transactions* can be done without the need of physical forms of payment that are not restricted to geographical and currency barriers. Suppliers can benefit from secure real-time collection of payment while the risk of unsuccessful receipt of payment is lowered resulting in a profitability improvement. With *delivery*, uncertainty of receiving time is reduced by separated logistics and shipment, while information flow or communication between suppliers and logistic third parties is facilitated.

4.   CASE STUDY: ELECTRONIC COMMERCE IN A TEXTILE/GARMENT INDUSTRY

Since the case study, HKTAIGA is a textile-based project in Hong Kong, therefore, in this section we will describe the textile industry in Hong Kong and give details of TAIGA as well as the impact summary of EC on the procurement of the textile industry.

4.1   The Textile and Apparel Industry and Its Supply Chain in Hong Kong

The textile and apparel industry stands out as one of the most globalized industries in the world today. This differs from buyer-driven supply chains led by multinational companies. The apparel industry is a supply-driven commodity chain led by a combination of retailers, contractors, subcontractors, merchandisers, buyers, and suppliers; each plays an important role in a network of supply chains that span from fibers to yarn, to fabrics, to accessories, to garments, to

Table 3
The Categorization of Impact of EC in the Procurement Function

	Categories of Impact	
	Buyer	*Seller*
Business process		
Pre-		
Sourcing		
ID	Online electronic catalogs for *quick, flexible* and *consolidated* sourcing policies Reduce the use of paper-based catalogs	Online electronic catalogs with *complete* information and responsive modification
IO	E-catalogs synthesize with procurement processes, purchasing is enhanced	Online e-catalogs can enhance *economic* development
Procurement		
Quotation		
ID	*Electronic* and *automated* forms for *quick* and *timely* inquiry	*Electronic* and *customizable* responses directed *quickly and timely* to buyers
IO	Communication between buyer and seller is enhanced, as there is no physical meeting involved, so time is saved	
Negotiation		
ID	*Transparent* and *timely* request directed *quickly* to seller	*Transparent, timely*, and *customizable* responses directed *quickly* to seller
IO	Communication between buyer and seller is enhanced, as there is no physical meeting involved, so time is saved	
Order		
placement		
ID	No need to prepare physical invoice manually, so time and paper are saved	No physical invoice needed to be dealt with—a paperless environment
	Automated, synthesized, and modifiable placement	*Automated* consolidation and *efficient* and *error-free* profiling management
	Quick and *timely* review of electronic purchase records	Online electronic records of sales for individual buyer
IO	No geographical restrictions, international purchases are possible	A more *accurate* demand forecasts, improving overall profitability
Transaction		
ID	*Electronic* transfer, ease of physical forms of payment	*Electronic, secure*, and *real-time* collection, *fast* and *timely*
IO	No geographical restrictions and currency barrier, international purchases are possible	Lower the risks of unsuccessful receipt of payment that results in the improvement of overall profitability
Post-		
Delivery		
ID	Once transaction is completed, just-in-time delivery is used which saves time and decrease the uncertainty of receiving time	Just-in-time delivery is achieved leading to better control of logistic

Table 3 (*Continued*)

| | Categories of Impact | |
	Buyer	Seller
IO	No geographical restrictions, international delivery is possible	Information flow/communication between suppliers land logistic third parties is facilitated *Separated* logistics and shipment and resulted in just-in-time inventory management, e.g., *make-to-stock*

Note.   ID = individual, IO = Interorganization.

trading, and to marketing. Geographically, they span multicontinents and cut across regional and national boundaries.

The supply chain of the textile industry involves product design and development, material sourcing and product manufacturing, product distribution, and retailing of products. The product design stage should involve customers in order to define and fulfill their requirements. The product and raw material sources development process has 45 days of lead time with 60% of the prototypes. From manufacturing to delivery to distributors, the lead time is 30 days with a total of 8 inventory turns annually. The delivery lead time from the distributors to the retailers is 24 h with 90% of order fulfillment. Therefore, the whole supply chain process may take at least 76 days [32]. Figure 2 illustrates the parties and business processes involved in a textile supply chain.

The 1995 report of the Hong Kong Government Industry Department [32] states that the raw material suppliers faced the problems of limited variety and availability of materials; and with the shrinking profit margin and advent of modern computing communication networks, it is imperative that Hong Kong's textile and apparel industry should seriously consider establishing a cost-effective IT infrastructure to maintain their competitive edge.

4.2   HKTAIGA Trading Online

HKTAIGA is an ongoing project funded by the Hong Kong Government since 1994. The government saw the need to provide an efficient communication channel for the SMEs, including suppliers and their buyers in the textile and apparel industry in Hong Kong, as most of them could not afford to invest in Internet-based technology and could not take the risk of experiencing errors. There are four phases in the development of HKTAIGA as summarized in Table 4: (a) catalog browser system in client/server architecture, (b) Web-based communication infrastructure, (c) electronic front-end system for SMEs, and (d) horizontal and vertical portals. The first stage started with the name Hong Kong Clothing Information Network System (HKCAINS), in which the information system was only used within the company. As it proceeded into the second phase, it changed its name to HKTAIGA, while extending the communication

Academia	Universities/Technical Institutes/Training Institutes (local/overseas)
Accessory	Basic and fashion garment trims
Apparel Buyers	Retailers/Buying Houses/Agents (local/overseas)
Associations	Textile/Garment/General/Industry/Trade/Special (local/overseas)
Chemicals	Dye stuff/Chemicals/Printing Inks suppliers
Financial Institutions	Banks/Insurance/Factors etc.
Garment Exporters	Traders/Manufacturers
Garment Manufacturers	HK/Regional/International/Global
Government	Trade & Industry/Education/Customs
Logistic Providers	Sea & Air forwarders etc.
Machinery	Textile/Garments/Technology Enablers
Textile	Spinners/Weavers/Knitters/Dyers/Printers/Yarn/Greige suppliers
Textile Equipment	Machinery Suppliers/Technology suppliers

(a) Organization in a textile supply chain

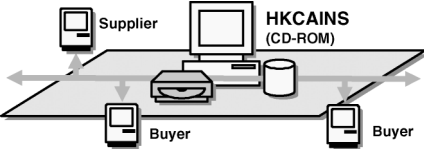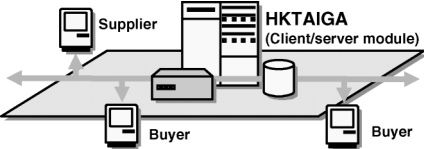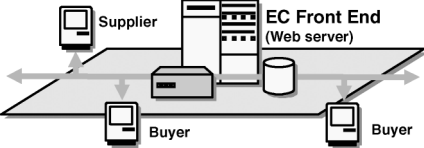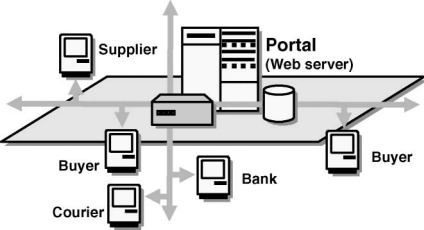| 1	Product idea submitted and discussed	20	Pick up shipment
2	Research materials supplier initiated	21	Return loaded containers
3	Exchange product idea with potential manufacturers	22	Submit bay plan
4	Collect material samples	23	Apply Export License
5	Submit product prototype	24	Issue Export License
6	Apply export quota	25	Submit relevant documents
7	Visit to review material and prototype	26	Issue Bill of Lading
8	Search revised prototype	27	Submit Export Manifest
9	Submit quota	28	Submit Import Manifest
10	Final approval prototype and material	29	Informing shipment status
11	Order placement material	30	Shipment arrival notice
12	Order placement manufacturing	31	Submitting Import License
13	Opening L/C for material and manufacturing	32	Instructing freight forwarders for shipment pick-up and delivery
14	Submit L/C		
15	Fabric delivery	33	Customs clearance and shipment pick-up
16	Basic shipment instructions	34	Shipment delivery
17	Shipment booking and shipment instructions	35	DC arrival notice
18	Instruct release of empty containers to shipper	36	Store delivery
19	Pick up empty containers	37	Store arrival notice

(b) Typical business processes in a textile supply chain

Figure 2.   Typical parties and business processes in a textile supply chain.

channel to a global level and later migrating it onto the Internet in the third phase. The last phase extended the system into a portal in 2001. The last phase has been extending the system into a portal in 2001 to cover the entire apparel and textile business community including the whole merchandising process to provide supports on operational management and transactional activities, as well as linkages to supporting industries, like logistics providers, bankers etc. It is built on a secured e-commerce platform covering four major areas: Infrastructural Portal, Encyclopedic Portal, Business Operation Portal, and Sourcing & Transactional Portal.

The architecture of HKTAIGA is a combination of databases, client/server modules, and Web-based systems for sourcing in textile and garment applications as shown in Figure 3 [33]. The EC front-end system supported by Web browsers (such as Netscape) is shown in Figure 4, and the back-end system acts as a combination of a database server and a Web server (such as the Internet information server). The client application provides various procurement functions and offers tools to catalog products, for example, templates are provided to companies for the generation of their own Web site and online catalogs. The search engine supports both image and text search functions that consist of a

Table 4
The Four-Phase Migration Process onto the Internet of HKTAIGA

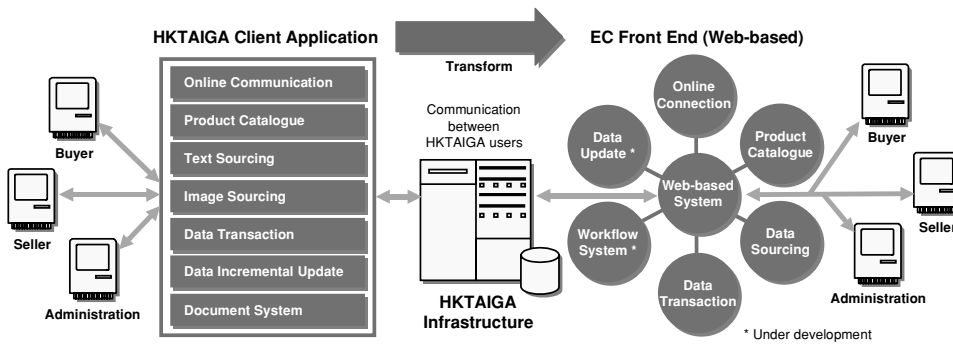| Phase	Physical Structure	Features	Remarks

1st phase
  Build up suppliers'
    database
		Information storage and retrieval
		Provide a CD-ROM media to
		  catalog products
			No. pilot companies involved: 20
			Period of phase: July 1995–Oct 1997
			Project size (investment, manpower):
			  $1.01 million, 10

2nd phase
  Build up communication
    infrastructure
		Information transfer/exchange
		Provide an effective communication
		  channel in order to facilitate
		  commaunications between
		  buyers and sellers
			No. buyers/suppliers involved: 10/40
			Period of phase: Nov 1997–June 2000
			Project size (investment, manpower):
			  $4,996 million, 15

3rd phase
  Build up electronic
  commerce front end
		Information processing in EC
		Provide templates to companies in
		  order for them to generate their
		  company Web site and electronic
		  catalogs, and implement hybrid
		  search engines (text and image)
		  into their electronic catalogs.
			No. buyers/suppliers/others
			  involved: 24/724/449
			Period of phase: July 1998–Dec 2000
			Project size (investment, manpower):
			  $3.26 million, 15
			<u>N.B.</u> Others are the academic,
			  dyeing-printing, garment
			  manufacturers and trading.

4th phase
  Extend the system to
  form a horizontal
  and vertical portal
		Information processing in EC with
		  third party co-ordinations
		Recruit third parties such as banks
		  and courier companies for
		  transaction and logistic activities
		  respectively as well as to provide
		  sourcing functions
			No. suppliers involved: Estimated
			  as twice of phase 3
			Third parties such as banks and
			  Internet Service Provider (ISP)
			  are also involved.
			Period of phase: projected
			Project size (investment, manpower):
			  $15 million, 30 (projected)

Figure 3.   The architecture of HKTAIGA for client/server and Web-based application.

Figure 4.   The EC front-end Web page of HKTAIGA.

combination of an image search engine, categorized product trees, and an intranet keyword search mechanism (such as Ultraseek). The tracking functions record usage patterns to identify the Web pages that are of major concern to individuals or groups. Apart from responding to users' requests, news, advertisements, and other information are forwarded directly to them according to their preferences by using *push* technology [34]. Another module underway integrates the infrastructure; EC front-end and workflow systems establish vertical and horizontals portals as mentioned above [35]. Established for secured e-commerce platforms, www.ApparelCircle.com supports major portals in conjunction with the service providers, such as Cable & Wireless Hongkong Telecom IMS Limited and UNI-Tech Technologies Limited. The EC front-end system was handed over to the non-profit organizations, Hong Kong Productivity Council (HKPC) and Quick Response Center (QRC), for support of operations, service, and management.

4.3 Summary of EC Impact

In an EC-based supply chain, the product development time may be reduced from six weeks to two. The buyer inventory in replenishment can be reduced from 17 weeks to an average 6 to 8 weeks and the total cycle time for orders can be cut from 40 to 20 weeks (see Figure 5). The supply channels are transformed from a hierarchical structure to a star-based direct link as shown in Figure 6. The manufacturers are organized either by product provided (such as button and lace) or general company characteristics. The former provided a full coordination on the shortened supply chain and the latter resulted in better procurement consolidation.

With HKTAIGA as the justification of our impact study in Section 3, we can see that from Table 4, HKTAIGA started its implementation from the first to the third phase, whereas the fourth phase is still in the planning stage. The first phase required ten workers to build a CD-ROM media to catalog its product information, which facilitates the storage and retrieval of such information. It involved 20 pilot companies with an investment of \$1.01 million for nearly 2 years. The problem that occurred in this phase was the delay in the distribution of CDs to the buyers, which affected the communication between buyers and sellers. Therefore in the second phase, as the number of buyers and suppliers increased, HKTAIGA decided to build up a communication infrastructure to solve this problem and to enhance the information transfer/exchange between buyers and sellers. This system required buyers to become connected to the suppliers' server in order to communicate with them, thus in the third phase HKTAIGA targeted migration of its communication channel onto the EC front-end while expanding it globally. In this phase suppliers can catalog their product information in a Web site allowing buyers to view their information without any geographical restriction. Not only for the use of information exchange, the fourth phase is planned to extend the EC front-end infrastructure into a portal with transaction and logistic functions.

Product Development	Product Manufacturing	Custom & Shipping	Product Distribution	Shelf & Backroom	
6	12	5	7	10	40 weeks

(a) Traditional textile supply chain

2	6	4	2	6	20 weeks

(a) EC-based textile supply chain

Figure 5.   Cycle time of textile supply chain.

Figure 6. (a) Traditional, (b) EC-based, and (c) portal systems in textile supply chain.
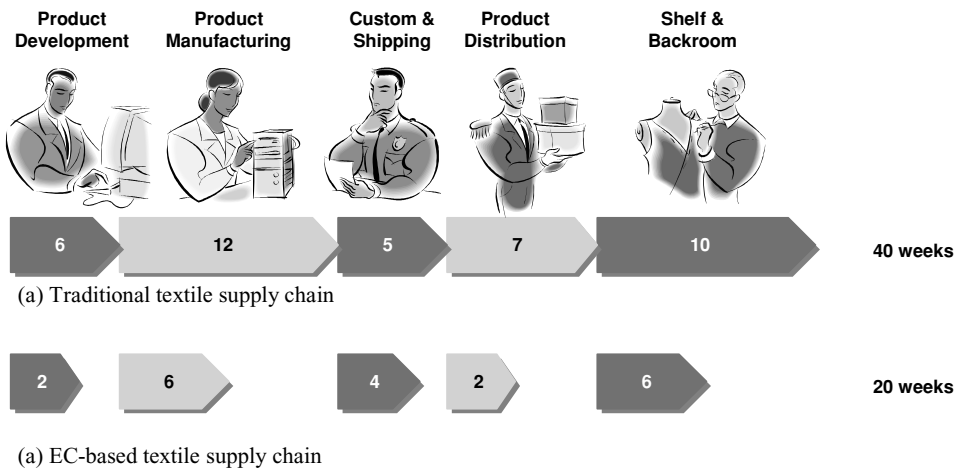
With the EC front-end system, HKTAIGA mainly provides the communication infrastructure that serves partial system requirement for sellers. Since it first launched on the Internet, it has accumulated a total of 1,206 members, in which 60.5% and 39.5% are sellers (write users) and buyers (read users), respectively. Both the read and write users require Internet accesses from Internet service providers (ISPs) to access and manage their database and EC functions via HKTAIGA and the EC front-end system. The Quick Response Center (QRC), a semigovernment organization, has been organizing workshops, seminars, and conferences to provide training on installation and management. With the electronic catalogs, buyers can use hybrid searching mechanisms (text/image, product/company, and Intranet/extranet) to efficiently search for information online. In addition, the sellers use the push technology to inform the target buyers of the new product information. The discussion group and online talk functions are responsible for the availability of the quotation/negotiation communication channel.

The EC impact that HKTAIGA brought to both buyers and sellers is shown in Table 5. In the traditional trade, suppliers have to produce paper catalogs for buyers to *source* the material information, but with HKTAIGA buyers can browse through suppliers' online catalogs. Similarly, with quotation and negotiation, instead of face-to-face contacts in the traditional trade, buyers and sellers can utilize the EC media offered by HKTIAGA to exchange information in a *timely* and *transparent* fashion. In addition to the traditional payment by cash, check, or credit card, some of HKTAIGA members also provide access to company-to-company proprietary or third-party online transaction functions. The delivery service is enhanced by Web-based tracking and tracing functions by third-party logistics companies in alliance.

Table 6 illustrates the amount of cost reduction gained by five material suppliers and two buyers after adopting HKTAIGA. An example of the material supplier is Loko Lace, an accessories supplier that mainly wants to use HKTAIGA for marketing purposes. Loko Lace believes that putting their contact details and description of their company on www.HKTAIGA.com is another way to advertise their company to potential buyers in the textile industry. The cost reduction within each business operation is estimated in percentage. The majority material suppliers had 0–10% of cost reduction in product catalog production, physical visit and presentation to clients, enquiries followup, and storage space. An example of the buyer is Bossini Enterprises Ltd., a well-known retail clothes chain store in Hong Kong that mainly applies the product search facility in www.HKTAIGA.com. It was seen that 60% of the buyers have 11–50% of cost reduction in material sourcing and storage space and 80% of them have 0–10% cost reduction in physical visits to suppliers.

4.4   Guidelines from HKTAIGA

With HKTAIGA as a case study to illustrate the impact of migrating procurement business process onto the Internet, we have learned that in order to maximize the benefits and minimize risk or loss, careful planning is essential before

Table 5
The EC Impact on HKTAIGA

	Categories of Impact			
	Buyer		*Seller*	
	Traditional	*EC*	*Traditional*	*EC*
Business process				
Pre-sourcing	Sample books and catalogs search or showroom visit	Online electronic catalogs or product search, product comparison in hktaiga.com	Production of printed catalogs by out-contracting to production house/printer, and hand-made sample cards/books/hangers	Creation and update of online electronic catalogs with hktaiga.com cataloging
Procurement				
Quotation	Physical meetings with buyers and/or post/ telephone/fax contacts	*Electronic* and *automated* inquiry in *sample request* forms	Manual preparation of quotation by computers, and/or handwriting and typing	*Electronic*, *quick*, and *customizable* quotations directly to buyers by online communication
Negotiation	Physical meeting with sellers and/or telephone/fax contacts	*Transparent* and *timely* request *directly* to sellers via hktaiga.com with Message, Discussion Board, and Company Homepage contact with online communication	Physical meeting with buyers and/or telephone/fax contacts	*Transparent*, *timely*, and *customizable* response directly to buyers with Message, Discussion Board with online communication
Order placement	Manual preparation of purchasing orders (POs), i.e., handwritten & typed POs; delivery of PO copies via fax and PO original copies by mail/courier to seller	*Automated*, *synthesized*, and *modifiable* placement through shopping cart via hktaiga.com	Manual preparation of sales contract (hand-typed/written) upon receiving of; delivery of sales contract copies via fax and sales contract original copies by mail/courier to buyer	*Automated* consolidation and *efficient and error-free* POs via hktaiga.com
Transaction	By cash/check/credit card	By cash/check/credit card; company-to-company electronic payment	Payment made via cash/check/credit card	Payment made via cash/check/ credit card *or proprietary/ third-party online payment* mechanism.
Post-delivery	By mail/courier	By mail/courier with *online tracking/tracing functions*	Choices of delivery methods are given to buyers	Choices of delivery methods are given to buyers or *third-party logistics in alliance*

Table 6
The Cost Reduction of Companies by Adopting HKTAIGA

| | *Material Suppliers* | | | |
| | Reduction of cost by percentage | | | |
Business Operation	0–10%	11–50%	Over 50%	N/A
Product catalog production	50%	16.6%	16.6%	16.6%
Physical visit & presentation to clients	50%	16.6%	16.6%	16.6%
Order & request follow up	50%	16.6%	—	33.4%
Storage space	50%	16.6%	16.6%	16.6%
	Buyers			
Material sourcing	40%	60%	—	—
Physical visit to suppliers	80%	20%	—	—
Storage space	40%	60%	—	—

the migration. HKTAIGA has followed the four-phase migration model starting with the digitization of information to moving onto an EC front-end. Nevertheless, each phase has to be accompanied by the right technical, security, and financial requirements in order for each phase to occur and proceed onto the next phase successfully. Some problems are expected to arise in each phase and will be treated as input for the next phase. For instance, in the first phase there was a communication delay between buyers and suppliers with the CD-ROM media, therefore in the second phase, they decided to build a communication infrastructure to solve the problem. The impact brought by HKTAIGA included handling processes electronically in a paperless environment which saves time and costs, enhancing communication and information exchange between each entity (e.g., buyers and suppliers), and operating in a more efficient and error-free way within the procurement process.

5. CONCLUSIONS

IT has been adopted to enhance the global competitiveness of various industries through the widespread application of cost-effective EC. Many Internet-based systems have been designed and developed for various industrial applications and they mainly center on information communication infrastructure, coordination in production and distribution, and purchasing functions with security mechanisms. In this article, we propose a model of impact study of EC on procurement in SCM accompanied by a four-phase migration model and impact categorization table. An example of EC procurement within the textile industry is also presented to demonstrate impact on buyers, sellers, and procurement processes. Nevertheless the procurement migration process is determined by the size of company and nature of the industry, and the requirements involved may vary as well. Although this study cannot totally reflect the EC deployment feasibility, this article provides guidelines to conduct an impact analysis in the procurement process. The following gives a list of future directions:

- Extend this study to include all the processes (such as transactions and shipment) in general supply chains to gain the insight for overall performance analysis.
- Investigate the characteristics (such as frequency and types) of information flow in supply chains to develop an economy model of information distribution and coordination.
- Compare the traditional and EC-based procurement processes on the issues of information and service quality.

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