Electronic Commerce Technologies and Applications-A Decade Review from 1995 to 2005

電子商務科技與應用－1995至2005年十年回顧

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Electronic Commerce Technologies and Applications - A Decade Review from 1995 to 2005

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Abstract

This paper surveys electronic commerce (EC) development using a literature review and classification of articles from 1995 to 2005 with keyword index and article title in order to explore how EC technologies and applications have developed in this period. Based on the scope of 160 articles from 75 academic journals of electronic commerce technologies and applications (retrieved from five online databases), this paper surveys and classifies EC technologies using the six categories as: EC framework/ survey, intelligent agent, information and communication technologies, electronic data interchange, statistics methods, and modeling methodology, together with their applications for different research and application domains. Some discussion is presented, indicating future development for electronic commerce technologies and applications as the followings: (1) EC technologies tend to develop towards expert orientation and EC applications development is a problem-oriented domain. (2) Integration of qualitative and quantitative methods, and integration of EC technologies studies may broaden our horizon on this subject. (3) The ability to continually change and obtain new understanding is the power of EC technologies and will be the application of future works.

Key Words: Electronic commerce, Electronic commerce technologies, Electronic commerce applications, Literature survey.

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摘要

本篇文章使用關鍵字的文章查詢與分類方法，以 1995 至 2005 年十年的期間，來回顧電子商務這段時間在科技與運用方面的發展。內容以 75 個與電子商務相關的期

刊 160 篇文章為基礎（來源為線上資料庫），以電子商務的架構；智慧型代理人；資訊與通訊科技；電子資料交換；統計方法；以及模式化方法等六個分類範疇與相關的應用，作為回顧與分類的基礎，來探討電子商務科技與應用在這十年的發展。本文提出回顧與分類的討論與建議如下：(1)電子商務的科技有朝向專家導向發展的趨勢，而電子商務的科技則有朝問題領域發展的趨勢。(2)結合質化與量化的研究方法，對於電子商務具有跨大研究領域與視野的功用。(3)持續的導入並結合不同的科技，對於不斷變動的電子商務環境而言，具有正面的意義。

關鍵詞：電子商務、電子商務科技、電子商務應用、文獻回顧

1. Introduction

Electronic commerce (EC) is an emerging concept that describes the process of buying, selling, or exchanging products, services, and information via computer networks, including the Internet (Kalakota and Whinston, 1997). The use of electronic data transmission and Internet commerce can implement or enhance business processes, which provide buyers with a wider range of choices than traditional commerce because buyers can consider many different products and services from a wider variety of sellers (Schneider, 2003). On the other hand, electronic commerce is the framework for inter- and intra-organizational collaboration, which provides a gathering place for community members, to learn, transact, and collaborate (Turban et al, 2002). Therefore, how to implement electronic commerce has become an important issue in the past few decades, and the EC community has developed a wide range of technologies and applications for both academic research and practical applications.

As a part of EC research, this paper focuses on surveying electronic commerce development through a literature review and classification of articles from 1995 to 2005 in order to explore the EC technologies and applications from that period. The reason for choosing this period is that the Internet was opened to general users in 1994 and this new era of information and communication technology plays important roles not only in electronic commerce but also in on-line database development. This literature survey work started on March, 2004 and the literature survey is based on a search for the keyword index and article title "electronic commerce" on the Elsevier SDOS, Emerald Library (MCB), EBSCO (electronic journal service), Ingenta, and Wiley InterScience online database, from 1995 to 2004 (May) online

database, from which 1,490 articles were accumulated on December 31, 2005. After topic filtering, there were 680 articles related to the keyword "electronic commerce applications" and 160 of them were connected to the keyword of "electronic commerce technologies and applications". Based on the scope of 155 articles from 75 journals on electronic commerce technologies and applications, this paper surveys and classifies EC technologies using six categories: EC framework/ survey, intelligent agent, information and communication technologies, electronic data interchange, statistics methods, and modeling methodology, together with their applications for different research and problem domains.

The rest of the paper is organized as follows. Sections 2 to 7, present the survey results of EC technologies and applications based on the above categories respectively. Section 8 presents some discussion, extending to suggestions for future development of knowledge technologies and applications. Finally, Section 9 contains a brief conclusion.

2. Research design -Why keywords are used as data source for literature analysis?

Basically, there are three aspects for research, including research problem, theory, and methods/tools. Sometimes, the research objective and motivation is described as the research problem, which contains the nature of a specific problem domain. In addition, a problem domain might be a person, a group of people, an organization, an object, or an event, which can be estimated and evaluated. This means that a problem domain has specific domain knowledge with certain complexity and that this knowledge may exist either tacitly or explicitly under different situations and conditions. This form of domain knowledge could be a threshold to researchers who have limited understanding of this problem domain. This means that researchers should understand or learn something on research problem domain knowledge before starting their research. On the other hand, a research problem may describe a process or procedure of research experiment, case study, system development, or modeling on a specific research field. These processes or procedures focus on a limited scope that social science or natural science can manipulate and observe the research problem by collecting and analyzing data from the problem domain. In this regard, a study must define the research process or procedure in order to illustrate the research scope from real world situations or conditions. A research problem is a logical description to show why a study is critical or what is its contribution and originality in a specific problem domain. Without good enough domain knowledge, the research problem can be the most difficulty part of work at the initial

stage of research. Because a researcher must spend great amount of time to understand the domain knowledge deeply and then can provide a basis to understand and define the research scope.

On the other hand, once the scope of a research problem domain has been determined, researcher can describe research problem by citing specific theory. A theory is generalized phenomena, which presents results or findings from specific research experiment or long term observation with systematic approach. However, a phenomenon can be extended to different theories on different research problem domain. For example, in physics, the principle of inertia states that objects continue in a state of rest or of uniform motion unless acted upon by forces. In knowledge management, the knowledge inertia describes that people may stem from the use of routine problem solving procedures, stagnant knowledge sources, and following past experience or knowledge (Liao, 2002). Due to diversity of research problem domains, researchers must to cite theory or read literature in relation to the research problem in order to fit how people refer to a phenomenon in a specific problem domain. This might be a problem for a neophyte or in a new research area for look for the appropriate literature in order to reference necessary articles to describe a research problem from the huge mass of journals, magazines, and other research materials. In this regard, a study might be different from others with different theories, even though have similar research phenomenon. Therefore, once a research problem and the chosen theory are combined, the axis of a study has been established. After that, when domain knowledge and theories have been determined to describe a specific problem, certain research methods or tools, such as software, hardware, measurement tools, can be implemented to solve the research problem. At this stage, specific data format collecting from the research problem domain is confined to research methods or tools. Therefore, a researcher must realize the fitness between the data format of a research problem and its methods/ tools, and then consider the possibility of explaining the research problem from the experiment results.

In Figure 1, this paper presents the research design. We consider that a research article contains three aspects including the research problem, theory, and methods/ tools. Furthermore, the keywords of a research article usually include these three aspects, which present what problem domain knowledge this research has, how it describes the research problem, and where results come from specific process or procedure with certain methods/tools (Liao and Wen, 2006). Therefore, this might be an approach to reference literature using a keyword index search from an online digital database to help a researcher establish the research framework from the three aspects as soon as possible. Thus, this paper uses article

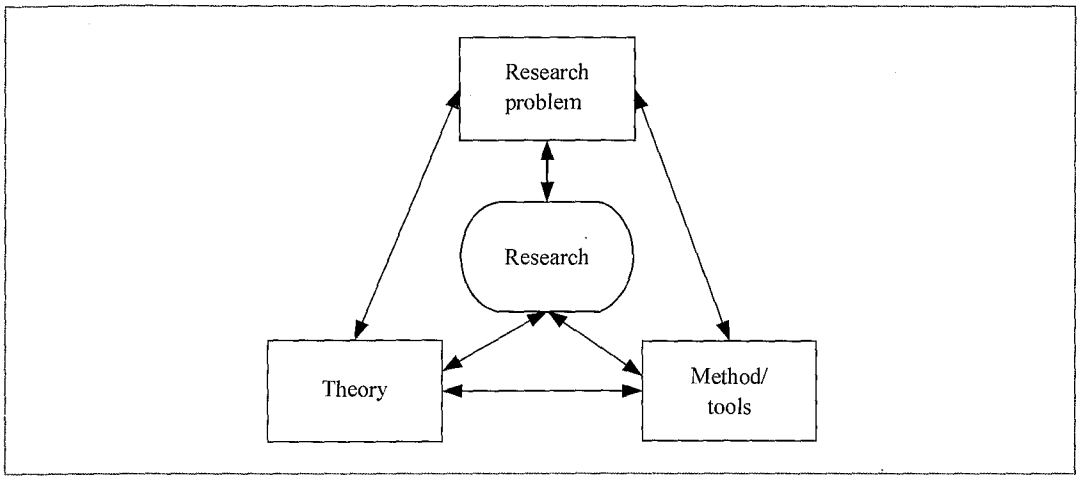

Figure 1 Aspects of a research

keywords as a data source in order to investigate EC technologies and applications development over the period from 1995 to 2005.

3. Electronic commerce framework and their applications

A framework can be considered as a methodology for understanding and exploring the relationship among the EC components and for conducting research in the EC field (Zwass, 1996). Many researchers were developed a set of management definitions, concepts, activities, stages, circulations, and procedures, all directed towards dealing with objects in order to describe the framework of electronic commerce as the EC methodology. Different EC working definitions, paradigms, frameworks, survey, concepts, objects, propositions, perspectives, impacts, classification, and empirical study have been described for investigating the question of: What is electronic commerce? What are its components? And what are its functions for supporting individual and organizations in implementing electronic commerce.

For example, Shaw reviews the scope, current applications, and the potential of electronic commerce and develops a framework for identifying the opportunities and research issues on EC (Shaw, 1999). Kardaras and Papathanassiou report the results of a survey of 120 companies in Greece in order to evaluate the potential of customer-oriented Internet applications (Kardaras and Papathanassiou, 2000). Miles and Howes propose a framework, which illustrates how this framework may be used to generate hypothetical technologies (Miles et al., 2000). Jeffcoate et al. present 15 recommendations for ways in which SMEs

can ensure that they can support high-volume E-commerce activity by adopting best practices for process improvement (Jeffcoate et al., 2000). Berg and Lieshout discuss trust in e-commerce and measures to increase it in web assurance service (Berg and Lieshout, 2001). Caskey et al., investigate what is needed to support SMEs to participate fully in supply chain integration and EC (Caskey et al., 2001). Hoek suggests practical approaches to avoid the common trap of a neglected and poorly designed and managed supply chain (Hoek, 2001). Cronin and Davenport suggest a social shaping of technology framework that may help explain how the pornography industry to achieve legitimacy (Cronin and Davenport, 2001). Kowtha and Choon examine the relationship between the strategic variables of competitive intensity, and existing competencies of the firm. This study was conducted with 135 firms from the travel, financial and information technology sectors in Singapore (Kowtha and Choon, 2001). Kardaras and Karakostas report on a survey of 33 IS and business managers and discusses the management practices, applications, problems and technological situation with respect to EC development in Mauritius (Kardaras and Karakostas, 2001). Ngai and Wat present a literature review and classification scheme for EC. Their scheme consists four main categories, including application areas, technological isues, support and implementation, an d others (Ngai and Wat, 2002). Kakabadse and Kakabadse examine the levels of satisfaction with application service providers from 178 service purchasers in UK (Kakabadse and Kakabadse, 2002). Dubosson-Torbay et al., propose a theoretical e-business model framework in order to find out compare the performance indicators used by e-business firms that are competing with similar business models (Dubosson-Torbay et al., 2002). Li et al., present a concept of e-union framework for developing a unified B2B e-trading construction marketplace (Li et al., 2002). Gunasekaran et al., define EC and examine major EC elements, and a framework for describing EC components and their role in different areas in order to find their impacts on operations management (Gunasekaran et al., 2002).

On the other hand, Knudsen and Sweden present a framework for assessing alignment between corporate strategy, procurement strategy and purchasing tools. The framework is built on generation of rents as its common denominator for assessing alignment (Knudsen, 2003). Delaney-Klinger et al., survey the Internet grocery industry strategy alignment by providing a comparison of two business models, Webvan and Tesco, in UK (Delaney-Klinger et al., 2003). Yen and Ng propose a framework of the EC impact on the supply chain and the measurement of impact (Yen and Ng, 2003). Noronha and Vinten review the situation of taxing profits arising from EC transactions in Hong Kong and compare it with the cases of the UK and USA (Noronha and Vinten, 2003). Merwe and Bekker present a frame-

work for evaluating EC wen site and present the results with graphic manner (Merwe and Bekker, 2002). Aguila et al. investigate the impact of digital economy and identify its dimensions on the firms in Spain (Aguila et al., 2003). Santos propos es a conceptual framework to investigate e-service quality dimensions (Santos, 2003). Papathanassion et al. report on the results of a survey of 48 information systems and marketing managers from food companies in Greece and investigate how the Internet can offer new opportunities for improving customer satisfaction (Papathanassiou et al., 2002). Petrovic-Lazarevic and Sohal explore the nature of ethical dilemmas related to e-business and propose possible solutions, drawing on information from case studies of two Australian companies (Petrovic-Lazarevic and Sohal, 2002). Mustaffa and Beaumont investigate the frequency of use of technologies in order to explore the effect of electronic commerce on small Australian enterprises (Mustaffa and Beaumont, 2004). McIvor and Humphreys examine the implications of electronic business-to-business intermediaries for the buyer-supplier interface. Innovations in EC have a key role to play in managing inter-organizational networks of supply chain members (McIvor and Humphr eys, 2004). Emiliani and Stec present the results of a survey conducted aerospace part and sub-assembly suppliers to quantitatively assess their reaction to online reverse auctions and its impact on their business policies and practices (Emiliani and Stec, 2004). Newman et al. investigate the impact of banner advertisement and web site congruity on consumer attitudes toward a brand's web site. The results indicate that if managers include such advertisement on their web site, these advertisements should be consistent with the web site brand and that certain consumer characteristics should be considered (Newman et al., 2004). Kearns (2005) observing practices at 12 companies provided insight into the impact of EC alignment on organizational profitability. A framework for its strategy types, derived from the Miles and Snow typology, was found to be useful in examining the strategic practices of the companies and results were generally consistent with the ideal profiles.

Some applications have been implemented using a EC framework such as: web strategy, customer satisfaction, human factors analysis, best practices in SMEs, electronic commerce trust, supply chain integration, supply chain management, pornography industry legitimacy, website development in Singapore, EC Management practices in Mauritius, ASP service satisfaction, corporate strategy, e-business model classification, e-trading marketplace, operations management, electronic commerce taxation, corporate strategy, e-service quality measurements, e-business ethical dilemmas, small business studies, B2B intermediaries, online reverse auctions, Internet advertising, and electronic commerce planning. The methodology of electronic commerce framework and their applications are categorized on Table 1.

Table 1. Electronic commerce framework and their applications

EC framework/Applications	Authors
Web strategy	Shaw (1999)
Customer satisfaction	Kardaras and Papathanassiou (2000); Papathanassiou et al. (2002)
Human factors analysis	Miles et al. (2000)
Best practices in SMEs	Jeffcoate et al. (2000)
Electronic commerce trust	Berg and Lieshout. (2001)
Supply chain integration	Caskey et al. (2001)
Supply chain management	Hoek, (2001); Delaney-Klinger et al. (2003); Yen and Ng (2003)
Pornography industry legitimacy	Cronin and Davenport (2001).
Website development in Singapore	Kowtha and Choon (2001)
EC Management practices in Mauritius	Kardaras and Karakostas (2001)
ASP service satisfaction	Kakabadse and Kakabadse (2002)
E-business model classification	Dubosson-Torbay et al. (2002)
E-trading marketplace	Li et al., (2002)
Operations management	Gunasekaran et al. (2002)
Literature review	Ngai and Wat (2002)
Corporate strategy	Knudsen (2003)
Electronic commerce taxation	Noronha and Vinten (2003)
Corporate strategy	Merwe and Bekker (2002)
Digital economy development in Spain	Aguila et al. (2003)
E-service quality measurements	Santos (2003)
E-business ethical dilemmas	Petrovic-Lazarevic and Sohal (2002)
Small business studies	Mustaffa and Beaumont (2004)
B2B intermediaries	McIvor and Humphreys (2004)
Online reverse auctions	Emiliani and Stec (2004)
Internet advertising	Newman et al. (2004)
Electronic commerce planning	Kearns (2005)

4. Information/communication technologies and their applications

In today's information economy, rapid access to knowledge is critical to the success of many organizations. An information and communication technology (ICT) infrastructure provides a broad platform for exchanging data, coordinating activities, sharing information, emerging private and public sectors, and supporting globalization commerce, all based on powerful computing and network technology. Information computing offers powerful information processing abilities and the network provides standards and connectivity for digital integration. Internet is a kind of ICT that combines with some other network technologies

and services, such as Intranet, Extranet, virtual private network (VPN), and wireless web, to construct a digital environment to consistently create new commerce opportunity, quickly response it, and extend service to customers at anywhere and anytime (Laudon and Laudon, 2002).

For example, Roberts and Mackay discuss how electronic commerce may be used a portfolio of supplier relationships. Information technology may be support different types of supplier relationships (Roberts and Mackay, 1998). Johnston examines the dynamics of knowledge economy, and its strategy for promoting electronic commerce from government viewpoint (Johnston, 1998). Santos and Peffers report an empirical investigation of the influence on the adoption decision for one of the earliest EC applications, the automatic teller machine (ATM) system, to determine whether marketing efforts by hardware and software vendors, imitation of competitors or a mixture of influences affected decisions among bank managers (Santos and Peffers, 1998). Portillo and Patel propose design techniques for complex environments are presented to avoid the development of unwieldy applications and standards. Applied to electronic commerce, these techniques lead to a five level framework with transaction, transport, user environment, syste m management, and business levels (Portillo and Patel, 1999). Jung et al. develop a risk analysis system in an EC environment using the case-based reasoning (CBR) technique (Jung et al., 1999). Aalst presents new existing architecture to enable inter-organizational workflow. The presentation focuses on two approaches to partition an inter-organizational workflow over multiple business partners (Aalst, 1999). Pakstas addresses the role of network management and associated security issues on his article, which outlined as crucial for the success of electronic commerce (Pakstas. 1999). Zentes and Swoboda analyze aspects of the changing structures of a co-operative organizational form in order to explain various stages to the evolution of information and communication technologies (Zentes and Swoboda, 2000). Hands et al. describe a reference model and functional architecture for value-added mediation in EC. The customers are provided with a uniform way of accessing heterogeneous suppliers without changes in th e supplier software (Hands et al., 2000). Lang outlines the principal security considerations for web-based CORBA applications and presents some of the implementation options to meet these requirements (Lang, 2000). Papavassiliou investigate on the effective management of wide-area electronic commerce networks supporting services and applications that require high availability and reliability (Papavassiliou, 2001). Anido et al. propose two solutions to provide full FTP access from a Java applet (Anido et al., 2001). Gangopadhyay describe a methodology for enhancing search and retrieval of product information using content-based im-

age retrieval in an electronic retailing application (Gangopadhyay, 2001). Pant and Ravichandran develop an e-business architecture planning model by identifying 12 generic e-business models and three axes on which drivers of the information architecture needs of e-business firms fall (Pant and Ravichandran, 2001).

On the other hand, Yen focuses on front-end to conjoin various business organizations and to strengthen business competence (Yen, 2002). Rodgers et al. discuss various issues of implementing e-business in the business world and the functions of e-business solutions are then developed (Rodgers et al., 2002). Chiasson et al. describe an architecture that uses personalization information to customize interactions with end-users in a way that reduces interaction complexity (Chiasson et al., 2002). Li et al. analyze the factors that impact the performance and scalability of a database-driven web site (Li et al., 2002). Basu and Muylle examine the extent to which companies in various industries are using the WWW and its associated technologies to conduct retail business (Basu and Muylle, 2002). Joh and Lee present a top-down control algorithm, which could improve the depth and balance of the directory significantly, and will result in automatically generating more effective buyer's directory (Joh and Lee, 2002). Kwok et al. introduce a digital rights insertion phase and a digital rights verification phase for Internet Open Trading Protocol (IOTP). In the proposed framework, digital watermarking plays a very important role in facilitating digital rights management (Kwok et al., 2002). Smith and Rupp examine the ASP model through the lens of Williamson's transaction cost model (Smith and Rupp, 2003). Kandampully examines the advantages of business networks and relationships, and elucidates how these have become increasingly imperative within the new e-business paradigm of the global marketplace (Kandampully, 2003). Paik et al. describe an Electronic Commerce Goods Search System (ECGSS) that increase the precision of search results through training of the search system and uses affiliated business transaction processes (Paik et al., 2003). Hutchinson and Warren propose a security framework for Internet banking based on discovering and defining these pathways in terms of adequate authentication mechanism s (Hutchinson and Warren, 2003). Tak and Park propose adaptive secure software architecture to support secure e-commerce transactions. Their software architecture dynamically adapts security classes based on the nature and sensitivity of interactions among participants (Tak and Park, 2003). Erasala et al., discuss the issue of Enterprise Application Integration (EAI) and develop a case for EAI in order to illustrate how firms can improve gains by implementing the appropriate EAI solution (Erasala et al., 2003).

In addition, Jameson et al. investigate a global mechanism that merges and automates

interoperability of heterogeneity structured and semi-structured sources in one process. They introduce the intelligent benevolent tool (IBT) system comprised of tools like assertions, integration rules, conceptual model constructs, and agents that enable the architectural components' versatility to reconcile the semantics involved in data sharing (Jameson et al., 2004). Gupta et al. propose modifications to the electronic signature process to enable innovative document management process using partial document ownership, soft signatures, and hard signature (Gupta et al., 2004). Kaefer and Bendoly investigate the impact of two organizational constraints, technological compatibility and operational capacity, on the success of business-to-business (B2B) EC efforts over a range of business settings. They focused specifically on the transactional efficiencies gained through the use of B2B e-commerce (Kaefer and Bendoly, 2004). Currie develops three construct of the ASP business model; strategic positioning; productive/service portfolio; and customer value proposition. Using a case study, it discusses the findings from four ASP firms; each having attempted to develop a unique ASP business model (Currie, 2004). Sindhu et al. discuss how to succeed in the new economy by utilizing e-business in transforming business process and strategy. The Collaborative One-Stop Virtual Engineering Services (COVES) portal provides users with collaborative engineering services for government agencies and private sectors involved in various areas (Sindhu et al., 2004). Jameson et al. investigate a global mechanism that merges and automates interoperability of heterogeneity structured and semi-structured sources in one process. They introduce the intelligence benevolent tool (IBT) system comprised of tools like assertions, integration rules, conceptual model constructs, and agents that enable the architecture components' versatility to r econcile the semantics involved in data sharing (Jameson et al., 2004). Changchien et al. propose an on-line personalized sales promotion decision support system in order to illustrate how the proposed system works in electronic commerce and simplified case of performance analysis is evaluated (Changchien et al., 2004). Liao et al. present a case study of e-business in Taiwan in order to describe how information technology can implement customer and supplier relationship management on small manufacturing firm (Liao et al., 2004). Garrity et al (2005) examined Web-based information systems (WIS) success and focused on User Satisfaction in the context of a consumer purchasing decision. The results indicate strong support for the research model consisting of three fundamental User Satisfaction components: Task Support Satisfaction (TSS), Decision Support Satisfaction (DSS), and Interface Satisfaction. The model explains approximately 50% of the variance in users' intention to use Web-based information s ystems.

Some of these applications which are implemented by information and communication

technologies include the following: supplier relationship management, information infrastructure, information technology adoption, user interface design, risk analysis, workflow management, network management and security, strategic alliances, electronic brokerage architecture, web security, network and service management, computing distribution, electronic retailing, computer architecture strategic planning, supply chain management, information technology strategy, peer-to-peer universal accessibility, web acceleration, digital rights management, application service providers strategy, business to business marketing, component-based software development, computer security on Internet banking, electronic commerce adaptive security, web development, buyer's directory control, enterprise application integration, system automating integration, digital signature, transactional efficiency, business planning, construction indus try automation, online personalized sales promotion, and Relationship management. The technology of information and communication technologies and their applications are categorized on Table 2.

5. Electronic data interchange and their applications

Electronic data interchange (EDI) is one of the most important components of electronic commerce because EDI helps automate and streamline businesses by eliminating clerical task, speeding up information transfers, reducing data errors, and eliminating unnecessary business processes (Schneider, 2003). For example, Bollo and Stumm present the use of EDI and the new way of intermediation in the transport logistics field (Bollo and Stumm, 1998). Blair and Boyer present an application of XML that allows organizations to move their paper-based forms systems to the Internet while maintaining the necessary attributes of paper-based transaction records (Blair and Boyer, 1999). Gunasekaran and Love propose a framework to improve the application of multimedia in business (Gunasekaran and Love, 1999). Truman proposes that interface integration is favorably related to performance outcomes, and that interface integration and internal integration are positively related. He concludes that EDI planning should centrally focu s on interface integration regardless of how intensively management plans to use EDI (Truman, 2000). Lu et al. propose a general implementation procedure for the industries that are interested in the application of XML/EDI (Lu et al., 2001). Yen and Kong present a Personalized Electronic Catalogue (PEC) system to synthesize the customization of information content, organization, and display for electronic catalogs. An industrial application is used to demonstrate the improvement of information access

Table 2 Information/communication technologies and its applications

Information and communication technologies/Applications	Authors
Supplier relationship management	Roberts and Mackay (1998)
Information infrastructure	Johnston (1998)
Information technology adoption	Santos and Peffers (1998)
User interface design	Portillo and Patel (1999)
Risk analysis	Jung et al. (1999)
Workflow management	Aalst (1999)
Network management and security	Pakstas (1999)
Strategic alliances	Zentes and Swoboda (2000)
Electronic brokerage architecture	Hands et al. (2000)
Web security	Lang (2000)
Network and service management	Papavassiliou (2001)
Computing distribution	Anido et al. (2001)
Electronic retailing	Gangopadhyay (2001)
Computer architecture strategic planning	Pant and Ravichandran (2001)
Supply chain management	Yen, (2002)
Information technology strategy	Rodgers et al. (2002)
Peer-to-peer universal accessibility	Chiasson et al. (2002)
Web acceleration	Li et al. (2002)
Web development	Basu and Muylle (2002)
Digital rights management	Kwok et al. (2002)
Buyer's directory control	Joh and Lee (2002)
Application service providers strategy	Smith and Rupp (2003)
Business to business marketing	Kandampully (2003)
Component-based software development	Paik et al. (2003)
Computer security on Internet banking	Hutchinson and Warren (2003)
Electronic commerce adaptive security	Tak and Park (2003)
Enterprise application integration	Erasala et al. (2003)
System automating integration	Jameson et al. (2004)
Digital signature	Gupta et al. (2004)
Transactional efficiency	Kaefer and Bendoly 2(004)
Business planning	Currie (2004)
Construction industry automation	Sindhu et al. (2004)
Online personalized sales promotion	Changchien et al. (2004)
Relationship management	Liao et al. (2004)
Web information systems	Garrity et al. (2005)

for electronic catalogs (Yen and Kong, 2002). Yen et al. discuss the impact analysis of the XML implementing on the EDI (Yen et al., 2002). Kumar and Zhao propose a blueprint for

XRL, an Extensible Routing Language that enables routing of commercial documents over the Internet and Helps in creating intelligent documents (Kumar and Zhao, 2002). Chan et al. implement the design of XML architecture and its application in retail inventory control EC with Java Servlets and CORBA (Chan et al., 2002). McIvor et al. examine the influence of EDI technologies in enabling companies to pursue more collaborative relations with their suppliers (McIvor et al., 2003). Mackay et al. present the study results of a national survey completed in the retail sector of the Australian economy, which assesses how well Australian industry is responding to e-commerce challenges with EDI implementation (Mackay et al., 2003). Seng et al. investigate EDI development by analyzing the structural and methodological paradigm shift in XML database technology (Seng et al., 2003). Lu and Cheng design and implement a mobile database system for Java phones and XML is adopted to describe the database (Lu and Cheng, 2004). Lu and Wu present a XML/EDI model that transformation templates will be generated automatically for documents with unknown elements, and the documents will be converted into expected format (Lu and Wu, 2004). Oppong et al. (2005) demonstrate how companies can benefit by adopting strategies that harness the potential of knowledge ma nagement technologies to transform their e-business activities. They define knowledge management; then provide an overview of the driving and impeding forces that help and hinder proper deployment of knowledge management strategies in e-commerce.

Some of the applications that are implemented by electronic data interchange include the following: transport logistics, Records management, multimedia development, EDI system development, electronic catalog personalization, enterprise resources planning, interface integration, document management, retailing inventory control, supply chain collaboration, supply chain management, EDI integration, mobile commerce, metadata design, and enterprise resource planning. The technology of electronic data interchange and their applications are categorized on Table 3.

6. Intelligent agents/ object-oriented technologies and their applications

An intelligent agent (IA) is a computer program that helps a user with routine computer tasks. Intelligent agents are a new technology, and as such they have several definitions, database capabilities, and different applications in autonomous programs. Several names are used to describe intelligent agents, including software agents, wizards, mobile-agent, and

Table 3 Electronic data interchange and their applications

Electronic data interchange/Applications	Authors
Transport logistics	Bollo and Stumm (1998)
Records management	Blair and Boyer (1999)
Multimedia development	Gunasekaran and Love (1999)
Interface integration	Truman (2000)
EDI system development	Lu et al. (2001)
Electronic catalog personalization	Yen and Kong (2002)
Enterprise resources planning	Yen et al. (2002)
Document management	Kumar and Zhao (2002)
Retailing inventory control	Chan et al. (2002)
Supply chain collaboration	McIvor et al. (2003)
Supply chain management	Mackay et al. (2003)
EDI integration	Seng et al. (2003)
Mobile commerce	Lu and Cheng (2004)
Metadata design	Lu and Wu (2004)
Enterprise resource planning	Oppong et al. (2005)

multi-agent (Turban and Aronson, 2001). The intelligent agent technology seems an attractive paradigm to support EC applications, because the introduction of intelligent agents acting on behalf of end-customers could reduce the effort required to complete an EC transaction. In addition, object-oriented (OO) technology can implement its functions similar to intelligent agents to end-users on EC. Object-oriented methodology combines into one object data together with the specific procedures that operate on this data, where the object combines data and program code. Instead of passing data to procedures, programs send a message for an object to perform a procedure that is already embedded in it. Then, the same message may be sent to many different objects, but each will implement that message differently. An object's data are encapsulated from other parts of the system, so each object is an independent software building block that can be used in many different systems without changing the program code. Accordingly, intelligent agents and object-oriented technologies are intrinsically autonomous and can be easily personalized to embody end-customer preference.

Alexandre proposes a flexible EC platform aimed at regulating the use and transfer of intellectual property. By doing so, the author presents lightweight software components that benefit both from traditional and agent-enhanced distributed programming techniques (Alexandre, 1998). Merwe and Solms develop intelligent trade agents that are able to roam a network, collect and analyze data from servers on the network and make decisions to buy and

sell goods on behalf of a user (Merwe and Solms, 1998). Lee and Lee propose a prototype agent-based commerce development environment as an extension of expert systems with the additional capability of communication control and meta-problem solving (Lee and Lee, 1998). Corradi et al. present an mobile agent environment to support secure and open electronic commerce applications and focus on how mobile shopping agents can be protected from malicious behaviour of execution sites and presents a range of solution strategies (Corradi et al., 1999). Saleh et al. introduce bo th distributed computing and Java as agent tools to facilitate the development of EC applications (Saleh et al., 1999). Cheng presents an object-oriented organizational model as an underlying model to support dynamic role definition and role resolution in EC solutions (Cheng, 2000). Kidawara et al. discuss multimedia data communications using the Internet from the standpoint of providing services, and propose a cost model based on multilevel complex objects for the purpose of responding to the various needs of users (Kidawara et al., 2000). Liang and Huang propose a three-layer architecture for organizing intelligent agents for EC implementing on Internet stores (Liang and Huang, 2000). Nissen describe a proof-of-concept multi-agent system called 'the Intelligent Mall' in the context of supply chain dis/re-intermediation (Nissen, 2000). Zacharia et al. describe an agent-mediated marketplace, with dynamically changing reputation ratings. In this regard, the seller reputations are updated in a co llaborative fashion based on the performance of the user in the delegated tasks (Zacharia et al., 2000). On the other hand, the standard design of on-line auction systems places most of the computational load on the server and its adjacent links, resulting in a bottleneck in the system. Hillston and Kloul investigate the impact, in terms of the performance of the server and its adjacent links, of introducing active nodes into the network (Hillston and Kloul, 2001). Antoniou and Arief propose the use of defeasible reasoning based on rules and priorities for implementing business rules in EC (Antoniou and Arief, 2001). Tsalgatidou and Pitoura discuss the business models in mobile electronic commerce and transaction modeling issues pertinent for the business models and the environment (Tsalgatidou and Pitoura, 2001).

In addition, Miao et al. propose a computational agent-reasoning model (CAR) for constructing intelligent agent and present a new type of agent, computational intelligent agent (CIA), which has the ability to model, reason and make decision on behalf of human beings and implements on EC over the Internet (Miao et al., 2002). Sarkis and Sundarraj discuss how brokering's role and practice needs to evolve with evolving organizational forms. Supporting tools, technologies, and mechanisms needed to implement EC based on brokering are also discussed on their paper (Sarkis and Sundarraj, 2002). Wang et al. present code-on-

demand mobile agents and a corresponding agent integrity protection scheme and propose the use of dynamically upgradeable agent code, in which new agent function modules can be added and redundant ones can be deleted at runtime (Wang et al., 2002). Shih et al., propose a generic mobile agent framework for EC applications based on collaborative computing architecture (Shih et al., 2002). Lee and Park present the EC model providing the process transparency of process sampling method that can provide online semiconductor customers with the performance information of available process sampling methods which can be used at all manufacturing process steps for their own products in make-to-order manufacturing environment (Lee and Park, 2003). Park and park propose agent-based system could accomplish merchandise management timely, autonomously and efficiently, and the effective merchandise management would reduce the inventory level while increasing sales and profits (Park and park, 2003). Lin and Lee investigate an object-oriented analysis method for the development of customer relationship management information system. This approach starts from the identification of prospect customers and their desired behaviors under preferable execution environments, and ends with the specification of system - internal objects/entities that collaborative to satisfy these behaviors and environment (Lin and Lee, 2004). On the other hand, Lin and Lin propose an object-oriented modeling approach that addresses the management of collaboration on the Internet between enterprise (Lin and Lin, 2004). Onieva et al. present agent-mediated non-repudiation protocols and analyze their security requirements and identify applications that could take advantages of these agent-mediated non-repudiation protocols (Onieva et al., 2004). Ursino et al. investigate an agent-based approach, which presents in each EC site, managing the information stored there. On the other hand, another agent is associated with each customer, handling customers´ profiles (Ursino et al., 2004). Garc1'a-Sa'nchez et al. (2005) presents a framework that merges various advanced information technologies for developing electronic commerce (e-commerce) applications. The use of e-commerce utilities provides several advantages to businesses. Intelligent agents can be used to facilitate some tasks from those that take place in a commercial transaction movi ng to a second generation of e-commerce applications.

Some applications are implemented by intelligent agents and object-oriented technologies such as: intellectual property protection, transaction authorization, electronic contract, business process management, copyright management, Internet stores, supply chain disintermediation versus re-intermediation, dynamic pricing, on-line auction systems, e-commerce transaction, decision support, supply chain management, agent code integrity protection, e-commerce recommendation systems, e-commerce process transparency, e-commerce appli-

cation tools, mobile shopping, merchandise management in retail industry, e-commerce business rules, e-commerce security, customer relationship management, collaboration management in virtual enterprise, web site management, and Ontologies. The technologies of intelligent agents and object-oriented together with their applications are categorized on Table 4.

Table 4 Intelligent agents/object-oriented technologies and their applications

Intelligent agents and object-oriented/ Applications	Authors
Intellectual property protection	Alexandre (1998)
Transaction authorization	Merwe and Solms (1998)
Electronic contract	Lee and Lee (1998)
Mobile shopping	Corradi et al. (1999)
E-commerce application tools	Saleh et al. (1999)
Business process management	Cheng (2000)
Copyright management	Kidawara et al. (2000)
Internet stores	Liang and Huang (2000)
Supply chain disintermediation versus re-intermediation	Nissen (2000)
Dynamic pricing	Zacharia et al. (2000)
On-line auction systems	Hillston and Kloul (2001)
E-commerce business rules	Antoniou and Arief (2001)
E-commerce transaction	Tsalgatidou and Pitoura (2001)
Decision support	Miao et al. (2002)
Supply chain management	Sarkis and Sundarraj (2002)
Agent code integrity protection	Wang et al. (2002)
E-commerce recommendation systems	Shih et al. (2002)
E-commerce process transparency	Lee and Park (2003)
Merchandise management in retail industry	Park and park (2003)
Customer relationship management	Lin and Lee (2004)
Collaboration management in virtual enterprise	Lin and Lin (2004)
E-commerce security	Onieva et al. (2004)
Web site management	Ursino et al. (2004)
Ontologies	Garc1'a-Sa'nchez et al. (2005)

7. Statistics methodology and their applications

Statistics methodology is an interdisciplinary field of electronic commerce. Given the sampling of data from subjective, statistics is a methodology necessary for data analysis and hypothesis test, providing different methods on an exploratory or confirmatory way for deci-

sion-making, analysis, planning, diagnosing, prediction, exploring, and learning hidden essences from problem domain in order to investigate the development of EC. For example, Henderson explores the notion of the use of a 'weighted application blank' (WAB) to identify individuals who will, or will not, use the electronic commerce service. In this regard, the author conducts a linear discriminant analysis to ascertain id a measure could be developed to discriminate between these two groups (Henderson, 1999). Houston and Taylor examine perceptions of the assurances provided by WebTrust and the effect of Webtrust on the willingness to make Internet purchases by asking 106 accounting majors to complete a case concerning a company en gaging in EC (Houston and Taylor, 1999). Liu and Arnett explore four factors associated with web site success (Liu and Arnett, 2000). Amit and Zott investigate the theoretical foundations of value creation in e-business by examining how 59 American and European e-businesses that have become publicly traded corporations create value (Amit and Zott, 2001). Chen e al. examine consumer behavior in the virtual store context. Confirmatory factor analysis (CHA) is performed to examine the reliability and validity of the measurement model, and the structural equation factor analysis (SEM) technique is used to evaluate the casual model (Chen e al., 2002). The importance of trust as a key facilitator of electronic commerce is increasingly being recognized in academic and practitioner communities. Bhattacherjee addresses this issue by theoretically conceptualizing and empirically validating a scale to measure individual trust in online firms (Bhattacherjee, 2002). Thuraisingham et al. describe collaborative commerce; their paper combine e-commerce, knowledge management and collaboration to carry out transactions and other activities within and across organizations (Thuraisingham et al., 2002). Chang et al. propose strategic initiatives by using content analysis to shareholders of 145 Fortune 500 firms in order to evaluate the importance of EC and strategic orientation (Chang et al., 2003). Kula and Tatoglu investigate the nature and extent of Internet use and the role of firm and industry specific factors affecting Internet adoption by SMEs in Turkey (Kula and Tatoglu, 2003).

On the other hand, Cho et al., develop factors representing characteristics of product/service processes and verified that those factors are significantly related to customer needs of geographical accessibility in the transactions of EC (Cho et al., 2003). Koyuncu and Lien analyze the roles of sexual preference, primary place of online access, and online experience as well as demographic and economic factors on the consumer's purchasing decision (Koyuncu and Lien, 2003). Lawson et al., present research results of factors affecting adoption of electronic commerce technologies by SMEs in Australian (Lawson et al., 2003). Park and Kim investigate the relationship between various characteristics of online shopping and con-

sumer purchase behavior (Park and Kim, 2003). Poulymenakou and Tsironis explore the relationship of EC and quality management on customer satisfaction with the point of total quality management (Poulymenakou and Tsironis, 2003). Chen and Dubinsky present an exploratory study of a conceptu al model of perceived customer value in a business-to-consumer e-commerce setting. Key precursors of perceived customer value included in the model are valence of on-line shopping experience, perceived product quality, perceived risks, and product price (Chen and Dubinsky, 2003). Gilkeson and Reynolds investigate how particular on-line auction features impact two important outcomes: auction success and final closing price (Gilkeson and Reynolds, 2003). Peterson and Merino present 14 propositions to stimulate and guide investigations of consumer information search behavior in the context of the Internet (Peterson and Merino, 2003). Anderson and Srinivasan explore the impact of satisfaction on loyalty in the context of EC. Findings indicate that although e-satisfaction has an impact on e-loyalty, this relationship is moderated by consumers´ individual level factors and firms´ business level factors (Anderson and Srinivasan, 2003). Swinyard and Smith examine the lifestyle characteristics of on-line households. It is hypothesized and shown that, compared with on-line non-shoppers, on-line shoppers are younger, wealthier, better educated, have higher computer literacy, spend more time on their computer, and are more fearful of financial loss from on-line shopping (Swinyard and Smith, 2003). McIvor et al. examine the impact of Internet technologies on value creation in the airline industry and focuses on the Internet strategies of two European low-cost and two traditional operators (McIvor et al., 2003). Vrechopoulos applies the customer relationship management process in the Internet retailing context and develops a mass customization model for the involved business players (Vrechopoulos, 2004). Harris and Coles examine the impact of the Internet upon marketing dynamics within UK banks. They draw upon ongoing empirical research in the retail sector of the financial services industry to report some preliminary findings as to the nature of change that is taking place (Harris and Coles, 2004). Brews and Tucci explore the structural effects of internetworking. Analysis of a multinational sample of 469 firms reveals that deeply internetworked firms are more focused and specialized, less hierarchical, and more engaged in external partnering than less intensively internetworked organizations are (Brews and Tucci, 2004). Raventos (2005) proposes a discussion of the factors leading to the spectacular growth of Costa Rica as a destination and of the way in which the Internet has transformed the sector value chain, leads to a benchmarking exercise of ICT as a destination marketing organization, and an analysis of whether the ICT should become involved in handling reservations and how.

Some of the applications implemented by statistics methodology including the following: supermarket customer classification, web assurance services, cybermarketing success factors, value creation in e-business, online retailing consumer behavior studies, online trust, collaborative commerce, market orientation strategy, Internet adoption, customer needs of geographical accessibility, consumer's purchasing behavior, e-commerce technology adoption, consumer behavior in retailing, total quality management, customer value perception, success factors of Internet auction, consumer information search behavior, e-satisfaction and e-loyalty, Internet consumer lifestyle study, Internet technology impact on airline industry, customer relationship management, marketing priorities on Internet, Structural effects of internetworking, and hotel planning. The methodology of statistics methodology and their applications are categorized on Table 5.

Table 5 Statistics methodology and their applications

Statistics methodology/Applications	Authors
Supermarket customer classification	Henderson (1999)
Web assurance services	Houston and Taylor (1999)
Cybermarketing success factors	Liu and Arnett (2000)
Value creation in e-business	Amit and Zott (2001)
Online retailing consumer behavior studies	Chen e al. (2002)
Online trust	Bhattacherjee (2002)
Collaborative commerce	Thuraisingham et al. (2002)
Market orientation strategy	Chang et al. (2003)
Internet adoption	Kula and Tatoglu (2003)
Customer needs of geographical accessibility	Cho et al. (2003)
Consumer's purchasing behavior	Koyuncu and Lien (2003)
E-commerce technology adoption	Lawson et al. (2003)
Consumer behavior in retailing	Park and Kim (2003)
Total quality management	Poulymenakou and Tsironis (2003)
Customer value perception	Chen and Dubinsky (2003)
Success factors of Internet auction	Gilkeson and Reynolds (2003)
Consumer information search behavior	Peterson and Merino (2003)
E-satisfaction and E-loyalty	Anderson and Srinivasan (2003)
Internet consumer lifestyle study	Swinyard and Smith (2003)
Internet technology impact on airline industry	McIvor et al. (2003)
Customer relationship management	Vrechopoulos (2004)
Marketing priorities on Internet	Harris and Coles (2004)
Structural effects of internetworking	Brews and Tucci (2004)
Hotel planning	Raventos (2005)

8. Modeling methodology and their applications

Modeling methodology becomes an interdisciplinary methodology of EC in order to build formal relationships with logical model design in different knowledge /problem domains. For example, the value of specific EC product/service knowledge, intellectual capital, and intangible assets, are difficult to measure on profit-loss sheets and accounting systems of most businesses when new EC enterprise is under development and collects funding on the market. Exploring problems that would remain hidden in ordinary profit and loss balance sheets could yield valuable information that could then be used to construct strategic decisions as to expenditure or income in different organizational areas, new product development, business assets measurement, and IT investment on EC business. In addition, modeling technology can provide quantitative methods to analyze data to represent or acquire individual and organizational knowledge with inductive logic programming or algorithms so that other research fields could have broader platforms to implement technologies for EC development. Some modeling methodologies have been developed in order to support the development of EC.

For example, Ye and Papavassiliou propose a practical algorithm which finds cost-efficient routes from Service Provider (SP) to Content provider (CP) dynamically in a multi-operator networking environment, using Genetic Algorithm (GA) concepts. The proposed algorithm is a kind of stochastic algorithm searching process in the solution space by emulating biological selection and reproduction (Ye and Papavassiliou, 2001). Bianchi and Bivona present a system dynamics (SD) approach to demonstrate how managing processes of accumulation and depletion of strategic assets, detecting inertial effects of decisions made in the past, and selectively acting on policy levels are likely to help entrepreneurs in understanding opportunities and pitfalls related to e-commerce strategies (Bianchi and Bivona, 2002). Tatisopoulos et al., propose a structured methodology for the evaluation of EC. The main tools are discrete event simulation and activity-based costing/management (ABC/ABM) (Tatisopoulos et al., 2002). Papamichail and Papamichail present computational methods that models decision preferences and traces exact or close matches to these preferences in real-time, therefore allowing the decision maker to form a starting point of negotiations, while being realistic in individual expectations (Papamichail and Papamichail, 2003). Calosso et al. discuss a standardized negotiation process occurring in a multi-enterprise setting and present three mixed-integer linear programming models that may be used by the different businesses involved (Calosso et al., 2003). Fones et al. develop a normative web-based commerce adop-

tion model developed from a review of the extant literature related to electronic marketing, entrepreneurship, and the diffusion of new innovations was empirically tested. A multiple case study design enabled the exploration of contemporary marketing and entrepreneurship issues within the real life context of five small firms (Fones et al., 2003). Subba Rao et al. present an in-depth analysis of the EC development stages and the facilitators and barriers for SMEs during each development stage (Subba Rao et al., 2003). Kirchmer proposes a methodology for the use of reference models, to design and implement inter-enterprise collaborations within value chain networks in order to implement supply chain management on business process (Kirchmer, 2004). Quaddus and Achjari (2005) suggest that increased benefits (both internal and external) from the use of e-commerce significantly predict the perceived and/or expected success of e-commerce. However, lowering of impediments (internal and external) does not significantly affect the success of e-commerce.

Some applications are implemented by modeling methodology, such as: network resources allocation, e-commerce strategies in SMEs, business process reengineering, group decisions and negotiations, production planning and order negotiation, small firm Internet adoption, supply chain management, and . The methodology of modeling and its applications are categorized on Table 6.

Table 6. Modeling methodology and their applications

Modeling methodology/Applications	Authors
Network resources allocation	Ye and Papavassiliou (2001)
E-commerce strategies in SMEs	Bianchi and Bivona (2002); Subba Rao et al. (2003)
Business process reengineering	Tatisopoulos et al. (2002)
Group decisions and negotiations	Papamichail and Papamichail (2003)
Production planning and order negotiation	Calosso et al. (2003)
Small firm Internet adoption	Fones et al. (2003)
Supply chain management	Kirchmer (2004)
Critical success factors	Quaddus and Achjari (2005)

9. Discussions and suggestions

9.1 Discussions

Electronic commerce technologies and applications are broad category of research issues on EC. Some specific technologies and methods are presented as examples in terms of

exploring the suggestions and solutions to specific EC application domains. Therefore, technologies and applications of EC are attracting much attention and efforts, both academic and practical. From this literature review, we can see that EC technologies and applications developments are diversified due to their authors' backgrounds, expertise, and application domains. This is why a few authors can appear in the literature on different technologies and applications.

On the other hand, some technologies have similar concepts, and types of methodology. For example, intelligent agents versus object-oriented technology. However, a few authors work in different methodologies and applications. This indicates that the trend of development on technology is also diversified due to author's research interests and abilities in the methodology and application domain. This may directs development of EC technologies toward expertise orientation.

Furthermore, some applications have a high degree of overlap in different technologies. For example, customer satisfaction, supply chain management, Internet advertising, relationship management, business process management, and web site management, which implement EC in a common problem domain. This indicates that those applications are the major trend of EC development and many technologies are focused on these problems. This may direct development of EC applications toward problem domain orientation.

In this paper, most of the articles discussed were business and management retrieved from Elsevier SDOS, Emerald Library (MCB), EBSCO (electronic journal service), Ingenta, and Wiley InterScience online database. We do not conclude that EC technologies and applications are not developed in other science and social science fields. However, we would like to see more EC technologies and applications of different research fields published to readers in order to broaden our horizon of academic and practice works on EC.

9.2 Limitations

Firstly, a literature review for the broad category of EC technologies and applications is a difficulty task due to the extensive background knowledge needed for collecting, studying, and classifying these articles. Although limited in background knowledge, this paper makes a brief literature review of EC from 1995 to 2005 in order to explore how EC technologies and applications have developed in this period. Indeed, the categorization of technologies and their applications is based on the keyword index and article title in this research. Some other articles may have implemented similar EC technologies in their applications without an EC index, so this paper might not find these reference sources. Therefore, the first limita-

tion of this article is the author's limited knowledge in presenting an overall picture of this subject and unable to present authors' research works with in-depth description.

Secondly, although 160 articles from 75 academic journals cited in this paper, some other academic journals listed in the science citation index (S.C.I) engineering index (EI) and the social science citation index (S.S.C.I), as well as other local journals (such as T.S.S. C.I) and practical reports are not included in this survey. These would have provided more complete information to explore the development of EC technologies and applications.

Thirdly, non-English publications are not considered in this survey to determine the effects of different cultures on the development of EC technologies and applications. We believe that EC technologies and applications in addition to those discussed in this article have been publishing and developed in other areas and languages.

9.3 Suggestions

Integration of qualitative and quantitative method. The qualitative and quantitative methods are different in both methodology and problem domain. Some articles present their variables, modeling, and system design without considering customer behavior from market situations. These belong to laboratory research and it is difficult to implement EC technology into individual and organizations. On the other hand, some articles have presented their brilliant EC concepts without a scientific or systematic approach, which leads EC methodology to remain at the stage of discussion. Therefore, integration of qualitative and quantitative methods may be an important direction for future work on EC technologies and applications.

Integration of technologies. EC is an interdisciplinary research issue. Thus, future EC developments need integration with different technologies, and this integration of technologies and cross-interdisciplinary research may offer more methodologies to investigate EC problems.

Change, is a source of development. The change due to social and technical reasons may either enable or inhibit EC technologies and application development. This means that inertia, stemming from the use of routine problem solving procedures, stagnant knowledge sources, and following past experience or knowledge may impede changes in terms of learning and innovation for individuals and organizations. Therefore, to continue creating, sharing, learning, and storing knowledge may also become the source of EC development.

10. Conclusions

This paper is based on a literature review on electronic commerce technologies and applications from 1995 to 2005 using a keyword index and article title search. We conclude that EC technologies tend to develop towards expert orientation, and EC applications development is a problem-oriented domain. Integration of qualitative and quantitative methods and integration of EC technologies studies may broaden our horizon on this subject. Finally, the ability to continually change and obtain new understanding is the power of EC technologies and will be the application of future works.

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