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**Business-to-business electronic commerce (B2B-EC) and its  
potential applications in the manufacturing industries (a  
review of literature)**

by

**Oliver B. Yau**

University of South Australia

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**About the Author**

Oliver B. Yau is a doctoral student with University of South Australia and he currently takes up a post of Director of E-Business with Noble Jewelry Limited, Hong Kong.

## **Abstract**

From an ongoing study of the impact of business-to-business electronic commerce (B2B-EC) on operations management and its potential applications in the manufacturing industries, the author employs both academic and practitioner viewpoints in discussing the changeover of B2B-EC from “EDI-base” to “Internet-base”. The paper examines the emergence of the B2B-EC revolution and how manufacturers are adopting this technology in the new millennium. The impact of the Internet on B2B-EC, including possible future directions, is then discussed. The paper concludes by proposing a framework to assist companies with the change towards the introduction of B2B-EC into the manufacturing supply chain so as to improve significantly supplier-manufacturer-customer relations.

**Keywords:** business-to-business, e-commerce, electronic data interchange (EDI), Internet, inter-organizational information systems (IOS), manufacturing, collaboration

**Article Type:** Literature review

### **Address for Correspondence**

*Correspondence address: Flat G, 3/F., Block I, Maywood Court, Kingswood Villas, Tin Shui Wai, New Territories, Hong Kong.*

Telephone: (852) 90170009

E-mail: [oliver@hongkong.com](mailto:oliver@hongkong.com)

## **Overview**

In a turbulent, highly competitive and global market, manufacturers are facing increasing pressure from customers to “reduce and control” their costs, yet, at the same time, improve customer service, shorten product development cycle time, and enhance product quality (Griffiths et al., 2001; Bhatt, 2001). The ability of a manufacturer to satisfy customer requirements in terms of order quantity, delivery lead time, product design and product quality, is essential to stay in business (Koh et al., 2000). The changing environment of the business market, with its focus on costs, quality, flexibility and technology to meet the competitive challenges, is thus causing major changes in inter-organizational business relationships. Many manufacturers are developing closer relationships with their suppliers and customers with the introduction of B2B-EC and other inter-organizational information systems (IOS) (Han, 1997; Bhatt, 2001). This paper shows how an Internet-based B2B-EC approach can bring greater benefits to such manufacturers.

E-commerce includes any business transaction conducted via digital processes over a network. It is not merely the exchange of products or services for money over the Internet. According to Trepper (2000), e-commerce is “an enabling technology that allows businesses to increase the accuracy and efficiency of business transaction processing”. E-commerce is also a way for manufacturers to exchange information with customers and suppliers to the benefit of everyone involved. The wide use of the Internet technology for e-commerce applications between business enterprises has created a new source of inter-organizational information systems (IOS) called the B2B-EC systems. According to the above-mentioned authors, Internet-based B2B-EC systems are computer applications that use Internet technology, its universal connectivity and the capabilities of the Web browser to integrate business processes, within and beyond an enterprise, for the sole purpose of business transactions and integration between the enterprise and its business partners.

In the B2B-EC environment, IOS have been used since the early 1970s to link one or more manufacturers to their customers or suppliers through leased lines, mainframes, and legacy application code (Walton and Gupta, 1999; Loebbecke and Schäfer, 2001). IOS make use of standard protocols to exchange information between the enterprise and its business partners through computer-to-computer exchange of electronic documents such as sales and purchase orders, shipping invoices, stock availability, financial information and associated data (Halhead, 1995; Bhatt and Emdad, 2001). The range of applications of IOS has now extended from simply handling transaction data to supporting all forms of information exchange, including procurement

transactions, supply chain management, sourcing information, new product development, shared electronic mail, etc. (Archer and Yuan, 2000).

Rapid development of IOS in the form of Internet-base is driving much B2B-EC in the new millennium. Fiedler et al (1999) show that “an important aspect in B2B-EC scenarios is how to meet response time and throughput requirements of applications in spite of their execution taking place across corporate boundaries and, in the future, via the Internet instead of using leased lines”. They believe that B2B-EC is transforming from traditional EDI-based practice to a more challenging, Internet-based, approach. This approach is based on the notion of enterprise networks, where different companies pool their services to offer complex, value-added products.

This paper is concerned with the impact of electronic forms of conducting business-to-business transactions, since the growth of Internet based e-commerce is becoming a major medium for IOS and business process integration. In particular, emphasis is put on the impact of B2B-EC adoption on the structure of supply chains in the manufacturing industries.

#### Research need

A review of the related literature indicates that, though there has been considerable research on the subject of Internet and e-commerce, insufficient attention has been placed on developing a comprehensive method for designing, applying and implementing B2B-EC in the manufacturing industries. Due to its rapid development, there are many questions related to B2B-EC that need to be clarified. Some of these questions might be related to the concept of B2B-EC, its development and potential applications. The research will try to close the gap between the development of Internet-based B2B-EC and its impact on the operations management of the manufacturing industries.

#### **Literature Review**

A wide selection of literature was visited in investigating the role of B2B-EC or related IT development - such as EDI, IOS, Internet-EDI, and e-commerce - to chart how new ideas were received and diffused throughout the particular industry. In this section, the author explains some general terms and concepts relating to Internet-based B2B-EC to provide a framework for B2B-EC adoption.

### Growth of the Internet and e-commerce

The popularity of the Internet has made the world change faster and has removed, to some extent, geographical and physical boundaries by enabling people from different countries to communicate with each other electronically and retrieve and disseminate information quickly and easily (Gattiker, 2000). The rapid development and wide adoption of the Internet technology has brought new business opportunities. Industry estimates suggest that the total value of products and services transacted over the Internet in Hong Kong alone will increase from US\$0.06 billion in 1998 to US\$2.4 billion by 2003, which means there will be a 3,900% increase of Internet transaction within these 5 years (Lau, 2000). On the other hand, the trend of market globalization and the increasing emphasis on knowledge management have quickened the business and economic process worldwide. The change of global information and communication technologies to Internet-based activity has many implications for the management of manufacturing industries. Similarly, by means of the Internet, B2B-EC creates some unprecedented opportunities for manufacturers to increase their trade directly and promptly by eliminating the role of middlemen, to collaborate with suppliers and other business partners without the need for full integration with other businesses. As a consequence, this change provides a larger and more varied customization to the market and an ability to react quickly to changes in customer requirements. The B2B-EC approach carries strong strategic implications for Hong Kong manufacturers and provides them with many opportunities to access global markets.

### Inter-organizational information systems (IOS)

Traditional business practice has for many years involved the exchange of documentary information between business partners. To deal with growing, turbulent and dynamic environments, increasingly manufacturers are forming network alliances with their business partners via inter-organizational networks to co-ordinate their activities. The term “business partner” is used here since traditional trading between purchaser and seller can be considered as trading between partners – both are reliant on one another (Robson, 1994). The use of widespread network connectivity between different firms makes it difficult to distinguish empirically between intra-firm and inter-firm infrastructure, and infrastructure flexibility (Bhatt, 2000). Dhillon and Caldeira (2000) regard IOS as “the technological result of a more general business strategy that may bring about a significant change in the way business is done, ... and they reflect the economic concept of globalization at a micro and business level, opening the boundaries of the firm to partnerships”.

Advancements in computer and communications technology have expanded the traditional role of information systems from the creation, storage, transformation and transmission of information within an organization (intra-organizational systems), to the establishment of IOS that exchange or share information-based products and services among organizations (Vijayasathy and Tyler, 1997). The integration between supplier-manufacturer-customer through an IOS may establish a collaborative relationship and such an integration can include just-in-time shipping and other supplier services, such as management of the customer's inventory as well as component quality functions (Archer and Yuan, 2000). Recent research indicates that suppliers, customers and competitors are the sources of significant information exchange. Flexible computer-to-computer links between firms can facilitate the process of quick information sharing, feedback, and better collaboration between manufacturers, suppliers, and customers. Internet-based B2B-EC can offer the advantages of information-sharing, speedy communication and strategic flexibility to manufacturers and their business partners.

In future, companies need to concentrate on cross-business processes rather than traditional areas to ensure an efficient co-ordination and management of the new processes. Generally speaking, integration refers to the strategic and operational linking of business processes across functionally specialized groups while at the same time preserving their individual orientations. Through the continued development of the Internet, this process is becoming more and more fluid and is responsive to changes in the traditional marketplace and to the unprecedented growth of market space (Skjoett-Larsen, 2000; Graham and Hardaker, 2000). At the same time as supply chain systems have been developing to support intra-company integration, so developments in EDI and communications technologies have helped to facilitate inter-company integration without the need for full vertical integration (Hammant, 1995).

There is a great deal of literature on the integration and relationship of IOS and supply chain management. Supply chain management aims to integrate all key business activities through improved relationships at all levels of the supply chain, i.e. internal operations, upstream supplier networks and downstream distribution channels (Al-Mashari and Zairi, 2000). With technology-enabled IOS and newly developing complementary Internet-based tools, the total flow of a channel from the first supplier of raw materials to the ultimate consumer is becoming more tightly connected (Angeles, 2000). Electronic commerce technologies are eliminating the activities of middlemen and such changes "pose an immense challenge to the role of the functions involved in managing the inter-organizational interactions" (McIvor et al., 2000).

### Defining e-commerce and B2B-EC

The Internet connects more than 100 million computers across the world to facilitate quick and cheap access to information and to enable the exchange of information (Fraser et al., 2000). E-commerce does not only lower the cost of trading significantly, but, more importantly, allows restructuring of the supply chain, of business processes and of the very nature of the business itself. Its effective deployment requires an understanding of the way in which the company operates here and now and a vision of the way it will be able to operate in the future (Fisher, 2000).

E-commerce generally refers to an inter-organizational information system that is intended to facilitate business-to-business electronic communication, information exchange and transaction support through a web of either public access or private, value-added networks (Min and Galle, 1999). Many technologies can be used to support e-commerce. As described by the Electronic Commerce Association, it may involve streamlining processes, interconnectivity, Internet, EDI, electronic funds transfer, e-mail, security, electronic document management, workflow processing, middleware, bar-coding, image processing, smart cards, voice responses and networking (Hsieh and Lin, 1998). B2B-EC covers a broad range of inter-organization transactions, including wholesale trade as well as company purchases of services, resources, technology, manufactured parts and components, and capital equipment (Lucking-Reiley and Spulber, 2000).

B2B-EC is a portfolio of computer and communications-based services that speed up the development and movement of goods and information through the value chain, by establishing electronic highways between various business partners—including supplier, original equipment manufacturer, wholesaler, and corporate buyer. I define Internet-based B2B-EC as a system or network that uses the Internet protocol and the public telecommunication system to share securely part of a business's information or operations with suppliers, vendors, partners, customers, or other businesses. For successful B2B-EC transactions, information must be exchanged and interpreted both within and between organizational boundaries (Drummond, 2000). In reality, a number of large manufacturers are adopting B2B-EC via EDI-base while some of them are changing more to the Internet-base. As B2B-EC moves more and more decisively onto the Internet, examples of large organizations, such as BHP Steel, show that Internet commerce is not merely a way of selling products to individual customers, but is rather a radically new paradigm for doing business (Chan and Swatman, 2000).

### Research forecast on B2B-EC

Research forecasts predict that the volume of B2B-EC will increase dramatically. However, the business-to-consumer sector is dwarfed by the extraordinary revenue predictions for B2B-EC (Bontis and Castro, 2000). The Boston Consulting Group estimates that B2B e-commerce will reach \$2.8 trillion by 2003, with a huge increase in transactions conducted over the Internet rather than via EDI (King, 1999). By 2004, B2B-EC will constitute 7 percent of the world's total sales revenue (Bontis and Castro, 2000). Forrester Research predicts that revenue from B2B transactions on the Internet will be over \$1,551 billion by 2003, whereas business-to-consumer e-commerce will attract only 7.4 per cent as much (Warkentin et al, 2001). Gartner Group reports that in 1999, worldwide B2B-EC reached \$145 billion, with the North American region accounting for 63 percent of the market. However, Gartner Group also reports that in 2004, worldwide B2B-EC is projected to surpass \$7.29 trillion, with the North American region accounting for just 39 percent of that market (Fridman, 2000). Gartner Group projects that, by the end of 2002, nearly 26 percent of all US companies will be using the Internet to deliver their B2B invoices (Bonisteel, 2001). According to IDC's report covering the Asia Pacific region excluding Japan, B2B transactions will be over US\$516 billion of direct and indirect materials through the Internet by 2005, which represents greater than a thirty-nine times increase over the US\$12.8 billion spent in 2000 (Edwards, 2001). According to the above analysis, transactions through B2B-EC in the coming years will be growing rapidly and it will become significantly the principal medium of electronic transactions.

### EDI as a traditional way of B2B-EC

Traditionally, organizations have used paper forms to exchange information which created problems of slow transaction and extensive human handling. Hence they have realized the importance of finding a more effective way to communicate and process data (Kappelman et al., 1996). EDI is "a form of electronic communication that allows businesses to exchange transaction data and documents in structured formats that can be processed by computer applications software" (Lankford and Johnson, 2000). Angeles (2000) believes that, with its new enhanced versions and new supporting technologies, EDI will continue to play a major role in facilitating B2B-EC transactions under a changing marketplace. Fraser et al. (2000) regard EDI as "a particular sub-set of e-commerce that uses standardized, agreed formats for electronic messages to create extremely cost-efficient handling of transactions, such as product re-ordering between distributors and manufacturers who operate a build-to-order philosophy".

EDI is a computer-to-computer exchange of commercial documents (such as invoices) between business partners, without human intervention, by using structured, agreed, national or international message standards (Halhead, 1995). EDI involves data communication between systems, usually two or more companies, by conforming to a common standard, defining the core information and where and how that information must appear (Bamfield, 1994). Bamfield (1994) concludes the main benefits of EDI are in cost and productivity, through savings in time, operating costs and inventories, while at the same time streamlining stock inventories. Ghobadian et al. (1994) maintains that a number of factors contribute to the growth in EDI, namely achieving lower cost, reducing paper dependency, improving customer service, reducing mistakes, and improving competitiveness.

Greater use of EDI means that operations between trading partners will be more integrated and these partners will have direct access to previously inaccessible information (Ratnasingam, 2000). According to Bamfield (1994), manufacturers could use EDI technology to pull electronically transmitted customer orders into their central computer system easily using software interfaces. The direct transfer of information between manufacturers and business partners (material suppliers, wholesalers and distributors) can improve logistics efficiency and support improved customer service levels. EDI can help to decrease cycle time significantly, because computer-to-computer order transmission is extremely fast. In addition, it can improve cycle reliability, if electronic purchase orders replace traditional way of placing orders. EDI should also increase immensely the accuracy and speed of information transferred. Information regarding price changes, stock levels, advanced shipping notices, material forecasts, purchase orders, invoices and billing notices can be transmitted back from the manufacturer to the wholesaler instantly on receipt of the initial electronic purchase order.

#### Internet-EDI

Although EDI was first used by major manufacturers with their suppliers back in the early 1970s, it was limited in its attempt to spread to operations management due to its high cost and technological complexity. Recent development of the Internet and World Wide Web (WWW) has made B2B-EC application over the Internet much more popular and at low cost (Bhatt and Emdad, 2001). The Internet is attractive, not only because it is free and can handle EDI, but because it affords even small retail businesses a new marketplace for linking with suppliers (Lankford and Johnson, 2000). Increased growth in the use of EDI via the Internet has paved the way for a less expensive means for small-medium enterprises (SMEs) to adopt Internet-based B2B-EC compared to the

traditional value-added networks (Ratnasingam, 2000). For smaller businesses, electronic commerce technology can be helpful in allowing them to club together with others to provide an excellent platform to collaborate and work together in solving the problems they all face in exchange of information with their major business partners (Loughlin, 1999).

Angeles (2000) shows how the Internet helps small companies which use EDI to interact with large customers and suppliers who have access to more sophisticated technologies. Internet EDI allows the automation of the entire supply chain (i.e. the synchronization of the demand, supply and production, from the raw material supplier to the ultimate product consumer) and extends the boundaries of intranets, so that they can transform themselves into extranets (Angeles, 2000). A more significant driver for the re-arrangement of Internet-EDI in the marketplace is, however, the imperative for improved supply chain management which results in the automation of functions that connect leverage points in the “value chain” namely, demand planning, forecasting, materials requisition, order processing, inventory allocation, order fulfillment, transportation services, receiving, invoicing, and payment (Angeles, 2000). Some manufacturers have considerable experience with some of the original B2B-EC technologies, such as EDI, but are finding the adoption of Internet-based forms of e-commerce a more complex process than they had anticipated (Chan and Swatman, 2000).

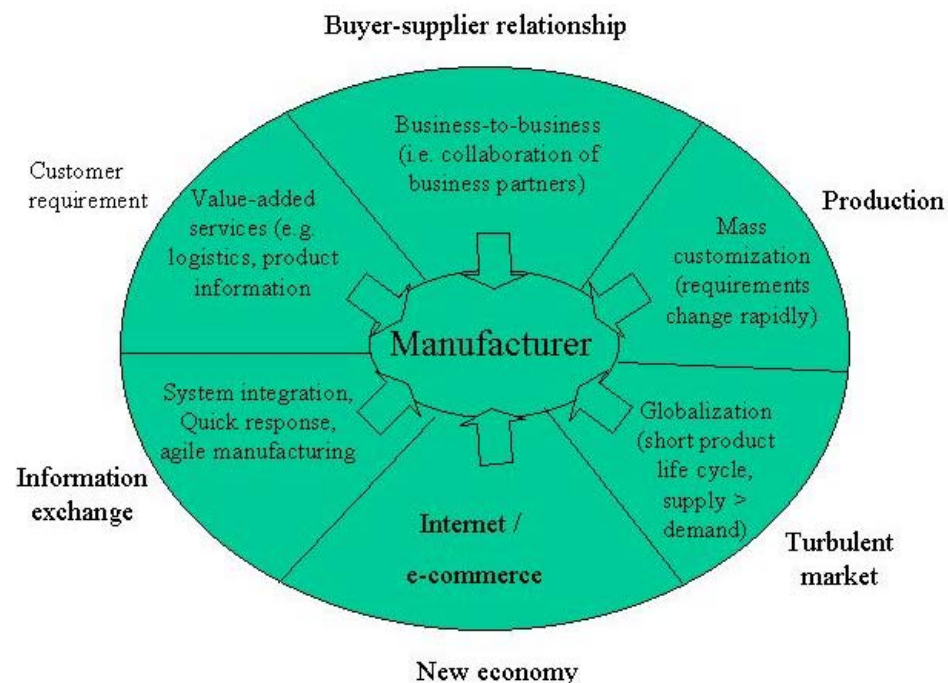
In the traditional e-commerce model, it was too expensive for these types of firms to be connected to a value added network in order to communicate with customers or suppliers. That barrier is taken care of by the widespread interconnectivity and accessibility of the Internet. Within minutes, even small firms with a personal computer and Web browser can access a Web site, fill out purchase order forms, verify their credentials, complete secure transactions, and receive confirmation from their trading partners. As a system of networks, the Internet has excellent throughput capabilities such as: e-mail, file transfer, World Wide Web (WWW) sites and remote log-ins. The factors in favor of EDI/e-commerce include lower cost, the availability of many more trading partners as it enables immediate connections between a wider range of participants and a single network infrastructure to do both regular e-mail messaging as well as EDI transactions (Ratnasingam, 1998; Angeles, 2000).

### **A conceptual framework for B2B-EC adoption in manufacturing industries**

As the manufacturing environment becomes more complex and competitive, the need for tools to assist in business-to-business collaboration could not be greater. One of the

biggest opportunities and challenges faced by manufacturing companies in the 21st century is the deployment of B2B-EC with web-based technologies. As a new channel for business transactions, B2B-EC will contribute fresh sources of revenue and opportunities for manufacturers that have carefully structured strategies. Networked B2B-EC applications, especially on the Internet and through IOS, have resulted in many changes in how B2B transactions can be carried out. Benefits from such approaches include rapid data exchange, low inventories and quick response times. All these require a high degree of interaction and some degree of system integration between supplier and customer (Archer and Yuan, 2000). A key challenge for B2B-EC is to overcome the difficulty in data interchange between supplier and customer. Traditional ways of B2B commerce, such as by EDI, seem beyond the resource capacity of many small and medium-size manufacturers, but it is often a requirement for doing business with a large company. The innovative B2B-EC using the Internet provides a means of achieving the desired degree of interconnectivity without a huge investment of time, money and sophisticated technology. The diagram below shows the environment manufacturers are currently facing (see Figure 1).

Figure 1. The changing manufacturing environment



The significance of the general nature of Internet based B2B-EC is clearly highlighted in the management literature and it may go further to actually replace some of the

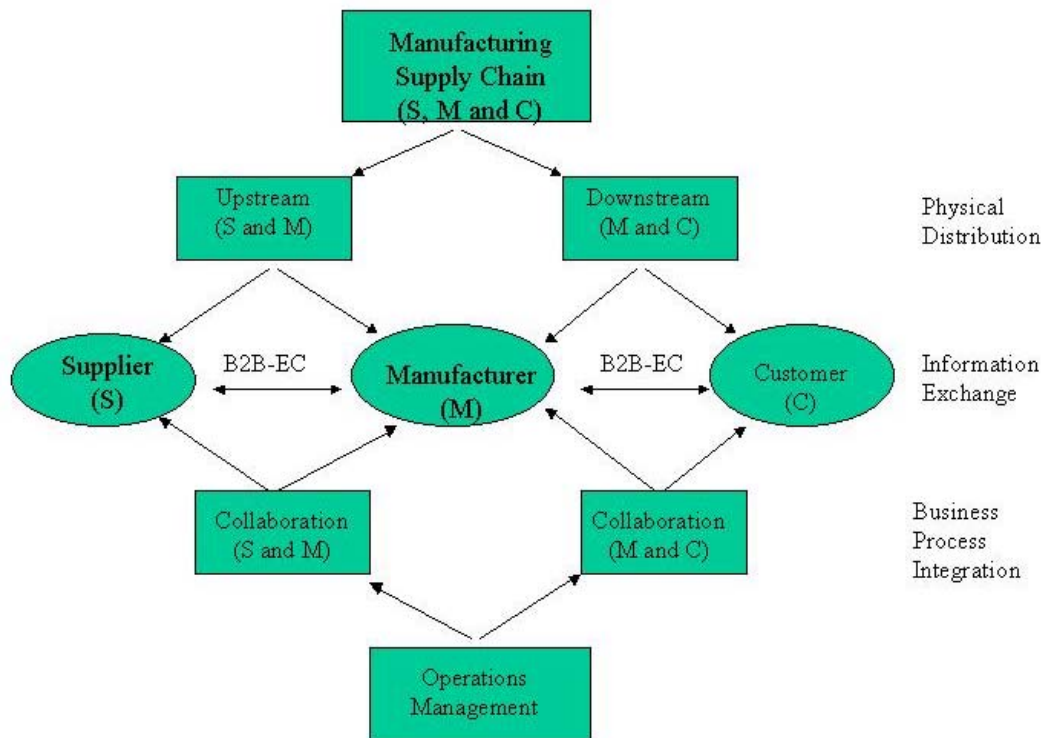
traditional forms of activity in the “manufacturing supply chain”. One great advantage to the manufacturers is that the information exchange between a manufacturer and its customer and supplier can be both direct and quick. A manufacturer can design and build tailored products and deliver them to their customers quickly. This in turn allows a manufacturer to move away from a production-oriented culture to a customer-focused one. Such focus may remove the need for a manufacturer to hold a large stock of finished goods, thus avoiding the problem of being left with obsolete stock in an environment of fast-changing consumer products.

The potential benefits of B2B-EC include online communication integrated with the information systems of business partners, which will lead to customized product and service, more diversified global market, better understanding of customer needs, real-time accurate information exchange and cost-efficient productivity. In the future, B2B-EC will influence supply chain systems in various ways. First, it will be applied as a fast and efficient means of communication between companies in the whole value chain. Customer orders, order confirmation, transport booking, invoicing etc., will increasingly take place via B2B-EC. The same applies to planning information - such as sales forecasts, production plans, up-to-date sales figures, stock levels etc., to which strategic partners will often have on-line access (Skjoett-Larsen, 2000).

According to Lucking-Reiley and Spulber (2000), expectations about productivity gains from B2B-EC can be usefully divided into four areas: (1) possible efficiencies from automation of transactions, (2) potential economic advantages of new market intermediaries, (3) consolidation of demand and supply through organized exchanges, and (4) changes in the extent of vertical integration of companies. The power of B2B-EC is that it allows a manufacturer to reduce costs, and, even more importantly, information from all sectors along the chain can be manipulated to exploit growth opportunities (Keeffe, 2001).

Having reviewed the literature on Internet-based B2B-EC, I propose a conceptual model of B2B-EC for manufacturing industries which illustrates the relationship of a manufacturer and its strategic partners by improving the information exchange of supplier-manufacturer-customer so as to streamline the manufacturer’s business operations and indeed the whole manufacturing supply chain. (Figure 2 below)

Figure 2. A conceptual model of B2B-EC for manufacturing industries



### Conclusions and implications

In the present dynamic business environment, B2B-EC may be critical for manufacturers needing to share information between themselves and their suppliers. The pressure that manufacturers are facing in a fast and dynamic environment is not only to reduce the cost of production, but also to increase the quality and the time-scale of new product development and services. B2B-EC can lead to high quality products/services, and low-cost and speed of information in responding to customer inquiries. By exchanging business information with external suppliers, B2B-EC enables a manufacturer to streamline its internal operation processes efficiently and to respond quickly to customers' shifting demands. Also, B2B-EC enables manufacturers to acquire and process information quickly across their boundaries, thus allowing the advantage of co-ordination to bring new products and services quickly to the marketplace.

Traditional EDI-based B2B-EC systems are being used extensively in the automotive industry, but in the current environment, a growing number of manufacturers are beginning to use Internet-based B2B-EC which offers the advantages of flexibility in co-ordinating between several trading partners simultaneously.

In conclusion, B2B-EC can enhance supply chain efficiency by providing real-time information regarding product availability, inventory levels, shipment status, and production requirements. B2B-EC has a vast potential to facilitate collaborative planning among supply chain partners by sharing information on demand forecasts and production schedules that dictate supply chain activities. Furthermore, B2B-EC can effectively link customer demand information to upstream supply chain functions (e.g. manufacturing, distribution and sourcing) and subsequently facilitate demand-driven supply chain operations in the shifting environment from mass production to mass customization.

#### Implications for business practitioners

With increasing pressure from globalization, increasing competition, continuing mass-customization and higher performance levels, there is a strong drive among manufacturing companies to introduce innovative ways for transacting business with their business partners. This will not only result in strengthened operational efficiency and effectiveness, but also to responding quickly and constantly to customer needs and competitive pressures with IT-enabled products, services, and distribution channels, and IT-enabled links with customers, suppliers, and other stakeholders. In the area of the management of inter-organizational relations, B2B-EC, especially Internet-EDI, is considered a major breakthrough for achieving dramatic improvements in efficiency and effectiveness. With the growing importance of B2B-EC and its projected widespread acceptance in the manufacturing industry, there is a definite need in the information system (IS) field to examine and better understand this phenomenon and the reasons and consequences of its application. The benefits associated with the introduction of B2B-EC have been substantiated by a few well publicized cases and the findings of other studies conducted among larger samples. This study has attempted to assess some of the reasons for B2B-EC adoption and the extent of its use in the manufacturing industry.

The outcome of the cost and benefit of B2B-EC to a manufacturer depends on a number of factors that can be analyzed by use of a theoretical framework. At the core of the attractiveness of e-commerce is the ability to achieve two possible impacts to the operations management of manufacturing industries:

1. The use of B2B-EC improves operation performance by a reduction in intermediation costs associated with wholesale and retail activities.
2. B2B-EC improves manufacturing supply chains by improving information gathering and processing that permits improved management of the supply chain.

### Implications for academic researchers

The B2B integration has been proved to provide customized service and product differentiation while making the relationship of customer and supplier closer and ultimately leading to greater collaboration. I conclude that all of these features are essential for an effective supplier-manufacturer-customer interaction model that can provide the customer with added value in product and service delivery, and the manufacturer with increased business opportunities. Whether this model is applicable to the manufacturing industries or not, it must be further tested and validated by empirical research in some specific industry sectors to incorporate manufacturers' views concerning the adoption of B2B-EC and the benefits of running such an efficient and effective information exchange system, benefits not only for the company itself but also for the company's business partners.

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