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Building an E-Business from Enterprise Systems

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Abstract. **Building their companies into successful e-businesses has become an important objective for today's enterprises. Conceptually, it embodies the enabling of the business with such capabilities as global networking, streamlining business processes, sharing information, agility in responding to the market, and intelligent decision making. But how can these concepts be implemented in actual enterprises? Why do these desirable attributes of business systems suddenly become the definition of competency of companies large and small? This paper describes the framework for building an e-business from the enterprise information systems' perspective.**

Increasingly enterprise systems have extended beyond the traditional business functions and include such new features as supply-chain management, customer relationship management and electronic commerce. The shifting focus is driven by the adoption of the Web as a new channel for product distribution, marketing, and interacting with customers. The integration of the traditional as well as the Web-oriented functions is the cornerstone for a successful e-business. This paper presents a framework for e-businesses that on one hand build on the enterprise systems but on the other hand encompasses the new e-business dimensions.

Key Words. **e-business management, enterprise systems**

1. Introduction

Building their companies into successful e-businesses has become an important objective for today's enterprises. Conceptually, it embodies the enabling of the business with such capabilities as global networking, streamlining business processes, sharing information, agility in responding to the market, and intelligent decision making. But how can these concepts be implemented in actual enterprises? Why do these desirable attributes of business systems suddenly become the definition of competency of companies large and small? This paper describes the framework for building an e-business from the enterprise information systems' perspective.

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Information systems have become the nerve center of most enterprise systems. As enterprise operations go increasingly global, proper coordination between business and manufacturing units in the global value-adding chain needs special attention. Information systems can help provide that coordination. What makes information systems the backbone of business operations is the emerging global information infrastructure. Through this infrastructure, enterprise systems can achieve business integration and coordination. That becomes the foundation of any e-business.

The key components of an e-business are shown in Fig. 1. The core of an e-business is three-fold: supply-chain management, back-office support, and customer relationship management. These three main lines of functions are integrated and coordinated through infrastructure management, knowledge management, and channel management.

The backbone of most enterprise infrastructure supported by information systems is the enterprise resource planning, or ERP, system. The first generation of ERP systems were focused on ensuring that all

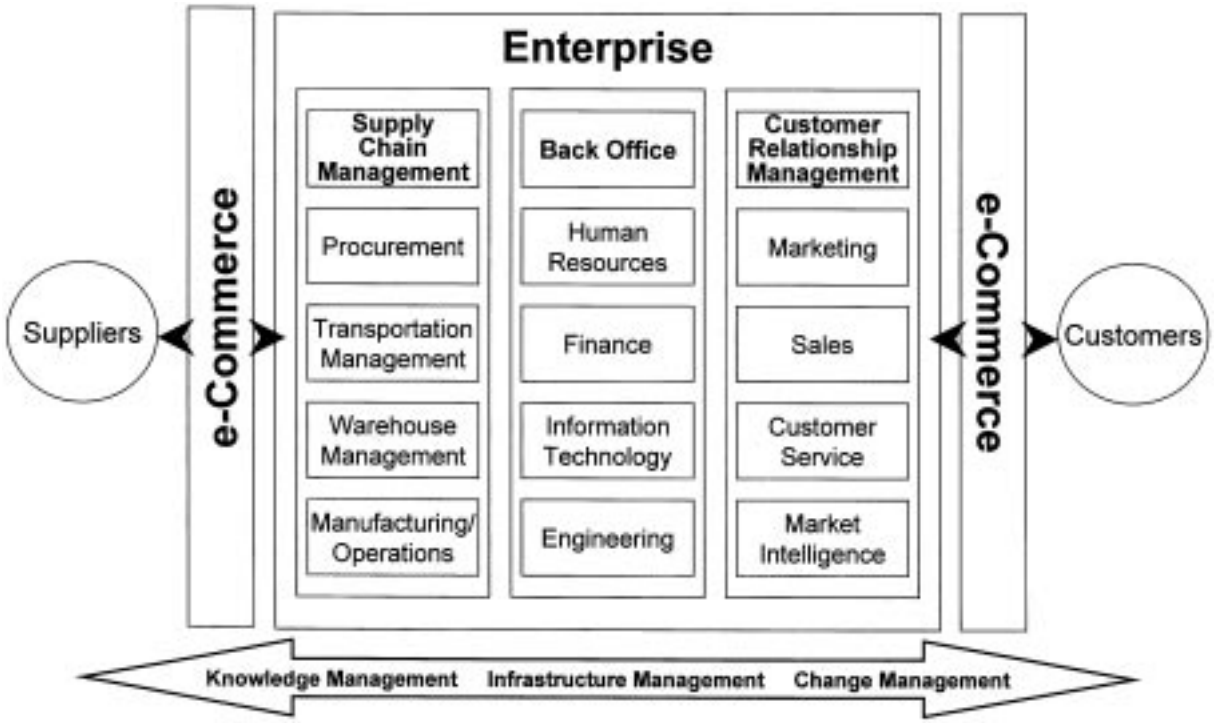

Fig. 1. *Components of e-business.*

business processes be fully integrated, often at the expense of a very rigid system environment. Increasingly ERP systems need to enable enterprises to quickly respond to customer orders, consumer demands and market opportunities. The information and connectivity available also make possible more outsourcing and better management of suppliers. The combination of these changes reinforces the view that (1) the supply chain networks (SCNs) should be the focus of any enterprise system and (2) the Web provides the global infrastructure for coordinating with the back office, supply-chain partners and interacting with customers.

Supply-chain networks can be broadly defined as groups of business units working together to deliver finished products from raw materials. Whereas the traditional capacity-based view usually focused on production planning and control, the emerging ''sense-and-respond'' model concentrates on responding to customer orders and market demands (Bradley and Nolan, 1998). Traditionally, the fundamental disposition of a capacity-based planning process is to pre-package and shrink-wrap as much as possible to take advantage of economies of scale and, then, to offer persuasively what has been made. Frequently, the product process and manufacturing capacity drive the production. In contrast, a sense-and-respond enterprise system concentrates an enterprise's resources on quickly responding to specific market needs (Tan et al., 1999).

Fig. 2 describes the basic functions of an e-business that builds on enterprise resource planning systems. It includes components for supply-chain coordination, customer relationship management, decision support systems, and human resource management. At the core of the e-business system is the e-business engine, consisting of ERP supports for not only processes, but also market sense-and-respond, business-to-business coordination, and electronic commerce.

The remainder of this paper is organized as follows. Section 2 discusses the Web as the enterprise information infrastructure as well as a new channel to reach out to the customers. Section 3 focuses on issues concerning information sharing and coordination. Section 4 describes the e-business fulfillment

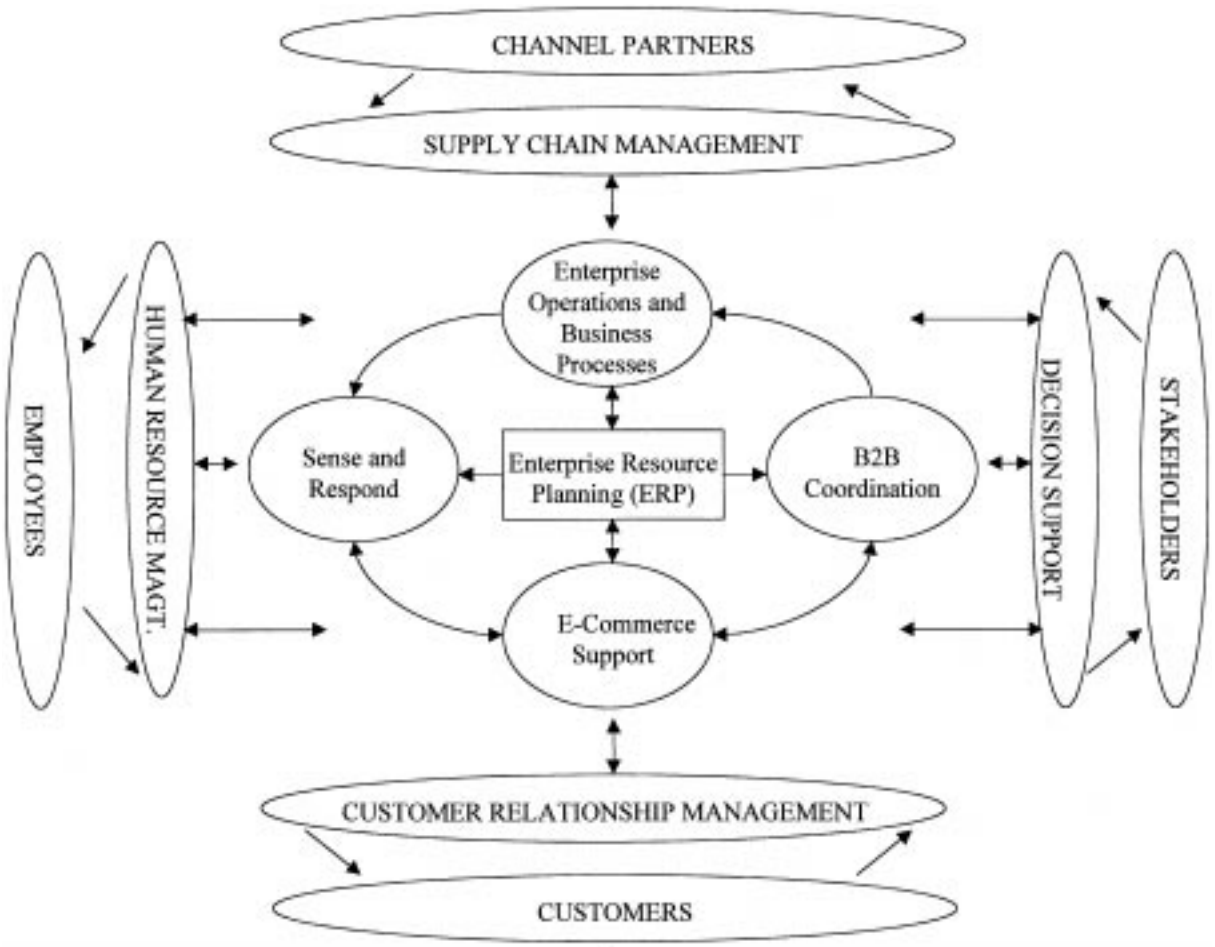

Fig. 2. *Building an e-business from enterprise systems.*

process, which depends greatly on the Web for coordination. Section 5 discusses the potential conflicts between traditional and Web channels and the resulting channel management issues. Section 6 extends the enterprise view to include business-to-business e-commerce functions. Finally, Section 7 concludes the paper.

2. The Web as the Enterprise Infrastructure and a New Channel

In order to coordinate various business units and processes in an e-business, an effective infrastructure is essential. The enterprise information system supports supply-chain processes and process coordination within and between enterprises. In addition, the infrastructure also includes (1) a global information network for supporting various electronic services such as brokerage and contracting, payment and banking, and transaction processing, (2) electronic access to external data, and (3) electronic connections to customers that support activities such as filling orders and customer service. Increasingly, the way to integrate these infrastructure components is to use the Web infrastructure supported by the Internet. Using the Web infrastructure, intranets support intra-organizational business processes, extranets connect enterprises to their channel partners and the Internet links the enterprises to their customers, other institutions and agencies (Strader et al., 1998).

Using the Web as the infrastructure, an enterprise

not only has a better means to coordinate with its supply-chain partners, as importantly, it has a new channel to reach out to the customers. With the Web channel serving as the virtual storefront, there are opportunities for product marketing, customer relationship management, and product branding. In addition, there is a new kind of consumer process emerging that combines information aggregation, navigation, and interactive exchanges. On the one hand it enables mass customization; on the other hand the infrastructure supports quick responses to market demands. To support such a new channel, as depicted in Fig. 3, new capabilities are needed from the enterprise systems.

The Web provides new paradigms for supporting enterprise and supply-chain processes. A Web technology that stands out as particularly useful for supporting enterprise and SCN activities is the component technology. The component approach potentially can better enable companies to integrate the supply chains and their processes among the supply-chain partners. They not only share product, manufacturing, and customer information with their partners, increasingly they are letting the suppliers adopt parts of their business processes and systems to enhance coordination. The traditional enterprise systems, such as ERPs, put the emphasis on process integration. With this component-based approach, we will likely see more highly modularized companies, as illustrated by Fig. 4, with each unit specialized in its core competency but always prepared to link up with business partners and their enterprise system (Baldwin and Clark, 1997).

The component concept can be applied to several different levels:

1. *The software and system level*, where software objects and components have been used as the building blocks to make the functional components portable and inter-operable.
2. *The process and application level*, where business processes and applications, such as order fulfillment, customer services, etc., have been managed as separate modules, sometime run at remote sites by applications service providers (ASPs).

Fig. 3. *The Web as a new consumer channel.*

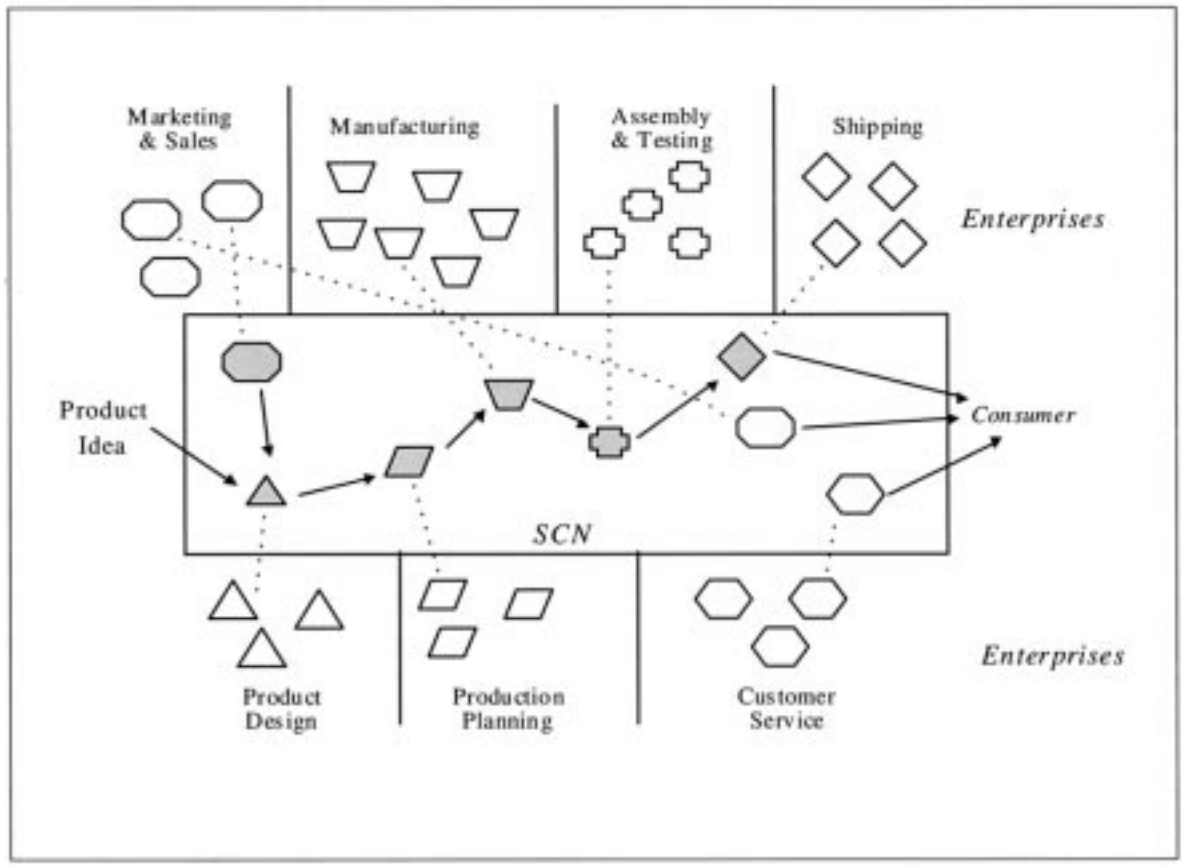

Fig. 4. *Component-based enterprise systems.*

3. *The enterprise level*, where business units can be quickly assembled to form virtual enterprises to explore a window of market opportunities.

The general trend these developments collectively point to is that in an e-business, there will be increasing use of modularity and the component model to increase portability, inter-operability, and plug-and-play functionality. The paradox, interestingly, is that the enterprise systems will be more integrated because of the greater use of modularized components.

3. Organizations, Information-sharing, and Coordination

A distinct feature of an e-business is its capability to adapt and react: the organization is more agile. The trend for e-businesses to gradually shift from hierarchical to networked organizations fits the general trend of the economy. With the increasing use of information systems in most organizations, organizations are shifting toward flatter and more adaptive structures, sometimes referred to as the market oriented networked organizations (MONOs). Instead of the command and control innate in traditional hierarchical organizations, MONOs require more coordination and the coordination is done in a way similar to the way goods are allocated in the marketplace through decentralized pricing and exchanges. A supply-chain network is a type of MONO when the business units are assembled through market forces. On the other hand, a supply-chain network may be a type of hierarchical organization if it is totally vertically integrated. Electronic commerce is moving e-businesses and their supply chains to be more on the MONO side.

An example of applying the market paradigm to

coordination was studied by (Shaw and Whinston, 1988). They presented a framework, called the Contract-Net, for organizing manufacturing systems. According to the framework a manufacturing system can be viewed as a marketplace in which jobs can be done by bidding and auctioning in real-time through computer networks. Quick-response, adaptability, flexibility, and fault-tolerance make such a framework appealing. Similar systems have become much more common as computer networks are a fixture in most enterprise systems. Increasingly the same shift will happen on the supply-chain level as well, and supply chain networks may be viewed as Contract-Net like organizations. They will become more dynamic, adaptive, and opportunistic. This will be further discussed in the B2B e-commerce context.

Web technology overcomes problems of system incompatibility in such e-businesses by encapsulating enterprise systems as object components that are made accessible by standardized interfaces, and defining a protocol for transmitting documents between these components. This improves e-business management by (1) reducing production costs through lower procurement and distribution costs, (2) better utilization of resources through enterprise specialization, and (3) greater integration of e-businesses' supply-chain activities.

The lack of information sharing is a common cause for supply-chain related problems. One example is the so-called bullwhip effect, in which a slight variation in demand at the consumer end gets increasingly amplified and results in wild swings at the supplier end. The bullwhip effect is attributed to four causes: demand signal processing, batch ordering, price fluctuation and shortage gaming (Lee et al. 1997). In demand signal processing, for example, because data on the quantities sold to consumers is not passed on to the upstream levels, each tier is forced to predict demand based on its adjacent downstream order. This results in multiple forecasts, with predicted errors escalating as the distorted demand information travels upstream. Meanwhile, supplier's production information (e.g., capacity and lead-time) is not shared downstream. This leads into a vicious cycle of shortage gaming and large demand swings. Countermeasures for this undesirable phenomenon include consumer direct ordering, sharing point-of-sale capacity and inventory data, vendor-managed inventory, and continuous replenishment programs. These solutions boil down to the need for information sharing and an information infrastructure to support it.

Information sharing has been used not only for reducing the uncertainties and smoothing out supply chains, it has been used simply to eliminate wasteful activities, efforts, and resources along the supply chains. Larger corporations are putting it into practice today. To sell at Wal-Mart, for example, its main suppliers must study the giant's weekly sales figures, forecast demands for its products, and place them on the shelf. In other words, information-sharing has gone beyond simply providing some type of data. It may involve a plan of action based on the data. This kind of partnership has proven to be mutually beneficial. The goal of information sharing is coordination. Three types of coordination exist in supply chain networks (listed in order of increasing need for partnerships and commitments):

a. Simple information exchanges.
b. Formulated information sharing.
c. Modeled collaboration.

Simple information exchanges are the most common type of coordination used between channel partners. It is done mostly as vendors and their customers pass data unique to their businesses to each other, via EDI or the extranet, on a transaction basis. The demand stream typically is based on future orders, warehouse flow, or sales forecasts.

Formulated information sharing is one in which an organization provides its suppliers with demand parameters and priorities, or a ''formula,'' to guide restocking. Typically, the customer drives the formula for restocking by dictating protocols and priorities. Wal-Mart, for example, provides its major suppliers with its sales data and restocking algorithms. Then, the suppliers decide the shipment schedules based on the shared information. Similar continuous restocking programs also fall into this category.

Modeled collaboration involves the sharing of operational models between two supply-chain partners so that each has a real-time view of the other's capabilities, factory loads, on-hand inventories and committed orders. As an example, a component manufacturer shares its production plans and a simulation model of its production lines with its customers. The customers can then use the models and data to decide its orders and the timing of them,

information that can be added to the production plan by the customer. Modeled collaboration could support the vision of virtual manufacturer (Upton and McFee, 1996), since each partner can make unilateral (but informed) decisions that may affect the resources of others.

The Web can enhance all three types of coordination. It has a special impact on the coordination mechanisms that require stronger partnerships, i.e., formulated information-sharing and modeled collaboration. In type (a) coordination, with simple exchanges of information, the Web can potentially enhance current EDI technology because it has much broader access and is cheaper to implement. Currently, the major risk associated with Web-based EDI is still the lack of security. In addition, Web technology needs to move to a more advanced phase. When technology such as XML becomes standard, the information being exchanged can incorporate semantic structures. In type (b), the commitment lies in the sharing of inventory related data and policy information. It is currently implemented mostly by EDI. The Web can help enrich the information shared. The major impact of the Web on coordinating e-businesses, in terms of forcing change in business models, will be in type (c). The capability of the Web for executing computational models and algorithms from remote sites makes this type of collaboration much more possible than before. The component approach just discussed can help facilitate development. For example, we may see increasingly more third-party contract manufacturers emerge as key partners in the supply chains. To coordinate better through the Web, these contract manufacturers can put their factory scheduling routines, simulation models, etc. on the Web. Their customers can run these models from remote sites to determine orders to be placed in view of the capacity available and the production plans already in place. It is interesting to note that that these effects of information sharing take on varying degrees of significance in different types of supply chains.

4. E-Business Fulfillment: From Supply Chains to Supply Webs

The Web infrastructure provides opportunities to redefine the fulfillment process. Increasingly, e-businesses will adopt network organizations of specialized units coordinated through electronic networks to replace the traditional hierarchical organization. Because of their agility, these network organizations can be configured and reconfigured rapidly. The Web also provides new ways to coordinate workflow, manage documents, and enhance group work.

Fig. 5 describes general e-business fulfillment processes. They may be executed differently according to the particular business model adopted. For example, ComUSA, a computer retailer, has expanded its role in the supply chain. It started to relabel computers made by third-party manufacturers under its own name. It also oversees parts procurement, assembly at the factory, and shipping. A customer can specify his own PC configuration on a kiosk in the store or via the Web, and the PC will be built to order. Dell Computers, on the other hand, has perfected its direct-sell, build-to-order business model by integrating the role of the retailer, the distributor, and the product brand-name company. It has achieved the fastest inventory turn-around time in the PC industry by adopting this business model. It has actually achieved a negative ''cash-to-cash cycle time,'' i.e., the time from when it receives payment from its customers to the time it pays its suppliers! That has fundamentally changed the valuation model used to benchmark an e-business.

In running an e-business the Web-based supply chain model provides opportunities for several companies to work together and form a virtual enterprise. An example is the plan of Ingram Micro Inc., the largest distributor in the PC industry, to team up with Solectron Co, a giant contract manufacturer. Their goal is to help brand-name PC makers, such as Compaq Computers or Hewlett-Packard, to build PCs to customer orders. Instead of the PC companies handling orders and manufacturing, Ingram uses the processes described in Fig. 5 to facilitate order fulfillment and shorten response time. PC ''makers'' such as HP and Compaq still have their brand-name labels, but they no longer actually make computers. Instead, they focus their efforts on marketing, quality assurance, product development, customer service, and building the whole ''supply web.''

A recent *Wall Street Journal* article declared, ''A revolution has swept through the nuts-and-bolts end of the information technology industry.'' (WSJ, 2000). It continues, ''Companies such as Flextronics

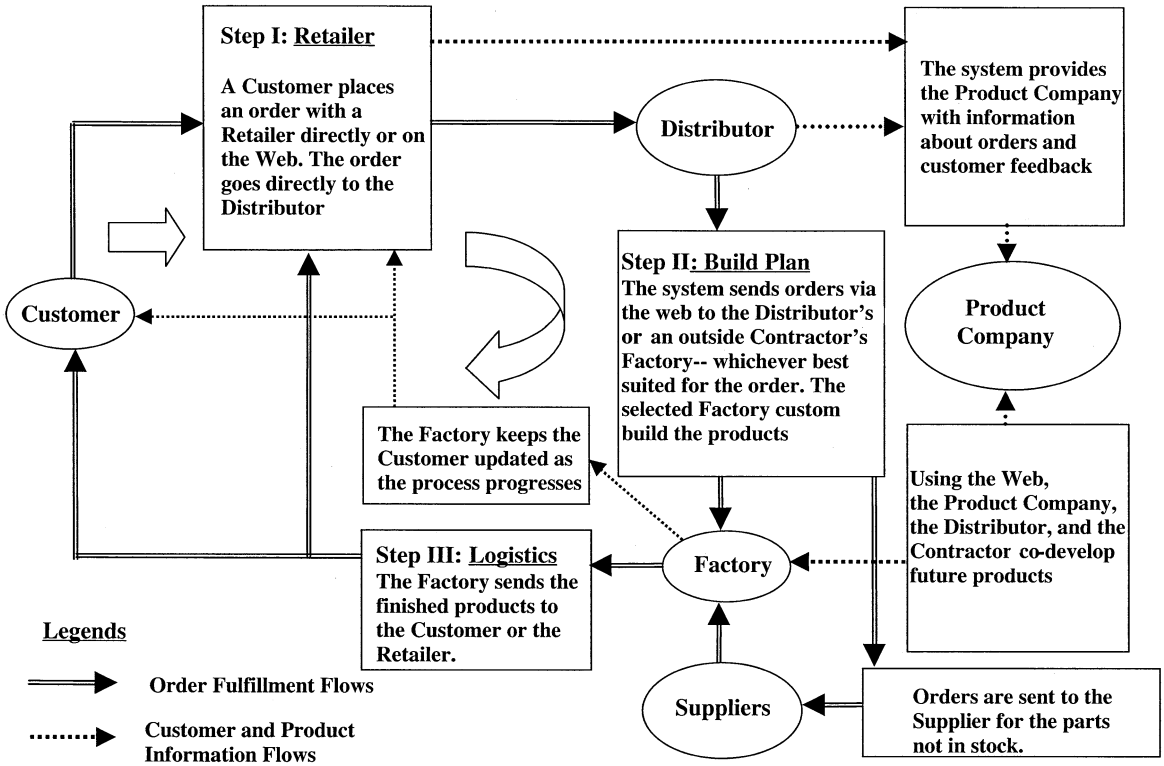

Fig. 5. E-business fulfillment processes.

International Ltd., Solectron Corp., Jabil Circuit Inc., and SCI systems, barely known just a few years ago, have emerged as highly efficient manufacturers and supply-chain managers that operate factories around the globe. The electronic giants whose names their products carry—Compaq, Ericsson, and Cisco Systems—are just as quickly getting out of making things, concentrating instead on developing new products and persuading consumers to buy them.''

This is happening because, with the Web providing the links for sharing information among channel partners and the component technology providing the interoperability to integrate business processes, companies will use more outsourcing in their business models. As a result, companies will concentrate on their specialized products while working closely with the suppliers. The ability to manage supply-chain networks will, thus, determine the competitive advantage of a company. Supply-chain networks represent the emergent behavior (Holland, 1995) among a group of business units working together to exploit the underlying adaptability, collective capabilities, and market opportunities. The Web helps facilitate coordination among the units, reducing the inventories and the cycle-times. The networked nature of the Web forms a natural infrastructure to support and transform e-businesses.

Because of the potential to manage e-businesses in these dynamic, innovative ways, the fulfillment process has become an important core competency in running any e-business. The Web has become an indispensable channel for marketing, distribution, and purchasing. At the same time, it has totally changed the nature of the fulfillment process. Now often time the fulfillment process involves multiple channel partners with different responsibilities in receiving orders, production, logistics, and servicing. Moreover, compared to the traditional fulfillment process, e-retailing usually involves smaller batch sizes, instant shipping, and more customization.

There are a number of common fallacies with respect to handling fulfillment in e-business: For instance, many companies in executing e-business focus only on the front-end processes for differentiation on the Web but fail to consider through most differentiating section of back-end processes. Poorly

integrated front- and back-end processes frequently lead to excessive costs and erosion of customer loyalty.

There are companies relying on existing logistics operations to handle Web commerce fulfillment, not realizing that highly automated warehouses are illsuited to ''picking and packing'' the smaller Web orders. Another common fallacy is relying on existing supplier relations to support Web commerce and failing to create a partnership with manufacturers to enable efficient fulfillment. By the same token, a company may rely on traditional order management system to handle Web commerce and fail to handle the high-volume transactions found with Web commerce. Some other e-businesses overlook the skills and willingness to work with multiple partners in carrying out fulfillment.

To overcome these fallacies of mismanaging e-businesses, a framework for e-business that focuses on integration and the effectiveness of fulfillment is greatly needed. This involves abilities to coordinate with multiple channel partners in carrying out the fulfillment process. It also requires process coordination so that the different partners and their involvement in the process are transparent to the customers.

5. Channel Management

For most e-businesses, the emerging Web channel for purchasing, distributing, and marketing has created enormous opportunities for reaching out to new markets and customers. While there are companies specializing in e-commerce and using the Web as the only channel, most companies that run e-business still maintain traditional channels. How to manage the Web channel along with the other channels increasingly has become an issue for any e-business. The prominent channel management strategies used in running e-business are summarized as follows:

1. *Web enhances traditional channels*. This is a commonly used cross-marketing model. Business Week and major TV networks, for instance, often use the Web to provide more detailed coverage than their traditional channels, thereby enhancing their brands and their traditional channels.
2. *Traditional channels promote the Web channel*. All e-commerce companies, the so-called ''dot-com'' companies, use traditional media to promote their brands. Some traditional retailers put kiosks in their stores to provide Web access to assist any need for additional product search.
3. *Web channel used to explore new markets*. Because of the specific demographics of Web users, some companies use the Web to reach out to segments of the market that they couldn't before reach. Furthermore, the Web enables an e-business to reach out to global consumers geographically.
4. *Add new product lines only for the Web*. For the same demographic reason as in (3) above, some companies use the Web to sell new products. This is especially effective when the business traditionally depends on powerful dealers/distributors and therefore selling the same products direct is not immediately an option. The auto industry is such an example.
5. *Integrate the Web and traditional channels*. This is the ''click and mortar'' model, combining hopefully the best of traditional and the Web channels. Pure dot-com companies need more traditional distribution channels to provide more efficient logistics and better customer services. Traditional channels need to add the Web channel to add new capabilities for searching, navigation, and interactive, hyper-linked information retrievals.
6. *Cannibalize traditional channels*. The new Web channel takes over the major share of the business. When this is inevitable in a given industry, a company might as well do the cannibalization rather than being eaten up by competitors.
7. *Spin-off the Web channel*. There are financial, strategic, organizational, and legal reasons behind spinning off the part of a company specializing in e-commerce. This is an antithesis to channel integration.
8. *Building alliances between ''new economy'' and ''old economy'' companies*. The alliances built recently between car-makers and pure e-commerce companies, for example, belong to this model, which stems from the desire to build synergy between the Web and traditional channels without having to do it in house.

What these channel management issues imply is that the enterprise information systems for an e-

business can no longer be just for integrating traditional enterprise functions in accounting, production, marketing, etc. There have to be additional components to provide capabilities for e-commerce trading, channel coordination, and dynamic market making with other e-businesses. The business-to-business (B2B) e-commerce has become a critical element of an e-business to those ends.

6. Business-To-Business E-Commerce

The Web provides an e-business with greater opportunities to interact with the market place in managing its supply chain. As a result, there is an increasing need to shift supply-chain activities to interact more with B2B intermediaries, markets, and exchanges. This emerging focus of supply-chain management on B2B e-commerce provides an important link for an e-business to coordinate with other e-businesses. Moreover, conducting B2B e-commerce over the Web has made e-businesses better connected in the global network matching sellers and buyers.

What does enterprise systems need to incorporate to fulfill these functions? Fig. 6 shows the taxonomy of the major types of B2B e-commerce models. For the B2B supply chains, there will be increasingly more market making activities even for the supply chains of main products and their components. As a result, the supply chain management function for an e-business needs to coordinate and integrate the transaction flows among channel partners on a more dynamic basis. In supporting business-to-business procurement, for instance, the B2B model can be based on Web-based catalogs, supply/demand aggregation, markets, or exchanges, as depicted in Fig. 6.

For web-based catalog systems, there are two key considerations. First, the suppliers' product information will have to be inter-operable, so that the customers can navigate between the product catalogs of different suppliers. Second, the catalog search and related activities must be integrated with the

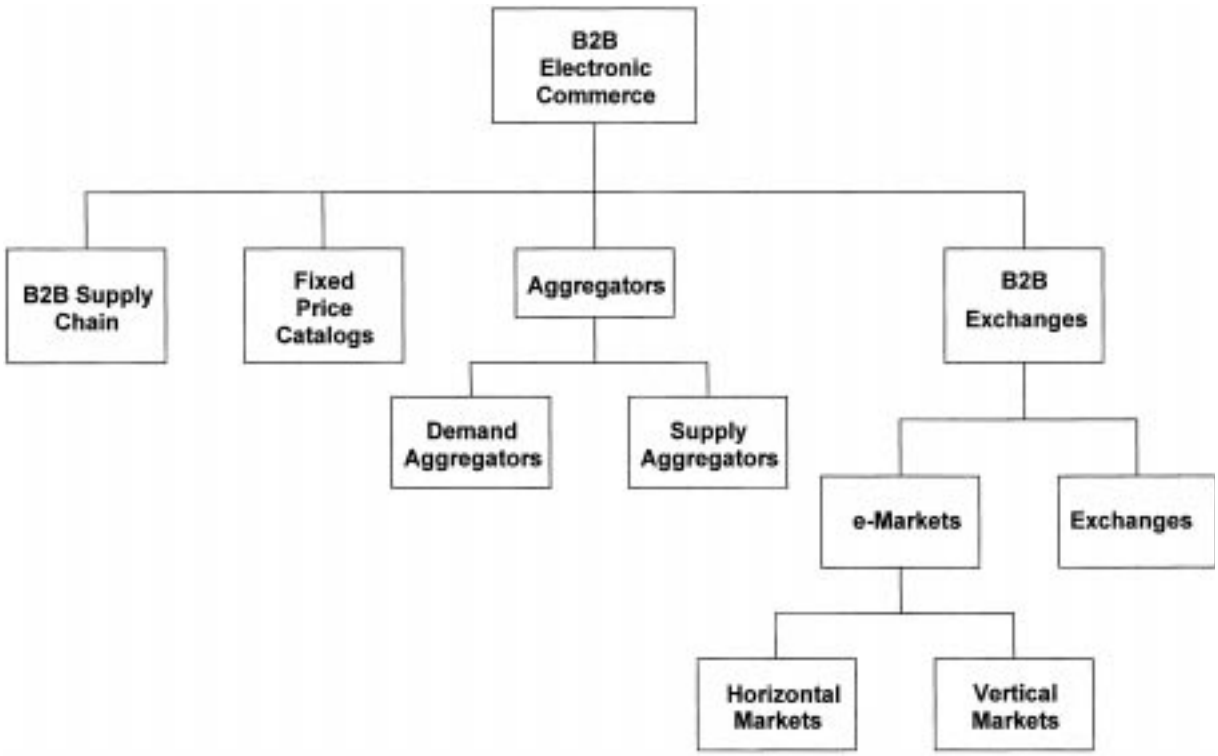

Fig. 6. A taxonomy of B2B e-commerce.

enterprise legacy systems, so that the front-end information search processes and the back-end support processes can be seamlessly integrated.

For supply/demand aggregation, market, and exchange models, the key to successful e-business development is to integrate transactions across multiple sites. More importantly, the back-end of e-business systems must be directly connected to the on-line market.

7. Conclusion

Web technology brings about opportunities for running e-businesses. There are several changes to the management of enterprise systems. First, the barriers erected by proprietary systems go down, allowing companies working in the same supply-chain to link electronically. Trust between channel partners is more important as the switching costs due to system compatibility are reduced. Companies will compete on other terms such as the quality of product, customer service, the timeliness of product delivery, etc. Second, as companies become more specialized in their key processes, a new breed of companies with focused manufacturing specialties emerges. As a result, more contract manufactures develop. Third, the number of virtual enterprises increases as specialized companies band together to provide the entire repertoire of e-business functions. Fourth, new dimensions are added to the enterprise system, two prominent ones are the customer relation management functions and the business-to-business e-commerce interfaces.

The e-business framework described in this paper therefore can be viewed as the next generation of enterprise systems, where the integration with B2B transactions, channel partners, supply-chain processes, and customer relationship management needs are equally important for managing an e-business. The framework also includes the capability to coordinate and integrate with other e-businesses. As opposed to the emphasis on hierarchical information organization to ensure process coordination and data consistency as is the case in traditional enterprise systems, the new generation of enterprise systems will be open, flexible, modular, and interoperable. As important, it will fully integrate with the Web channel for supporting business-to-consumer and business-to-business transactions.

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