Business-to-Business E-Commerce: A Transition Model

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Abstract

The creation of Internet-based companies is changing the way business is being carried out and increasing the pressure on traditional firms, which now need to adapt to the new challenges brought about by the so-called digital economy. Successful electronic commerce activities depend on the partners involved in the product or service being delivered. Firms able to communicate with their partners electronically for procurement, sales, or supply chain management have become what many call clicks-and-mortar companies.

An empirically based technological model that helps organizations understand the requirements of moving towards the seamless integration of intra- and inter-organizational processes is proposed. This five-wave transitional model accompanies key decision-makers through progressive steps that correspond to different business-to-business e-commerce needs and specifications. As organizations move along these technological waves, we can witness the gradual opening-up of new opportunities for carrying out business. This paper presents the model, its requirements and its technological and organizational underpinnings. The model is illustrated with examples from organizations in a major industrial sector.

1. Introduction

At the dawn of this new millennium, we are finally starting to witness the exponential growth of electronic commerce (e-commerce) that most specialists have been forecasting for the last few years. It is clear that the diffusion of electronic commerce will persist, and indeed accelerate, in the years to come [4]. Five of the largest North American research firms have provided forecasts of the projected growth of Business-to-Business e-commerce (see appendix 1). As for the definition of “electronic commerce”, there are several and they differ considerably. The OECD tackled the issue in its e-commerce work program initiative [22] and came up with the following: “Electronic commerce refers generally to commercial transactions, involving both organizations and individuals, that are based upon the processing and transmission of digitized data, including text, sound and visual images and that are carried out over open networks or closed networks that have a gateway onto an open network” [21].

Elsewhere, the Japanese Ministry of International Trade and Industry (MITI), which has been a strong promoter of supply chain integration, defines electronic commerce as “the conducting of commercial transactions (the exchange of merchandise, services, information, and/or money between suppliers and receivers for the commercial transfer of goods between economic actors) through electronic mediation using Internet technology” [20].

Clearly, electronic commerce facilitates the exchange of information by developing stronger buyer-supplier relationships. Suppliers are no longer seen as potential competitors but as partners [23]. Bakos and Brynjolfsson discuss the value-adding partnerships that have emerged with the new information technologies. These collaborations favor outsourcing to a smaller number of faithful suppliers [2]. Indeed, Collins and Bechler conclude in their study that the outsourcing of manufacturing has become a competitive imperative and is now a strategic choice for most organizations [7]. Furthermore, despite the increasing need for an integrated and flexible supply chain where the focus has shifted from push (forecast-driven) management to pull (demand-driven) management, long-term partnerships between manufacturers and suppliers have been more beneficial than arm’s-length relationships in terms of quality, time to market, and product development [7, 11, 12, 13, 14]. The label Supply Chain Management (SCM) is currently being used to designate these activities: “It integrates planning and balances supply and demand across the entire supply chain -- it ties suppliers and customers together in one concurrent business process that focuses on the ultimate customer” [24].
Cox et al. have analyzed different types of buyer-supplier relationships and are convinced that a buyer with a dominant position can and should exploit its situation to benefit the overall relationship (i.e. improve quality and reduce costs) \[9\]. These relationships are being promoted through the creation of major electronic platforms (or marketplaces) where large organizations are joining forces to increase their buying power. Four of the world’s biggest defense and aerospace firms (Boeing, Raytheon, Lockheed Martin and BAE Systems) have pooled their resources and merged with Commerce One to form a Web-based marketplace for aerospace parts and services. The platform brings together 37,000 suppliers and a significant number of airlines in order to process $71 billion in annual procurement expenditures. The automobile industry has been moving in a similar direction, with the likes of Ford, General Motors and DaimlerChrysler creating, in May 2000, a marketplace known as Covisint, along with new members Renault, Nissan and Toyota. This platform is expected to handle more than $300 billion in transactions annually.

This paper will look at some of the new business-to-business electronic commerce functionalities (transaction processes) that seem to be emerging between manufacturers and suppliers, with a special focus on the technologies required to support these e-commerce applications.

2. Electronic commerce transaction processes

Most of the business-to-business electronic commerce platforms that have emerged in the last year, or even months, in various industrial sectors have focused on catalogues, auctions and bidding systems. Most of these marketplaces plan on developing sophisticated technical and graphical exchange tools but very few have been able to market them effectively yet. The automobile and aeronautic platforms, along with more company-specific platforms such as GE’s TPN system, are still dealing with basic transactional services. Others such as E-vis have developed collaborative design and engineering platforms that meet the needs of innovative firms in a niche market. These more advanced platforms will evolve in the years to come such that SMEs, which often have an important role in designing a product (up to 70% of a car or a plane), will have to learn to use these technologies and, most importantly, deal with them securely in order to transfer confidential and often very strategic information.

A comparative study conducted by the MITI in Japan and Andersen Consulting in the U.S. has identified the major B-to-B electronic commerce transaction processes carried out by organizations engaged in electronic commerce \[20\]. These e-commerce functionalities, shown in figure 1, will intensify in the years to come. Most of the electronic commerce functionalities singled out by the

![Figure 1 - E-commerce functionalities](source: MITI and Andersen Consulting, *Size of Market Study for Electronic Commerce*, March 1999.)
MITI study are procurement-oriented. Other reports and papers in procurement and electronic commerce identify similar activities [15, 26]. This obviously raises some very fundamental questions with respect to e-commerce functionalities and their supporting technologies.

3. Research questions and methodology

The organizations that will benefit from these initiatives are those that understand the needs and requirements of carrying out electronic commerce activities and how this will ultimately change the way business is conducted. In this paper, we will try to answer the following questions:

1) Are electronic commerce transaction processes cross-functional within the organization? If so, which functions of a company (sales, marketing, manufacturing, design, etc.) are the most affected by organizational and technological changes?

2) What technologies are required to optimize the flow and management of information that supports e-commerce functionalities within and between organizations?

In order to answer these questions, we have closely monitored the activities of four manufacturing SMEs in the electric/electronic industry along with their major client, a large public utility company. Information was first obtained from a questionnaire administered to the management team1 of each organization. Interviews were then conducted to capture information that might not have been understood by the representatives of each organization or by the researchers. Frequent visits to these companies enabled us to identify the individuals (operators, technicians, buyers, etc.) who were most able to address very specific questions and to validate the answered questionnaires and the information collected during interviews. All of this was conducted over a three-year period, which allowed us to witness the gradual change, from the creation of web sites, to the implementation of ERPs (Enterprise Resource Planning), to the creation of electronic marketplaces. These in-depth case studies were determinant in understanding the evolving nature of technological requirements associated with the changing functionalities and applications of e-commerce.

The on-site studies, along with our technological monitoring activities, led us to formulate a wave model, which is illustrated in figure 5. The model was first developed to describe the evolution in technologies that would enable an organization to formulate an e-commerce business plan. In order to validate our work, we then presented the model to different organizations. In most cases, the natural reaction of management teams was to position their company along the waves while trying to benchmark themselves, taking into account the current state of advancement of their respective technologies within their industries. One important aspect for management to capture was the variation in technological advancement for the different organizational functions of their company. A large aeronautical company is a good example of this: the technology exploited for design purposes is state-of-the-art and easily configurable to communicate with suppliers. Yet the manufacturing system is ancient and difficult to manage in a supply chain environment. This has incited us to focus our efforts on the most e-commerce-influenced functions of an organization, which are identified in section 4. To fully grasp the implications of technologies in these functions, we then illustrated a technological wave/function matrix with the most current e-commerce transaction processes identified by the MITI/Andersen Consulting study (see section 2) [20]. Displayed in section 6, the matrix presents electronic transaction processes related to different organizational functions and technological waves which can provide management with a tool to reflect on their e-commerce-related activities.

4. Value chain activities

In the 1990s, with the advent of technologies such as ERPs, a great deal of activity was concentrated on cross-functional applications within an organization. But ERP vendors like SAP and Oracle are now focusing on inter-organizational activities such as supply chain management or advanced planning and optimization. Business-to-business e-commerce will allow organizations to gradually share information with their suppliers and their customers. The question then becomes, where should companies start and how should they organize themselves?

The literature describing the key functions of an organization that does business electronically is scarce. A Japanese Investigating Committee Report produced by the MITI and the Japan Electronic Commerce/CALS Organization (JECALS) has classified business segments into three categories of activities [19]. According to the study, the vast majority of e-commerce business operations fall under marketing and sales, design and manufacturing, or procurement. Our research has led us to believe that e-commerce transaction processes will be

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1 In most cases, it was administered to the department heads of design, manufacturing, sales and procurement.
mostly product-oriented. A great deal of the efforts now being conducted by major electronic suppliers like Dell or automobile manufacturers like Volvo, BMW and DaimlerChrysler are aimed at supporting integrated product life cycles from design right up to recycling. This requires the gathering of a lot of information on all parts and components of a product throughout its useful life. The information gathering is made possible by the use of product life cycle databases which support the electronic collaboration between product integrators, suppliers and customers. Birou et al. singled out three functional areas to demonstrate cross-functional integration using the product life cycle approach, namely logistics, operations and purchasing [3].

The integration of suppliers requires major changes to product development processes that may force several key functions within an organization to adjust their processes. Handfield et al. [12] suggest that, although the design and engineering phases account for a minor fraction of total product costs, it is in those phases that 80% of the total cost of the product is determined. It is also important to mention that purchased materials often account for over 50% of the cost of goods sold, reaching as high as 80% in some industries [1, 12]. Consequently, procurement plays a crucial role in product and process development, which includes identifying the right technologies and suppliers, and also leveraging opportunities by taking the leadership of cross-functional teams [18]. For example, global strategic suppliers for the Boeing 777 project were integrated in the design process from the beginning, which resulted in the rapid development of the aircraft [1].

Procurement has evolved from a reactionary and operational function to a more strategic and proactive one. It has been prompted by cross-functional objectives and highly collaborative environments [25]. Efficient, secure and quick transactional exchanges, along with new planning and forecasting tools and methodologies, have allowed a shift from current tasks to more strategic and value-added activities [6]. As shown in figure 2, procurement activities and competencies, which are now mostly related to transactional buying, will gradually shift to sourcing strategy and analysis, supplier development and new product and process development [17], all of which are much more strategic in nature and which hold important potential benefits for organizations.

According to our analysis, electronic commerce will mainly transform the engineering and design, sales and distribution, and procurement functions. The sales and procurement transaction processes are closely linked while distribution, which has been identified by specialists as the most important outsourced activity, will require a large amount of information exchange. The implementation of design and engineering transaction processes will lead to the second boom in e-commerce.

In the automobile industry, the initial focus will be on procurement and then supply chain planning; it will finally move towards collaborative design and shorter market time cycles [8]. Electronic commerce will eventually modify manufacturing functionalities. At present, a majority of shop floors are not computerized. Companies are not ready to share manufacturing data and only the critical information required by procurement is processed electronically. Developments in modular production should greatly enhance the transition to electronic commerce [27].

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2 The Boeing 777 was entirely designed electronically, linking a supplier base located in Europe, North America, Australia and Asia.

3 This definition of distribution includes external transportation activities.
5. Assessment of e-commerce technologies

The concepts of electronic commerce and supply chain management are increasingly appealing to most organizations. Reductions in inventory, product development time, time to market, procurement workforce, and the like, have encouraged large companies to adopt advanced technologies in order to achieve the potential savings. Some complex e-commerce transaction processes require the combination of several technologies that must evolve progressively in an integrated environment. Our case studies in the electric/electronic industry led us to develop a technological model that helps large and small companies. The five-wave model accompanies an organization through the different phases of technological integration required to support increasingly complex e-commerce applications.

The GartnerGroup has drawn up a list of technology enablers for supply chain management (table 1). It sorted these technologies into three distinct classes: Intra-, Inter- and Extended Enterprise [10].

Langenwalter has also classified supply chain relationships into five stages that show the probable evolution of supply chain integration in relation to its potential effectiveness (figure 4) [16]. Even though technology is not the focus, the development of a supply chain is well presented. At the highest level of effectiveness, a fully integrated supply chain involving technology sharing generates flexible, seamless processes.

The proposed five-wave transition model goes beyond classifying supply chain management or electronic commerce concepts, like the two previous examples. It identifies different business-to-business e-commerce needs and specifications and assists firms in detecting their technological and organizational requirements. The highest wave is one where the organization focuses on products, is at ease with international norms and standards, and feels secure dealing electronically with suppliers and clients. We will describe each wave, illustrating some of the related technological and organizational issues.

The first wave consists of the integration of the different internal systems within the organization with various electronic communication tools (Internet, EDI, VPN, etc.). The systems concerned usually relate to simple administrative functions such as invoicing but may also correspond to more complex information exchanges as is the case with production planning activities. These systems support the connection of commercial transactions (sales, procurement, etc.) through simple electronic links. There are numerous examples of activities realized in this first wave. They range from the use of the Internet to regularly inform suppliers or clients of the most recent production plans generated by an MRP

![Figure 4 – Supply chain relationships](source)

Source: Langenwalter, G., Enterprise Resources Planning and Beyond, 2000.

### Table 1 – Technology enablers

<table>
<thead>
<tr>
<th>Concept</th>
<th>Issues</th>
<th>Technology enablers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intra-enterprise</td>
<td>Enterprise functions require information beyond transaction-oriented data.</td>
<td>ERP, data collection tools, data warehouses, data mining and service control point groupware.</td>
</tr>
<tr>
<td>Inter-enterprise</td>
<td>Suppliers’ and customers’ needs to be successful.</td>
<td>Extranets, schedule sharing, customer and supplier self-service applications.</td>
</tr>
<tr>
<td>Extended enterprise</td>
<td>Trading partners’ abilities and capabilities.</td>
<td>Supply chain monitoring system, CPFR, EDI, POS data, extranets, opportunity management systems.</td>
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</tbody>
</table>

Source: GartnerGroup, 1999.
system to bidding on a request for quote (RFQ) received electronically through private or public bidding platforms (e.g. www.tpn.com).

The adoption of computerized management systems to coordinate activities within an organization characterizes the second wave. Two technological scenarios are usually favored by organizations:

1) Integration of independent management systems to form a “best-of-breed” solution.
2) Total or partial adoption of various modules of an ERP tool that can be complemented with specialized applications.

As examples of the second wave, we can mention the adoption of ERP systems in order to manage internal activities right up to the integration of an advanced planning system (APS) into an MRP system to optimize production planning.

The third wave focuses on automating the capture of information generated during operations (production, warehousing, distribution) and integrating it into the company’s management system (ERP, for example). In this operations-oriented stage, a manufacturing company may integrate its shop floor activities (CNC machines, etc.) with its ERP using a manufacturing execution system (MES).

The term collaboration has been widely used in e-commerce and supply chain descriptions. It forms the focal point of the fourth wave, which we refer to as Product/Service Value Chain Integration. It centers on the collaboration between various organizations from the same sector to develop products and services through processes or supply chain activities in a virtual mode. At this stage, the customer is also integrated into the value chain, thus facilitating product or service customization. Examples range from a consortium of organizations using CPFR (collaborative planning, forecasting and replenishment) technology to monitor their supply chain activities to the simultaneous and collaborative design of a virtual prototype (product and manufacturing processes) by a prime contractor and a few strategic suppliers.

The fifth wave emphasizes the product life cycle support strategy based on the integration of multi-sector B-to-B platforms. As mentioned previously, it embodies the notion of a virtual enterprise where access to a larger number of subcontractors is facilitated by communication technologies based on specific protocols (e.g. XML, STEP) and where supplier certification (e.g. ISO 14040) becomes a barrier to entry for the supply base. The product life cycle optimization wave allows a temporary, ad hoc consortium of independent enterprises to pool their respective competencies in order to create a product or

Figure 5 – The technological wave transition model

<table>
<thead>
<tr>
<th>CAD : Computer-Aided Design</th>
<th>CALS : Continuous Acquisition and Lifecycle Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDI : Electronic Data Interchange</td>
<td>ERP : Enterprise Resource Planning</td>
</tr>
<tr>
<td>LCA : Life Cycle Assessment</td>
<td>MES : Manufacturing Execution System</td>
</tr>
<tr>
<td>PDM : Product Data Manager</td>
<td>VPDM : Virtual Product Development Manager</td>
</tr>
<tr>
<td>ISO 14040, CALS, GII and LCA tools</td>
<td></td>
</tr>
<tr>
<td>Common working platforms (VPDM, CPFR, White boarding, Extranet, etc.)</td>
<td></td>
</tr>
<tr>
<td>Integration of management systems into operations</td>
<td></td>
</tr>
<tr>
<td>Links between ERP, PDM and operational systems (MES, CNC, etc.)</td>
<td></td>
</tr>
<tr>
<td>Implementation of PDM, ERP, ISO 9001 and 14001</td>
<td></td>
</tr>
<tr>
<td>Use of Internet, EDI, etc., to communicate with existing systems (MRP, CAD, etc.)</td>
<td></td>
</tr>
<tr>
<td>CNC : Computerized Numerical Control</td>
<td></td>
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<tr>
<td>GII : Global Information Infrastructure</td>
<td></td>
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<tr>
<td>MRP : Material Resource Planning</td>
<td></td>
</tr>
<tr>
<td>CPFR : Collaborative Planning, Forecasting and Replenishment</td>
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</table>
support a product line. Very few fifth-wave projects have yet been undertaken; one example is the development of a system that optimizes the environmental impact during the design, manufacturing, utilization and recycling phases of a product. This is now being simulated in firms such as BMW.

One important aspect of the model is the possibility to evolve through the waves. The decision for an organization to move on to another wave is often triggered by events, which we will refer to as transitional milestones. Proactive and innovative firms will have a strategic plan with clear transitional milestones to guide them through the process. But most of the time, organizations are confronted by unexpected or undesired milestones that force them to adopt new technologies very rapidly, without having time to prepare adequately. We have identified five types of transitional milestones (market, organizational, political-economic, sectorial and technological) that can influence the technological plan of an organization. Examples of transitional milestones that have prompted some organizations to jump from the first wave (simple electronic communications) to the second (ERP) are shown in table 2.

### 6. The transaction processes

The wave model implicitly assumes that technologies will affect certain organizational functions and activities. Bridging these two dimensions forms a conceptual framework in which electronic commerce strategies can be developed. Evidently, these strategies are often revealed through transaction processes, which are crucial to the flow of information within and between organizations.

To illustrate this context, we aligned the five technological waves horizontally and the selected functions vertically in the matrix shown in figure 6. In order to demonstrate the value of the matrix, we integrated the e-commerce transaction processes

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**Table 2 – Possible transitional milestones from the 1st to the 2nd wave**

<table>
<thead>
<tr>
<th>Type</th>
<th>Transitional milestone</th>
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<tbody>
<tr>
<td>Market</td>
<td>Emerging opportunities in e-commerce such as new products or services</td>
</tr>
<tr>
<td>Organizational</td>
<td>Mergers or acquisitions of 2nd-wave organizations</td>
</tr>
<tr>
<td>Political-economic</td>
<td>Multi-country or international financial reporting</td>
</tr>
<tr>
<td>Sectorial</td>
<td>Sectorial or industry pressures</td>
</tr>
<tr>
<td>Technological</td>
<td>Y2K bug</td>
</tr>
</tbody>
</table>

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**Figure 6 – Technology / function matrix**

- Sales & Distribution
  - 5) Exchange of product shipping information
  - 4) Delivery inquiries
  - 3) Provision of items and specifications from suppliers

- Procurement
  - 9) Payment of funds
  - 12) Initial contracts
  - 10) Negotiation & discussion during supplier selection
  - 8) Supplier registration
  - 6) Negotiation / discussion of price, volume, etc.
  - 2) Provision of estimate prices from suppliers
  - 1) Order booking

- Engineering & Design
  - 7) Design and graphics exchange

- Integration of
  - 11) Study and decision of detail specifications
  - Intra-enterprise mgmt systems integration
  - Integration of mgmt systems to operations
  - Prod/service value chain integration
  - Product life cycle optimization

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identified in the MITI study described in section 2. Three of the twelve transaction processes were selected to demonstrate the model. These three processes are very different and yet complementary with respect to the organizational function concerned and the technology required.

The following illustrates how each transaction stands in the matrix and shows its potential evolution as we move through the different waves.

**Provision of estimate prices from suppliers**

This transaction involves purchasers. It occurs very frequently in supply chains and covers four technological waves since the methods used by the procurement department to purchase a product/service differ in complexity. A brief description of this transaction across different technological scenarios follows:

1st wave: Obtaining a price (and CAD file) through the Internet.

2nd wave: Being able to easily obtain information on a product or service (bid history, last price paid, etc.) and to compare it those of competitors.

3rd wave: “Make or buy” decisions requiring faster feedback from the shop floor and/or distribution center.

4th wave: Collaborating on product development in order to get quicker, more accurate prices on, for example, custom-made products and special demands.

**Delivery inquiries**

This transaction involves the sales and distribution workforce. It can be carried out automatically through various systems:

1st wave: Exploiting electronic communications such as e-mail to minimize costs and errors when compared to fax or telephone communications.

2nd wave: Processing inquiries by accessing information systems (e.g. ERP) without any human intervention from the seller/manufacturer (through the use of specific APIs).

3rd wave: Allowing the transmission of critical information to key customers and suppliers by:

   (i) Linking a Global Positioning System (GPS) to an information system to trace a fleet of trucks.

   (ii) Monitoring the manufacturing activities of an organization with the help of an inventory control system on the shop floor.

**Study and decision of detail specifications**

This transaction involves the design and engineering departments. It entails precise details that are very frequently listed on a CAD file or other types of electronic blueprints. To be effective, this activity must be executed in a real-time collaborative environment:

4th wave: Developing products on common platforms (e.g. VPDM) through the collaboration of engineers and design specialists (from various organizations).

5th wave: Understanding the product life cycle by involving the different stakeholders (designer, manufacturer, recycler, distributor, etc.) that may influence the development of a product.

**7. Conclusion and future research**

This research project started in the early days of electronic commerce in 1997, when e-commerce transaction processes were mainly exploited by large organizations. Although the project is very broad in that it touches upon the study of numerous functions in firms in a specific sector of industrial activity known to be relatively advanced in e-commerce applications, our objectives have been to understand the global e-commerce picture, to identify the emerging technologies and to create a conceptual framework using a technological transition model. The wave model was further illustrated through a technology function matrix identifying different functional processes and their evolution over the waves.

In the future, we hope to expand the model to other organizational functions and e-commerce functionalities as they become more diffused in organizational settings. Technologies will most certainly evolve over time, offering new opportunities but also requiring new organizational capabilities and skills. Monitoring these changes will become a constant challenge for researchers and organizations.

**References**


iv) Globe and Mail, E-commerce Growth, IDC Canada, April 28, 2000


Appendix 1

Projected growth in B-to-B e-commerce