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CHAPTER 13

Achieving advanced supply chain management through Internet-based electronic commerce

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INTRODUCTION

The use of electronic commerce (EC) technologies to improve the efficiency of supply chains has been widely promoted in the retail and general merchandising industry. This business-to-business EC makes use of standardized product numbering, automatic identification technologies,
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electronic data interchange (EDI), electronic marketplaces (Kaplan and Sawhney, 2000) and data synchronization hubs (GSI Australia, 2006) as its essential core technologies (Johnston, 1998; 1999; Mak, 1998; Turban et al., 2006). Most large retail chains now make use of EC with their larger, technologically sophisticated suppliers to control a significant proportion of their replenishment transaction value. To that extent, EC can be thought to have reached significant adoption levels in the industry. Direct operational savings accrue from the elimination of data rekeying, through the speed and accuracy of application-to-application transfer of machine-readable data, and via the automatic identification of products and shipments. However, in keeping with the Pareto principle, the remaining transaction value is spread over a large proportion of non-EC-compliant suppliers, usually small- to medium-sized enterprises (SMEs) who are technologically unsophisticated.

Furthermore, it is increasingly being realized that the greatest benefits of supply chain EC are to be derived through its role in enabling advanced replenishment and distribution techniques which require strong coordination between the operational activities of various supply chain parties. To be practical, such tight coordination of activities demands 100 per cent compliance to EC. Thus, despite their small contribution to transaction value, the existence of a large proportion (by number) of non-EC-enabled suppliers creates a barrier for large retailers and distributors in implementing supply chain reforms. Unwillingness on the part of SMEs to adopt EDI in particular has proved to be a problem for large retailers. These SMEs typically do not have enough to gain from the application-to-application functionality and global connectivity offered by the traditional approach to EDI to justify its high cost (Iacovou et al., 1995; Kurnia and Johnston, 2003; Mak and Johnston, 1998; Mehr tens et al., 2001). In being the most transient and least strategi
ing sector of the economy they have also proved difficult to coerce.

Increasing interest is being shown by large retail players in new Internet-based EC methods for the exchange of electronic trading documents with unsophisticated small suppliers (Mak, 1998; Mak and Johnston, 1999). The latest development is the commercial promulgation of AS2 (Internet Engineering Task Force, 2006) as a secure transport layer for document exchange over the Web, largely led by Wal-mart’s initiatives with its suppliers (Barlas, 2002). Not only is the Internet a global network of networks with high throughput and low cost, it brings through the Web new open and highly standardized data exchange protocols that are ideally suited to the transfer and presentation of digital business documents (Mak, 1998; Turban et al., 2006). A large number of products and services have recently appeared
purporting to support Internet-based EDI and a significant target for these products has been the particular requirements of small trading partners (Mak and Johnston, 1997; 1998).

The aim of this chapter is to elaborate on the way in which these Internet-based supply chain EC products and services are transforming the prospects for universal supply chain EC compliance in the retail industry. We illustrate this analysis using a case study of the EC infrastructure used by Australia’s leading supermarket chain, Coles Myer Limited (CML), which makes use of these Internet-based EC products. CML’s aim is to leverage their considerable existing EC investment by achieving 100 per cent supplier compliance to EC, thereby enabling advanced supply chain reforms.

We begin by describing in detail the concept of cross-docking as an example of a distribution technique used in advanced supply chain management. Cross-docking is currently being widely advocated in the grocery industry, for instance as part of the influential Efficient Customer Response (ECR) concept (Hoffman and Mehra, 2000; Kurnia and Johnston, 2001; Kurt Salmon Associates, 1993). Improving existing cross-docking operations and extending the concept to wider product ranges forms one of CML’s main motivations for 100 per cent EC compliance by suppliers. Additionally, cross-docking affords an excellent example of the basic paradigm shift of advanced supply chain reforms in general – away from islands of automation and towards the use of a high quality data communications channel between trading parties to deal with operational complexity. This shift brings high operational efficiencies, but demands EC compliance in the construction of such a channel for coordinated activity. The analysis of cross-docking also sets the scene to discuss the contribution that Internet EC can make to enable these reforms.

We then discuss in detail why the traditional approach to EDI was unable to deliver 100 per cent EC compliance. We also analyse two key ideas that Internet-based EC products and services have contributed that appear to overcome these difficulties. We then present the case study of CML’s EC infrastructure, which strongly incorporates these ideas, and discuss the further development of the underlying concept of EC infrastructure. In our concluding remarks we describe the latest trend in this area toward process-driven EC using service-oriented architectures (SOA). We also note the emergence of a new conception of supply chain EC that features a richer choice of network topology, delivery media and message types commensurate with the variety of participating trading partner capabilities, in order to improve supply chain visibility and end-to-end process integration.
CROSS-DOCKING AS AN EXAMPLE OF EC-ENABLED SUPPLY CHAIN REFORM

Cross-docking (Abdolvand and Kurnia, 2005; Kurnia and Johnston, 2001; Luton, 2003) is a new method, currently being advocated in the grocery and general merchandise retailing industry, of distributing goods from a large number of manufacturers to a large number of retail outlets via a centralised distribution centre (DC). As an innovation it typifies new approaches to supply chain acceleration and buffer stock reduction, which employ greater coordination of the activities of participating parties by means of EC.

The traditional approach to distribution of high variety products via a distribution centre, the so-called ‘pick-and-pack’ approach, relies on a buffer stock of each product at the DC. (In the following discussion we use CML’s terminology for various distribution techniques since across the industry there is some variation in the use of various terms.) Goods are generally ordered from the DC frequently and in small quantities by the retail store in order to minimize its stock levels. However, replenishment of stocks from the manufacturers is triggered by reorder point methods. In the interests of economies of scale these orders are generally large and infrequent. There is thus little coordination between the replenishment by the retailers of goods from the DC and the replenishment of goods from the manufacturers by the DC. This lack of coordination of activities has several consequences. First, it results in large stocks of products at the distribution centre. This problem becomes worse as a retail chain tries to distribute a greater variety of products. Managing this stock requires both a large area for storage and sophisticated systems. Managing stocks within a finite warehouse capacity under variable demand requires sophisticated computerized warehouse management systems, forecasting systems and inventory management systems. To some extent it also requires double handling of goods since these are put away in store and then picked at a later time. Finally, since replenishment orders are consolidated at the distribution centre, the manufacturer is effectively denied sight of events at any individual store. The manufacturer, therefore, cannot gauge consumer buying patterns. The advantage of the method is that it is able to provide rapid replenishment to stores at low risk.

Cross-docking, by contrast, seeks to eliminate all DC buffer stocks by converting the distribution problem into one of sortation. Retailers place frequent small replenishment orders directly with manufacturers, preferably using EDI. Manufacturers deliver goods, generally for
several stores, to the distribution centre for immediate distribution. Shipments are broken down to individual store level and sorted by destination, preferably using bar-coded destination information and electromechanical means, and then repacked by the store for dispatch. Radio frequency identification (RFID) is set to have a role in this area too (Sarma, 2001). Such an approach achieves a much more efficient use of space, requires no double handling of goods and sortation can be accomplished with relatively low technology. However, it requires strong coordination between the activities of the retail stores and the manufacturers. Such coordination can generally only be achieved through speed-of-light digital communication. This is accomplished first by using EDI purchase orders between the retailers and manufacturers. It is also necessary to simplify, as much as possible, the processing of goods at the distribution centre. The minimum technical requirement to automate sorting is the use of manufacturers’ bar-coding on cartons from which the destination store can then be machine read. However, the additional requirement to check actual articles against orders can be further reduced by the use of other electronic commerce technologies such as the GS1 standardized product numbering scheme (GS1, 2006) and automatic identification technologies (bar-coding or RFID), to increase data accuracy through procedures at the manufacturers’ dispatch site. For example if, as goods are packed, an EDI advanced shipping notice (ASN) message is created by scanning product bar-codes (so-called ‘scan-packing’) and this is sent to the DC ahead of the shipment, and a unique shipment number for the ASN is bar-coded on the cartons, the contents of the cartons can be retrieved at the DC by scanning the shipment number. Individual item checking can be automated or eliminated.

Thus, while cross-docking promises operational and infrastructural cost savings it presents a new range of system implementation issues that require cooperation across the boundaries between retailers, distributors and manufacturers (Abdolvand and Kurnia, 2005; Kurnia and Johnston, 2001; 2003). The pick-and-pack approach uses sophisticated physical and computer systems to deal with the complexity of distributing a high variety of products between multiple manufacturers and retail stores, essentially by predicting and planning the future. By contrast, cross-docking relies heavily upon electronic commerce technologies for the establishment of a high quality communication channel between participating parties to achieve coordinated action, since the use of paper-based control documents provides insufficient processing speed, accuracy and data integrity. The level of technology involved in establishing such a communication channel is fairly low.
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The key challenge is not the technology itself but achieving 100 per cent participant compliance to the technology. Thus, advanced supply chain reforms, which incorporate electronic commerce, can be seen as part of a general paradigm shift. This fundamental shift is in the perception of the role of IT in business performance improvement. It is a shift from the earlier vision of computers as intelligent logic engines (to be applied to problem solving and planning), to a view of computers as a medium for communication and coordination between parties and business transactions.

THE FAILURE OF TRADITIONAL EDI IN ADVANCED SUPPLY CHAIN MANAGEMENT

Prior to the commercial use of the Internet, the standard method for implementing electronic business information exchange in a large-supply chain was via EDI. This used the services of a value-added network (VAN), which provided store and forward facilities for messages transmitted over private wide-area networks (WANs), which they frequently owned (Emmelhainz, 1990; Johnston, 1998; Turban et al., 2006). Outputs from diverse business applications operating on diverse platforms were translated into standard EDI transaction sets using mapping software – again often provided by the VAN. This use of industry-wide, national or international EDI message standards ensured that the EDI network was open since it allowed potential participants to choose mapping software and VAN services independently. It was assumed that these EDI messages would be transmitted from computer application to computer application, in order that the maximum operational benefits from labour reduction, increased accuracy and greater speed would be realized through the elimination of unnecessary data re-entry.

This traditional vision of EDI has changed in three ways. First, the Internet has largely replaced private networks as a transport medium for EDI messages, although post-Internet private TCP/IP networks such as ANX (ANX, 2006) have also emerged for applications requiring high security and high reliability. Second, eXtensible Markup Language (XML) has been widely hyped as a superior syntax for structuring EDI messages (Huemer, 2000), although replacement of traditional EDI messages by XML structured ones has not been as universal as initially anticipated (Kanakamedala et al., 2003). Finally, the AS2 standard has simplified transmission of messages (either traditionally structured or
using XML) over the Internet in a simulated point-to-point connection by making use of open encryption and handshaking protocols. Despite these changes in the favoured transportation network, the transport layer and the message formatting layer, the basic business concept of traditional EDI, which is to send a standardized message between trading partners running diverse applications, remains.

In the grocery and general merchandise retailing industry, this traditional approach to EDI has been widely adopted by the larger, more technically sophisticated retailers and manufacturers. Since interactions between these sophisticated players represents perhaps 80 per cent of all transactions in the supply chain, from the point of view of the value of transactions controlled, traditional EDI can be thought of as having achieved considerable penetration in the industry. This translates into considerable direct cost saving in the replenishment cycle. However, a large number (perhaps 80 per cent) of all suppliers, who are technically unsophisticated and generally small, fail to use EDI. Their non-compliance is not a significant barrier to achieving the direct benefits of EDI, since their transaction value is small. However, it does nevertheless present an obstacle to achieving the more significant benefits obtainable from EDI as an enabling technology for supply chain reform initiatives such as cross-docking, which do not run smoothly with less than 100 per cent EDI compliance. The size of this obstacle is measured in terms of the number of firms that have to be persuaded to come onboard, rather than their transaction value.

It is now clear to many large retail chains that have the most to gain from advanced supply chain management that 100 per cent EC compliance cannot be achieved using the traditional approach. In the early EDI era, it was generally believed that small suppliers could be brought into the EC network through mutual benefit, coercion or critical mass effects (Emmelhainz, 1990; Sarich, 1989; Zinn and Tahac, 1988). However, as a result of the persistence of the non-compliance problem, it is now recognized that these ideas are flawed and new solutions are being sought. The problem is that these traditional approaches to achieving compliance are not compatible with the profile of the typical SME (Iacovou et al., 1995; Mak, 1998; Mehrzens et al., 2001). Small to medium-sized enterprises typically interact with a small number of trading partners (Johns et al., 1989; Mehrzens et al., 2001), and often have only one large customer. They therefore have little to gain from the global connectivity offered by the traditional EDI open network. The system purchase, installation and running costs of the traditional approach are high. Such firms typically have simple (often manual) operational and financial systems (Iacovou et al., 1995; Rodwell and
Shadur, 1997) and therefore have little to gain from the application-to-application connectivity offered by the traditional approach (Scala and McGrath, 1993; Turban et al., 2006). Thus, both the initial set-up costs and ongoing operating costs of the traditional approach cannot generally be justified by any operational benefit to SMEs. These businesses would need to bear these costs simply to protect themselves against the threat of 'de-sourcing' (Zinn and Tahac, 1988). Moreover, small enterprises are the most transient and least strategically-oriented segment of the economy, which makes them difficult to influence on this basis. Finally, because the VAN offerings were designed to interact with existing applications on diverse platforms they were usually general purpose rather than turnkey in nature, and to install and operate them generally required higher levels of technical sophistication than is typically present in SME organizations.

USE OF INTERNET EC TO FACILITATE SUPPLY CHAIN REFORMS

The large EDI players with the most to gain from supply chain reforms are increasingly looking to non-traditional Internet-based EDI solutions as a means of resolving the problem of EDI non-compliance of small unsophisticated trading partners. To comply with their EDI-enabled trading partner’s information requirements, non-EDI-enabled trading partners can use a Web browser to fill in a form-based Web page representing a business document. To access the Internet they need only a personal computer, a modem and an Internet Service Provider (ISP). They require little more computer expertise than that which is fast becoming common knowledge.

The last decade has seen a large number of new software products and services that enable Internet-based EDI. These products have been conceived in response to the new cost structure of the Internet, the access to a global market it creates, and the reduction of the stranglehold of the traditional VANs upon EDI software and services that this new global public network has afforded. Mak and Johnston (1997; 1998) propose a classification of these Internet EDI products. Some of these products merely translate the traditional approach to the new Internet transport medium. For instance, message-mapping software is available to translate application output to traditional standardized EDI messages. These EDI messages are then sent between parties using Internet protocols such as Simple Mail Transport Protocol (SMTP),
Multipurpose Internet Mail Extensions (MIME), File Transfer Protocol (FTP) and/or Secure/HyperText Transfer Protocol (HTTP/HTTPS). More recent products use AS2 standards, which bundle these Web standards with encryption to produce a fully endorsed secure message transport vehicle over the Web. Small traders can gain access to the Web through ordinary ISPs or through Application Service Providers specializing in EDI, variously called Internet Value-Added Networks, Integrated Value-Added Networks (IVANs) or Internet Value Added Services (IVAS). These are often commercial offshoots of the transitional VANs (for instance, GXS Trading Grid).

A significant proportion of the new products differ markedly in their approach from traditional EDI. Two important new concepts are increasingly being embodied in this group of non-traditional Internet EDI products that are crucial to a new match between EDI requirements and SME capabilities. These are:

1. The provision of a new mode of distribution and collection of electronic business documents between large players and their small unsophisticated trading partners that is more appropriate to the capabilities and requirements of the small players. These products (for example, see Mak and Johnston, 1998) generally provide the tools to build a hub-and-spoke network between the large player and its small suppliers using Web-based client/server technology. Since these products generally require that the client and server programs are built with the proprietary tools provided, these subnetworks are not open in the traditional EDI sense, and often use proprietary or Web messaging standards rather than traditional EDI standards. These products feature the capability to tailor business documents and document handling processes to the needs of the large player while providing a cheap, easy-to-use and turnkey client package to the small trader. These products recognize the inadequacy of the one-size-fits-all approach of traditional EDI, which was only appropriate for interactions between sophisticated trading partners.

2. The recognition of the need for large players to support and efficiently manage multiple modes of delivery and receipt of electronic business documents appropriate to the existence of multiple kinds of trading partners. This requirement is addressed in ‘intelligent gateway’ products (Mak and Johnston, 1998) which are capable of receiving application flat-file, XML or EDI message inputs, and route the data to trading partners
using various formats and media based on a profile of the trading partner. The reverse process is also supported. The media supported include private VAN networks, the Internet, public telephone lines and dedicated connections. The formats supported include traditional standards-based EDI messages intended for sophisticated trading partners, XML-based EDI messages, proprietary or Web-form messages of the type described above intended for unsophisticated partners, formats based on popular software packages including Excel, proprietary formats specific to use in high-volume exchanges between cooperating trading partners, and fax for non-EDI-enabled trading partners.

Intelligent gateways provide a link between the traditional open EDI network of sophisticated trading partners, who value global connectivity and application-to-application functionality, and the hub-and-spoke networks specifically catering to large players' needs and small players' capabilities. Thus, what is emerging is a new vision of universal business-to-business EC based on a richer network which explicitly recognizes the existence of multiple kinds of trading partners and trading relationships, multiple delivery modalities and message formats, and a fairer distribution of costs, benefits and risks between participating parties. From the large traders' point of view these new products allow them to leverage their considerable investment in traditional EDI by achieving the benefits of 100 per cent EDI compliance at a relatively small extra cost. We would argue that the emergence of these new EDI concepts is at least as important a contribution of the Internet to advanced supply chain management as the more heavily hyped electronic marketplace concept (Kaplan and Sawhney, 2000).

CASE STUDY – COLES MYER LIMITED

Coles Myer Limited is Australia's largest retail store chain and is the country's largest non-government employer, with over 165,000 staff and annual sales of over A$36 billion. CML operates eleven retail brands through 2600 stores in Australia and New Zealand including Coles, Coles Express, Bi-Lo, Kmart, Target, Fosseys, Liquorland, Theo, 1st Choice, Harris Technology and Officeworks. CML spends over A$27 billion each year on buying merchandise and services (Coles Myer Limited, 2006). At the time of the case study in 1997, CML had more than 15,000 suppliers (including grocery, general merchandise and
service suppliers): 1800 suppliers used the traditional EDI approach, while the remainder used conventional paper-based document processes via regular mail, phone calls or fax, to exchange business data with CML.

This case study describes how CML is making use of Internet-based EDI products to enable them to handle all their grocery and general merchandise replenishments (from approximately 10,000 suppliers) through a single centralized EC system. CML is aiming for 100 per cent compliance to electronic purchase orders and ASNs by using the system, which includes an Internet-based component tailored to the needs of small suppliers. The following account of the EC infrastructure at CML and its significance in enabling cross-docking is based on a number of data sources. These sources include: semi-structured interviews and follow-up communications with the Electronic Trading Coordinator; company documents; participation in CML’s original ‘proof of concept’ project as observer; and involvement in the product and Internet EDI strategy evaluation for CML’s front-end Internet EDI system as an independent evaluator.

An in-depth case study and participatory research method was chosen to gain deep access to the practices of a significant industrial player. In keeping with the limitations of this research method (Galliers, 1992; Yin, 1989), it has been used mainly to generate novel propositions concerning the role of the Internet in advanced supply chain management that will be tested empirically in future research.

CML has various business applications for different retail brands, running on different system platforms. In the past, there were a number of translators mapping flat-file outputs from these applications into traditional EDI messages that were sent via the store-and-forward facilities of a VAN to EDI-enabled trading partners using the VAN’s private network. In addition, there were multiple manual systems to send and receive trading documents to and from non-EDI-enabled suppliers via regular mail, phone calls or fax. The previous EDI infrastructure is shown in Figure 13.1.

This EDI infrastructure presented a number of problems for CML, both in achieving direct operational cost saving through EDI and in implementing EC-enabled supply chain reforms such as cross-docking. First, there is the basic undesirability of maintaining multiple document distribution systems, including manual ones. Second, manual systems offer little opportunity to control the integrity of delivery data received from non-EDI-enabled suppliers. When preparing a manual delivery docket from a CML purchase order (PO), suppliers can easily alter the quantity, price or the ordered item itself, either intentionally or by
error. Ideally, CML would like suppliers to base an electronic ASN upon data received in the electronic PO in order to improve data integrity. The principle at work here is the data turnaround principle (Johnston, 1999) which states that data received by a trading partner is likely to be more accurate if it is derived from data sent earlier by that trading partner. Accuracy would further increase by providing some intelligent data checking to the supplier's interface and by using bar-code scanning to acquire product numbers direct from the packed items.

Due to reliance on the traditional VAN-based approach, CML experienced difficulty over many years of EDI operation in bringing small suppliers into the network. Small suppliers lack the technical, financial and human resources to develop a traditional EDI system to handle all the functionality required by CML. According to the Electronic Trading Coordinator at CML, the conventional VAN-based EDI development costs for small suppliers, including the costs of purchasing and EDI translator and communication software, are in the range of A$5000 to A$20 000. Transferring 10 kilobytes of data via a VAN might cost a small supplier, at list price, A$4 per document, plus a monthly VAN subscription fee of A$100. While these costs may be justifiable for a larger supplier who can gain mutual benefit from the investment, small suppliers generally have primitive in-house business systems (often manual) and cannot use the potential benefits from application-to-application transfer of data from the VAN-based EDI approach to justify the decision. With very few customers, they also gain little from the global connectivity of traditional EDI.

Finally, two further issues prevented CML from reaping the full benefits of cross-docking operations within the previous infrastructure: a lack
of data accuracy resulting from the use of paper-based trading documents, and operational complications resulting from the existence of non-EC-compliant suppliers. While it is possible to use cross-docking without EC compliance, it incurs labour-intensive activities at the distribution centre, such as manual bar-coding of cartons and manual inspection and verification of carton contents. Such activities can be substantially reduced when all suppliers are compliant to standardized product and shipment numbering schemes, such as the EAN numbering system, bar-coding and electronic ASNs.

Based on a need to overcome these problems and extensive experience with the capabilities of small suppliers, CML determined the following requirements for the new system:

1. The systems need to support existing VAN-based EDI. Both CML and its larger suppliers have a considerable investment in the existing VAN-based infrastructure and it was decided that investment in the new Internet system should leverage this existing investment rather than replace it.

2. There should be a single centralized system to handle business documents from all retail brands.

3. Use of the Internet should be part of the system because of its ability to deliver documents to small suppliers at low cost and in user-friendly form. According to the Electronic Trading Coordinator at CML, the incremental cost of transferring a 10 kilobyte message over the Internet is about A$0.50 (mainly associated with telecommunication costs, such as telephone call charges), plus, typically, a A$25 monthly subscription fee for an ISP. Small suppliers could use a CML-provided Web-form Internet application as a data entry system, not necessarily using the traditional EDI standard format needed for application-to-application data transfer. However, this use of the Internet requires issues of security and reliability to be considered. It was decided that mission critical transfers should continue to be made via the VAN network. Thus, the transfers to be made via the Internet component were not subject to high security and reliability requirements. Nevertheless, the security of HTTPS using the Secure Socket Layer (SSL) – which enables point-to-point data transmission without storage at the ISP site – together with the password protection and document control facilities provided routinely by third party Internet EDI development software, will provide a secure and reliable transport mechanism for these Web forms and other file
types. Eventually, this may provide a low-cost alternative transport system even for standard EDI files.
4. A limit was placed on the system so that the cost of participation to small suppliers should be no more than A$500 for a basic system and A$1000 for a system with extra bar-code scanning and label printing facilities. The monthly running cost should not be greater than A$25 for an ISP subscription plus phone calls. Suppliers must also provide a PC, a modem and a printer.
5. The requirement to keep operating costs down to these low levels has led to an additional requirement that the front-end used by the small suppliers must be capable of running offline from the central CML system while shipments are packed. Otherwise ISP charges might become prohibitive.
6. In order to facilitate cross-docking distribution the system should provide for the highest quality data about impending shipments. This led to the requirement that the system should make use of the electronic turnaround document concept and scan-packing. A paper-based turnaround document is one that is expected to be returned by the receiver to the sender with certain data added. From the viewpoint of data integrity, this approach is superior to receiving a separate manual response, since it does not require transcription of data on the original document. In electronic form this means that a document message sent by a small supplier to CML can only be constructed based on the contents of the original document source from CML to which it is a response. Scan-packing means that any data used to construct the ASN should be entered by directly scanning the EAN product number barcodes on the products as they are packed.

To satisfy these requirements, CML developed a new EC infrastructure that makes use of both the intelligent gateway concept and an Internet-based hub-and-spoke network for use by small unsophisticated suppliers. The intelligent gateway replaces the multiple translators of the current system and transfers flat-file outputs to and from the various brands’ application programs. It translates these flat-files to various formats, determined from a trading partner profile database, including fax, traditional EDI and Web-forms, which are also routed via various communications media including the private network of their VAN, the Internet, telephone lines and point-to-point fixed connections. The new EC infrastructure at CML is shown in Figure 13.2.
An important component of the new infrastructure is the Internet EDI hub, shown shaded in Figure 13.2. There are many products now available for exchange of business documents over the Internet using a wide range of approaches (Mak and Johnston, 1997; 1998). These differ mainly: in their use, or non-use, of traditional EDI standards; in whether they involve third-party Internet sites; and in whether they force the use of software from the same provider at both sender and receiver sites. The choice between these various options should be made on the basis of the degree of system integration (application-to-application or application-to-person) and the degree of connectivity (global or hub-and-spoke) required of the Internet EDI system (Mak, 1998). On the basis of their evaluation process and 'proof of concept' project, CML chose an approach which uses software from a single provider to create both the CML hub and the small supplier front-end data entry application. This allows for document exchanges that are not structured using traditional EDI standards, and facilitates the participation of SMEs in the EC network, without needing full EDI translation facilities.

For this Internet EDI subsystem, CML chose to use client/server technology. The server interfaces with business applications via the intelligent gateway and distributes business documents as Web-forms that can be displayed by the small suppliers using a client program incorporating a Web browser. CML produces customized form-based document templates using tools provided by the software vendor, and these are distributed with the suppliers’ front-end program.
CML had to choose between so-called 'thick client' and 'thin client' approaches. In the thin client approach, nearly all the data processing operations are performed by the server (hub) program and the client software may consist of little more than a Web browser. In the thick client approach, the client program has some capability for processing the exchanged data, independently of the hub. A typical example is where the client program performs data editing without needing to refer back to data stored at the hub. This would generally result in duplicate storage of data at the hub and client. A thick client approach is more suitable when the business running the client program wishes to use the exchanged data in their own applications, because in this instance the well-known problems that attend data duplication might be justified. Hence, we would normally associate the choice of thick client approaches with a desire for application-to-application system integration.

CML had an additional requirement that the small suppliers should be able to perform much of their data entry offline – that is, while not connected to their ISP. Consequently, motivated by the desire for a high standard of data integrity, CML chose to adopt a thick client approach in order to enable extensive data editing to be performed while processing offline. While not a primary requirement, this choice also reserves the opportunity for suppliers to integrate their in-house applications with the front-end data entry system by reusing the local database or exporting the data from the front-end system.

The Internet EDI subsystem incorporates the 'data turnaround' principle. Purchase orders are received by the hub program from the application programs via the gateway and are converted to Web-forms. These can be retrieved by the client front-end program over the Internet using HTTPS and can be displayed or printed. Upon despatch of goods these purchase orders form the basis for the creation of an ASN and a bar-coded carton label. The original purchase order is stored temporarily at the client site and is used as a basis for edit checks upon packed quantities and product numbers. In the scan-packing process, the product numbers and quantities for the ASN are entered by actually scanning the EAN product number bar-codes on the items being packed. A label for the shipment carton is also printed which shows, among other information, a bar-coded Serial Shipping Container Code (Application Identifier '00') using the EAN/UCC128 label standard, and a bar-coded destination store number (Application Identifier '90'). Figures 13.3 to 13.5 show the purchase order, the ASN entry interface and the carton label. The ASN is transmitted via the Internet as a Web-form to the server program and the receiving applications are updated via the
gateway to reflect this impending shipment and to facilitate receiving at the distribution centre.

At the distribution centre, the bar-coded shipment number can be scanned and the data are used as the key to retrieving the contents of the shipment via the ASN. Having the packed EAN product numbers available in this way facilitates checking of the shipments. When full EC compliance and scan-packing is in place, the quality of the shipment data will be enhanced and, therefore, checking upon delivery may be
Figure 13.5
Sample shipping container label

reduced to a low level. Payments can also be made based on this data, referred to as Evaluated Receipts Settlement (Johnston, 1998; 1999), leading to further process simplification. The bar-coded store number is used to control the electromechanical automatic carton sorting facility. With full ASN, bar-code and scan-packing compliance, there is the potential to approximately halve the all-up distribution cost per carton using cross-docking compared to the pick-and-pack method (Kurnia and Johnston, 2001). The main savings are through reduced warehouse and computer system infrastructure and reduced double handling of cartons.

FROM DOCUMENT-DRIVEN TO PROCESS-DRIVEN ELECTRONIC COMMERCE

The new infrastructure at CML is one company’s approach to achieving a richer connection to a variety of trading partners through Internet-based electronic commerce. CML chose to purchase and install a gateway product provided by a third-party software provider and also to use third-party software to build their Internet-EDI subnetwork. CML is a sufficiently large player in the industry to justify these outlays in terms of operational benefits and the flexibility that a tailored solution
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offers them in designing new business processes. However, these same Internet EDI connectivity concepts are also available to sophisticated EDI players in other ways. The new breed of third-party Internet-based EDI service providers, IVANs, also offer services based on these same concepts to allow traditional EDI-enabled players to reach both other EDI-enabled trading partners and small unsophisticated trading partners. Typically, IVANs will receive traditionally structured EDI messages and route them via private networks or the Internet, or convert them into Web-forms or fax for small trading partners. They also support the reverse translation processes. The Perth-based Australian company Atkins Carlyle (Anonymous, 1998) chose this approach to EC with small trading partners. Other examples of this third-party gateway approach include ‘AT&T InterCommerce’ (AT&T, 1999), an IVAN service that enables SMEs to reach their EDI-enabled trading partners using Web-based solutions.

The initial concept of the intelligent EC gateway and the Internet-based hub-and-spoke network was transaction/document driven, where a business transaction initiates the data transformation based on trading partners’ profiles including transaction type relationships and communication channels. As large retailers, including CML, have achieved many operational benefits via the enhanced connectivity obtained from document-driven EC through 100 per cent EC compliance in business document exchange while leveraging their traditional EDI investments, they have identified the need for end-to-end business process integration; this is not just with their back-end applications such as ERP, inventory control, order management systems, and so on, but also with their operational management systems such as transportation management systems (TMS) and warehouse management systems (WMS), to enhance business process flows and the visibility of their supply chain operation. Therefore, more recently, the concept of a process-driven business-to-business (B2B) EC gateway has interested many organizations wishing to improve their business process integration and supply chain visibility.

Typically, process-driven B2B EC gateways are developed based on Service-Oriented Architecture (SOA) rather than client/server architecture. SOA applications are built using loosely coupled and interoperable services and thus support integration and consolidation activities within a complex enterprise system (Oracle, 2006). B2B solution vendors (see, for example, Sterling Commerce, 2006) have developed process-driven B2B EC gateway products that help organizations to establish the required platform to enable business-to-business collaboration among trading partners with different systems and infrastructures across the
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supply chain. The concept of process-driven EC should not be considered a completely new concept, but it should rather be seen as a progression of document-driven EC.

Unlike document-driven EC, which only facilitates the exchange of business documents electronically through various channels based on trading partners’ profiles, process-driven EC also deals with the entire business process involving transactions or documents exchange. With this process-driven EC concept, visibility throughout the supply chain is enhanced because business processes among trading partners and enterprise supply chain operations systems can be streamlined and integrated. Therefore, organizations can identify any business transactions or exceptional events and respond to them more quickly. In addition, business logic is often embedded into the system to drive or monitor business processes and trigger automated responses. As a result, an improvement in business process management across the supply chains can be obtained. Process-driven EC has become the fundamental infrastructure for achieving the vision for advanced supply chain management and many leading organizations are moving towards it.

CONCLUSIONS

This chapter has analysed the role that Internet-based EC is playing in making advanced supply chain management initiatives, such as cross-docking, achievable in the grocery and general merchandise retailing industry. We have described the problems that the traditional approach to EDI poses to large retailers in achieving 100 per cent EC compliance from small, unsophisticated suppliers. We have also indicated two contributions that new non-traditional Internet-based EDI products are making toward a viable solution to this problem which recognizes the limited capabilities and requirements of small suppliers. In the case study, we have illustrated how these new ideas are being used in a large retail chain in Australia. We have also discussed how the new infrastructure of this large retail chain, which is based on a document-driven EC gateway, has improved connectivity with small trading partners while leveraging the traditional EDI investment with large trading partners. Furthermore, we have briefly discussed the relatively more recent concept of process-driven EC that is seen as a progression from the document-driven EC concept to provide better supply chain integration and visibility.
The traditional vision of EDI was that trading partners would send data seamlessly from their application programs to those of their trading partners - transmitting digital documents structured according to international standards from application to application without manual data entry. Despite changes in the delivery medium (i.e. from private networks to the Internet), in the formatting syntax (i.e. from traditional EDI formats to XML) and in standards (e.g. from UN EDIFACT to ebXML) this traditional EDI approach is still the backbone of inter-organizational system connectivity among large manufacturers, distributors and retailers in the retail industry. The new non-traditional Internet-based EDI products such as EC gateway solutions and low-end form-based EDI compliance solutions now enhance this backbone with proprietary hub-and-spoke networks catering to the particular needs and capabilities of small players. The hubs will be centred on large players or Internet third party sites.

This new EDI network topology involves relaxing a number of rigid and utopian ideas of the traditional, one-size-fits-all EDI approach. In the traditional approach, the universal adoption of internationally regulated message formatting standards was supposed to provide unlimited connectivity between trading partners and to facilitate application-to-application data transfer between diverse application platforms. When used in hub-and-spoke subnetworks, the relaxation of traditional standards requirements by these products may not be a backward step, since it provides greater flexibility to the large players to develop systems quickly that meet their particular needs. Since application-to-application and global business connectivity are not particularly important to small trading partners, proprietary message formats can be used by them in a hub-and-spoke configuration without compromising the global nature of the backbone network. The platform independence of the network that was traditionally supposed to require universal compliance to standards is now achieved in additional ways through intelligent gateways at large player or Internet third-party sites.

Additionally, this richer approach to EDI connectivity embodies more realistic ideas about the nature and relations between trading partners within and along retail supply chains. It recognizes the existence of a variety of levels of technical sophistication and capability among trading partners, but also an uneven distribution of potential benefits from EC among them, particularly from the most advanced supply chain management initiatives. The new range of connectivity options made available by Internet-based EC allows for a more equitable distribution of the costs and risks commensurate with benefits, which, being more in keeping with the political realities of the industry,
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should enhance the chances of widespread adoption of EC over traditional enforcement approaches.

The increased connectivity will not only benefit large players but also the small players. For the small players this new form of Internet EDI may prove to be a palatable point of entry into electronic commerce with subsequent benefits. With a working familiarity of electronic exchange of data, initially through an application-to-person approach, the benefits of transferring data directly to a simple accounting package may become apparent. Knowledge gained through the use of a single customer EDI system might be leveraged by small suppliers to provide a first-mover advantage over their peers with other customers. An important issue will be the provision of migration paths for small trading partners between these alternative modes of connection, moving to the greater EC network as the sophistication of small players increases.

REFERENCES


