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The impact of e-business on supply chain management

An empirical study of key developments

Supply chain
management

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Abstract

Purpose – E-business systems and processes that use ubiquitous platforms such as web browser and internet have a profound impact on the management of inter-organisational processes. Consequently, a major implication of e-business is its impact on supply chain management. This paper focuses on the developments in e-business system adoption and deployment in support of supply chain management.

Design/methodology/approach – The research conducted for this paper was empirical in nature, involving an interview study with a large sample of organisations and selected case study visits. Analysis of the impact of e-business on supply chain strategy also examines three representative areas of supply chain management – procurement, customer relationship management, and fulfilment process.

Findings – E-business systems deployment was also seen to act as a significant catalyst for each of the three areas examined, although this paper presents only the findings from the exploratory study.

Originality/value – From the research analysis it was possible to develop a normative, five-stage, model classifying the evolution of e-business systems deployment for supply chain management. Finally proposes the need for longitudinal research to surface the underlying dynamics of e-business adoption and deployment.

Keywords Supply chain management, Electronic commerce, Procurement, Customer service management, Distribution management

Paper type Research paper

Introduction

In this paper we report on the findings of a study into the consequences for supply chain management decisions and strategies of e-business implementation. We define e-business here simply as the use of systems and open communication channels for information exchange, commercial transactions and knowledge sharing between organisations.

Research relating to the impact of the internet as a communication platform on business processes and management decision making is still very much in its infancy simply due to the lead times involved in undertaking and disseminating empirical analyses. There is antecedent literature in the fields of inter-organisational systems as well as previous studies into the impact of electronic data interchange (EDI), to which reference will be made.

The author wishes to acknowledge the support provided by BT plc for this research and the contribution to the empirical data collection by A. Brandon-Jones, S. Mustafi and B. Venpursad, postgraduate researchers at Warwick Business School.



International Journal of Operations &
Production Management
Vol. 25 No. 1, 2005
pp. 55-73
© Emerald Group Publishing Limited
0144-3577
DOI 10.1108/01443570510572240

The main intention of this study was to chronicle “strategic” developments (i.e. medium- to long-term plans) in supply chain management for organisations across a diverse range of industries. It became evident very quickly that e-business, incorporating technology and systems issues, were very near the top of the agenda for participants. Our study thus evolved into one concerned with the impact of e-business developments on supply chain management practices and strategies.

The paper is organised as follows:

A literature review relating to the two areas of e-business and supply chain management is provided in order to establish the foundation and previous research in this area. This review draws on literature in a number of fields: information strategy, inter-organisational systems, e-strategy and supply chain management. Specific attention is given to three areas of the latter field, namely customer relationship management, fulfilment and procurement. An overview of the research methodology is provided.

The main section of this paper is dedicated to detailed presentation of the findings from our analysis. This section provides the analysis relating to six key elements of our study. First, we explore the strategic objectives for e-business, followed by discussion of e-business infrastructures development. The discussion then focuses on the main supply chain management priorities before examining in turn the three issues identified in our literature review of customer relationship management, fulfilment and procurement.

This paper is intended to reflect a specific approach to the phenomenon of e-business, that of “chronicling” major developments in supply chain-related adoption (Eilon, 1974). At this stage of our research we do not set out to provide explanatory models or derive structural models of causality.

The primary contribution of the paper is outlined in our summary in which we set out the model of e-business evolution in supply chain management. This paper concludes with a brief discussion of future research.

E-business and supply chain management

What we now call e-business arose through the proliferation of the internet as a platform for inter-organisational systems (IOS) in the late 1990s and has been particularly significant for developments in the operation and strategic management of supply chains and networks. This is not a surprise, for Evans and Wurster's (2000) thesis is that the rise of the internet as a communication channel (and its supporting systems and software) has changed the economics of information, gives rise to opportunities, new forms of affiliation between organisations, new forms of relationship between organisations and new forms of transaction between organisations.

A significant theme for research into IOS has focused on their impact on governance structures. Employing Williamson's (1979) transaction cost terminology and theoretical construct, much of the IOS literature has explored conditions under which electronic markets and electronic hierarchies exist. Two opposing views have been posited: On one side, Malone *et al.* (1987) for example, argue that since developing inter-organisational electronic networks improves co-ordination between firms to reduce the costs of searching for appropriate goods and services (which they call electronic brokerage effects), one of the major effects of inter-organizational networks

would be a shift from hierarchical to market relationships. On the other side, others (e.g. Johnston and Lawrence, 1988; Konsynski and McFarlan, 1990; Holland, 1995) have contested that greater collaboration supported by IOS favours the development of electronic hierarchies rather than markets.

The impact of e-business on the supply chain is recognized in the information strategy (IS) literature. Galliers (1999, pp. 229-230) states:

... with the advent of inter-organizational systems, and e-commerce in particular, it is clear that questions of alignment go beyond what we have come to know as the business – IT alignment issue (e.g. Baets, 1992). It is no longer simply a case of internal alignment alone. Such issues now include alignment with collaborating companies' business and IT strategies (Finnegan *et al.*, 1998) and customer requirements (recent heightened interest in customer relationship management).

In other words, e-business/e-commerce has a significant impact on level of analysis issues in management research, specifically broadening the perspective to analysis of supply chains and networks. As noted by Croom *et al.* (2000), while research at such levels of analysis implies a broad, holistic perspective to chains and networks, such research is relatively lacking. Van Hoek (2001) has further claimed that little research has been carried out into e-supply chain management.

There is some debate about the scope of supply chain management, Oliver and Webber (1992) considered it as the planning and control of the total materials flow; Ellram (1991) viewed it as an alternative form to vertical integration; and Christopher (1992) and Lee and Ng (1997) have defined it as the management of a network of organisations or entities. One way of dealing with the diversity of definitions is to concentrate on some of the core processes and functions relating to the management of supply chains – namely sales and marketing, fulfilment (i.e. logistics, warehousing and distribution) operations planning and procurement. Naturally, this is not an exhaustive approach, but we would contest that it can provide sufficient scope for an analysis of the key initiatives being undertaken by organisations in their supply chain management. From this perspective we have seen discussion of the implication and impact of e-business on supply chain processes pointing to greater integration and collaboration across e-business supported supply chains (Chandrashekar and Schary, 1999; Marchewka and Towell, 2000; Johnson and Whang, 2002; Lancioni *et al.*, 2003; Cagliano *et al.*, 2003; McIvor and Humphreys, 2004). Frohlich and Westbrook (2001) in particular, claim that as supply chain integration increases as a result of e-business, stronger relational ties develop between the companies across supply chains.

Focusing specifically on the implication of e-business for supply chain management, Tan (2001) identifies potential for improvements arising from adoption of e-business systems in the following areas:

- cost performance (from improved productivity and lower input prices);
- customer service (service quality);
- process capability (quality consistency); and
- productivity and dependability (from increased control of material flows along the supply chain).

For industrial marketers, e-business has triggered a growth in interest in network (rather than dyadic) levels of activity which concentrates decision making on issues of

supply chain optimisation (Normann and Ramirez, 1993; Quelch and Klein, 1996; Borders *et al.*, 2001; Swaminathan and Tayur, 2003; Rohm and Sultan, 2004). Avlonis and Karayanni (2000) highlight the contribution of e-business to supporting value added services to the end customer and improving relationships between customer and supplier.

In the fulfilment field, a major impact of e-business is its role as a mechanism for improved control of supply through collaborative planning, forecasting and replenishment (widely known in industry supply chains as CPFR) (Frook, 1998; Lewis, 2001), a view reinforced by Lee *et al.* (1997) in their analysis of the opportunities for removing the “bullwhip effect” from supply chains. An integrated control system supported by e-business infrastructures allows companies to benefit from reduced inventories, total cost reduction and increased service to customers (Papazoglou *et al.*, 2000; Vakharia, 2002; Muffatto and Payaro, 2004). According to a recent white paper from the management consultants, Accenture, e-fulfilment makes it possible to satisfy customers who are demanding more and more in terms of faster service, regardless of geographical location, thus requiring greater efficiency in the distribution process of the product.

Fisher (1997) and Abernathy *et al.* (2000) underline the importance of clear identification of the demand profile on a product-by-product basis (or service-by-service). They contend that the choice of fulfilment policy has a profound effect on the profitability of an operation. They highlight the trade-off often inherent in a single fulfilment policy between customer service level (i.e. percentage of orders fulfilled on-time) and inventory costs. In particular, where a supply chain handles high volume and low volume products, there is often either a high inventory cost for low volume products, or conversely a low customer service performance for high volume items.

For industrial procurement, e-business offers purchase process efficiency gains and price reductions (Croom, 2000; de Boer *et al.*, 2002), enhances collaborative relationships (Holland, 1995; Dyer, 2000; Tang *et al.*, 2001) and provides significant opportunities for improving internal service levels (Stanley and Wisner, 2002).

E-business can thus be seen to impact on supply chain structures; supply chain coordination and supply chain relationships (Giannakis and Croom, 2004).

Research methodology

This study was supported by BT plc in the UK. The sponsors requested a two-year period of confidentiality surrounding the publication of the results, which has enabled us only now to report in detail on the findings from our study.

The main objective of the research was to conduct an exploratory study of supply chain management practices and policies across a range of European organisations using interview survey and case methods of data collection. Consequently, our primary method incorporated semi-structured telephone interviews.

The pilot phase of the study, conducted to test the survey instrument involved eight organisations. Their responses and data are not included in this analysis as the principal role of the pilot phase was to develop and validate the research instrument.

The second phase of the study involved a series of telephone interviews conducted by the research team over a five week period. The sample had to meet three fundamental issues, typical of those faced when conducting an exploratory and to a large extent qualitative, study (Punch, 1998). First, our intention was to access as many

organisations as possible in the timescale available. Our contact database was provided by the University of Warwick and represented over 500 organizations. Second, the sponsoring organisation required us to survey a minimum of 25 manufacturing organisations and ten retail organizations. Their requirement was dictated by their key client industries. Third, we were not intending to make substantial claims in the first instance about the generalisability of the sample.

We were fortunate to be able to garner responses from 98 organisations. This, we feel, provided us with a sufficiently significant sample in order to make certain observations about the representativeness of this study.

Interviews were documented contemporaneously, approximately a quarter were tape recorded and all were summarized in interview reports. The survey instrument used by the researchers contained a mixture of open and closed questions and allowed sufficient flexibility for further discussion and data to be gathered. Furthermore, the questions provided for both quantitative and qualitative data collection. All qualitative data from the interviews were coded once preliminary evaluation of the response data had been completed (Miles and Huberman, 1994).

The third and final phase of the study involved the development of six case studies, produced through site visits, interviews, observation and analysis of internal management data. Extracts from a number of these cases are presented in the discussion of our findings.

Finally, from our analysis we chronicled e-business evolution in supply chain management by clustering the research data and applying our clustering to a simple SPSS discriminant analysis. We present this model in the summary section of this paper.

Profile of the respondent sample

In total, 92 companies participated fully in the interviews conducted for this study, with a further six organisations participating in our case study analysis. The distribution of respondent sample in terms of size (turnover) and by industry sector is illustrated in Table I.

Some of the participants in this study included well-known corporations such as Apple Computers, AT&T, Arthur Andersen, BAA, Corus Group, Dell Computers, Ford Motor Company, Heinz, IBM, Lloyds-TSB Bank, NHS, Nestle, Pepsico, Procter & Gamble, Sainsbury's plc, Sony Corporation and Unilever.

Turnover per annum	<i>N</i>	Industry	<i>N</i>
Less than £250 million	29	Manufacturing	34
£251-£500 million	11	Wholesale and retail	15
£501-£1 billion	5	Transport	7
£1-£10 billion	18	Banking and finance	5
Greater than £10 billion	12	Business services	4
Not disclosed	17	Telecommunications	4
		Government	2
		Other	21

Table I.
Distribution by size
(annual turnover £s) and
industry category

Strategic objectives of e-supply chain developments

E-business was seen as “a major strategic initiative” for 79 per cent of our respondents and in all of these cases the chief executive officer played a significant role in defining the scope of the organisation’s e-business activities and instigating the processes for e-business developments. The reasons why e-business was seen as a key strategic issue varied across our sample, although opportunities for improved supply chain management were by far the most dominant aim. Using open questions and coding the responses we identified the main objectives for e-business implementation in Table II.

In terms of supply chain integration, a number of these criteria demonstrated the general desire for closer management of the supply chain. The particular significance of this was the recognition that competitive improvement can be gained through closer attention to the management of the total supply chain – or at least active management of the major links in the chain. Organisations were often not primarily concerned with every stage in their upstream supply chain links (i.e. towards original sources of supply), considering that while first, second and possibly third-tier suppliers may be considered critical within certain links of the supply chain, other suppliers and many other links were not so critical. For example, consider the situation where an organisation has a relatively low degree of expenditure, say on an MRO category such as entertainment. It may be considered sufficient to exercise limited control over entertainment expenditure through the deployment of procurement cards. So, while supply chain integration was certainly a major concern, it was recognised that there are limits to the extent to which it is necessary or desirable to integrate the links across the whole supply-side of the chain.

However, in terms of customer side (downstream) supply chain, a heavy emphasis was placed on providing improved customer service through closer alignment to customer systems, processes and operations. A significant factor here was the role of large, global customers in driving increased co-ordination and the adoption of customer relationship management.

Price pressures and cost reduction was the second major supply chain issue facing organisations. The majority of an organisation’s costs are vested in the supply side of their operation (typically averaging 60 per cent of an organisation’s total revenue), and improvements in the efficiency and effectiveness of customer-facing activities are necessary to respond to mounting competitive pressure. Many of our study participants saw attention to supply chain cost issues as the logical development of their on-going operations improvement initiatives. The influence of major customers was again significant through their adoption of policies such as year-on-year supplier

Table II.
Primary objectives
served by e-business
implementation

Supply chain strategy	Incidence (%)
Supply chain management and integration	79.5
Price pressures and cost reduction	69.9
Knowledge development and learning	56.6
Intellectual property and information flow control	51.8
Speed of change in business	45.8
Managing global customers and suppliers	41.0
Development of e-procurement practices	38.6
Lead time management	19.3

price reductions. Additionally, raising the value-adding capabilities of the organisation in order to retain customers was being recognised widely as a critical supply chain issue.

Knowledge management, intellectual property and the management of information flows represented an important element of supply chain strategy. "Knowledge", in this context, referred to the application by organisations of accumulated information and data for specific strategic aims. It should be clearly noted here that a major catalyst in raising the issue of knowledge and information management was the advent of distributed and shared information systems. In particular, the use of Microsoft Outlook, Lotus Notes and computer aided design tools were repeatedly cited as significant facilitators for knowledge deployment (see also Table III). Knowledge management was seen as being of significance in two prime areas – customer intelligence and new product innovation. Customer (and supplier) interaction typically involved multiple touchpoints across an organisation, and the ability to co-ordinate and consolidate knowledge pertinent to specific customers was seen as absolutely critical to improved customer retention and to growing customer value. With respect to new product innovation, sharing data and knowledge across the supply chain had taken on an increased significance due to the increased involvement of suppliers in development.

In terms of the status of procurement in our examination of supply chain strategy, less than 40 per cent of respondents saw e-procurement as a *strategic* issue – i.e. one with a potential to influence competitive advantage. Centralising the procurement function was seen as desirable, achievable and necessary for E-procurement adoption.

A further contemporary theme in the business press and consultancy practice has been a concern for speed, specifically in terms of lead-time reduction. Often couched in the term "*fast flow logistics*", speed of response to customer orders was considered by a fifth of our respondents to be a major strategic initiative for supply chain development.

Organisation for e-business initiatives was devolved to cross-functional teams in all organisations above £250 million p.a. turnover. In many cases, however, we saw a significant number of independent E-business projects with little clear evidence of any

"E-system"	Incidence (%)
E-mail	85.9
Web sites	83.5
Funds transfer	83.1
Electronic data interchange	73.5
MS outlook	69.9
Lotus notes	39.8
Knowledge sharing	63.9
Customer relationship management	56.6
Enterprise resource planning	53.0
Computer-aided design	49.4
E-procurement	38.6
Intranet	36.5
Middleware	37.3
Extranet	36.5
Portals	34.9
Global positioning systems	22.9

Table III.
E-business systems/IOS
penetration

overall co-ordination. Consequently, respondents reported that they had experienced poor project management and poor project validation for many of their e-business initiatives.

E-supply chain infrastructures

As Galliers notes (1999), the systems deployed through an organisation's information strategy (IS) impacts directly on the operation of its processes and systems across the supply chain. In evaluating the implications of e-business on supply chain processes we were thus interested in the evolution of inter organisational systems (IOS). Open questions were used to identify the main areas of IOS activity; responses were then coded to fit within the broad descriptors used in Table III.

In the context of current supply chain practices conducted electronically, it is not surprising that e-mail, web sites, funds transfer and EDI dominated the list. E-mail and web sites are dominant and ubiquitous systems, while all major financial institutions provide support for electronic funds transfer – providing a secure, low cost means of payment. EDI on the other hand is relatively costly except for high volume communications between common trading hierarchies. The advantages of EDI include integration and presentation of data in a common format. Thus, we found EDI in common use for the exchange of data between frequently trading partners, such as retailers and their major suppliers, manufacturers and their major suppliers. Often, EDI was deployed for the management of direct supply chains, i.e. for components and materials in manufacturing, or saleable products in retailing. The cost per unit is then relatively low, the benefits of high speed transmission and the sunk cost of investment are all factors which are seen as likely to sustain EDI, or at least integrate it into an internet-EDI structure for the management of specific high frequency exchange supply chains.

In terms of knowledge management (a major e-strategy issue as we saw above) nearly two-thirds of respondents were employing knowledge sharing systems, which included Microsoft Outlook (The preferred platform for nearly 70 per cent of our survey), Lotus Notes and certain more specialist systems. Using an existing, and to some degree ubiquitous, package such as Outlook within organisations was enabling greater communication and coordination in areas of innovation, product development, customer strategies, sourcing, specifying and supply management, and training and development co-ordination.

Customer relationship management (CRM) and enterprise resource planning (ERP) systems were in use in over half of the respondents, highlighting the emphasis being placed in supply chain strategy on customer-facing and operations control. Less than 40 per cent of respondents were currently deploying e-procurement, indicating a phasing, or lag, in supply chain e-business evolution between customer-facing and supplier-facing processes.

The use of "middleware" (i.e. software used to integrate two systems) recognises the challenge of integrating e-solutions with legacy systems, and thus 37.3 per cent of respondents were addressing system integration challenges.

Our study of transport and logistics systems identified only just over one fifth of respondents deploying or exploiting any form of order tracking or vehicle tracking system.

Having identified major areas of extant activity we also set about established future intentions in terms of the principle e-business infrastructure deployment for supply chain management during the subsequent 12 months. Our findings are summarised in Table IV.

Here, we found that ubiquitous “protocols” such as email, web and information networks were again regarded as core platforms for supply chain management. The two principal developments in more *dedicated* supply chain systems were intended to be supplier and customer interfacing areas of procurement and customer relationship management. We will discuss these areas in more detail shortly.

E-supply chain management priorities

As illustrated in Table II, the management of supply chains was regarded as a critical element of successful e-business implementation. In Table IV we saw that common platforms such as e-mail and web systems reinforced the focus on supply chain integration in the development of inter-organisational systems. In our study, though, the emphasis was almost exclusively on “squeezing” costs out of the chain. This objective was common to all sizes of organisation and across all of the sectors surveyed. An important catalyst to enhancing customer service through the use of e-business systems was competitive cost pressure from large customers. Although customer service and cost are seen by many as two distinct strategic objectives (e.g. Christopher, 1992), our respondents considered that customer satisfaction was directly dependent on their ability to focus on cost reduction as their primary order winner (Hill, 1993) in the case of their main (largest) customers. We further explored this issue with our case study participants and found that in all cases e-business strategies were most heavily influenced by their major customer or major accounts – in other words, the requirements of an organisation’s 3 or 4 major customers dictated strategic prioritisation.

The difficulties of integrating both internal and supplier legacy systems were seen as a major barrier to increased supply chain integration. In particular, supplier readiness and capability was felt by many to be the main constraint, particularly where the supply base consisted of a high proportion of SMEs. Integration was seen as central to improved control and coordination for improved materials flow through the chain, yet while many small suppliers did not have the necessary technology infrastructure, even large suppliers had very different levels of compatibility in areas such as database integration and use of XML.

Table V provides a view of the three main supply chain priorities for the main sectors represented, comparing this to the total sample. The sectors illustrated here

E-supply chain management deployment during next 12 months?	Yes (%)	No (%)
E-mail	85.9	10.6
Web sites	83.5	7.1
E-procurement	43.5	54.1
Intranet	38.8	57.6
Extranet	36.5	60.0
CRM	29.4	67.1

Table IV.
Major e-business
infrastructure
deployment areas in
supply chain
management

Table V.
“Top three” supply chain
initiatives by main
sectors in the study

Sector	Strategic supply chain issue	%
All (<i>n</i> = 92) (from Table III)	Supply chain management and integration	79.5
	Price and cost improvement	69.9
	Knowledge management	56.6
Manufacturing (<i>n</i> = 34)	Price and cost pressures	100.0
	Supply chain integration	82.0
	Knowledge management	58.0
Wholesale and retail (<i>n</i> = 15)	Price and cost pressures	77.0
	Supply chain integration	86.0
	Globalisation	62.0
Transportation (<i>n</i> = 7)	Price and cost pressures	100.0
	Supply chain integration	86.0
	Globalisation	71.0

(manufacturing, wholesale and retail and transport) are intended to provide a view from three different levels in the chain. It is significant that price and cost pressures were important to all three sectors, yet only in the wholesale and retail sector do we see some equation between improved integration and cost efficiency.

Customer relationship management

We found that the main initiative supporting improved customer relationship management within supply chain activities was the adoption of CRM systems (such as *Siebel*). As we saw in Table III, customer-facing initiatives were among the first phase of evolution of e-business in the supply chain with 56.6 per cent of our respondents adopting some version of a CRM system. In addition, the main rationale for a number of other e-business initiatives was the perceived impact on customer service and profitability. We found that 62.5 per cent of respondents cited improved customer service as the main benefit they expected to gain from their e-fulfilment initiatives (Table VI).

A CRM case example

GPI is a global manufacturer of engineering products serving a number of high precision sectors and their implementation of a CRM system represented a key aspect of their strategic account management process. They recognised that the CRM system alone would not deliver the improvements in customer service and account profitability, but would be a major facilitator in an organisation-wide strategic change process towards effective strategic account management. However, one of the early benefits they gained was to focus the organisation on the nature and significance

Table VI.
Issues in customer
relationship management

Issue	Incidence (%)
Customers seen as primary driver for e-business initiatives	64.4
Current deployment of CRM systems	56.6
Deploying CRM in next 12 months	29.4
Use customer call centres (telephony)	77.0

of customer relationships, even for the smaller customers. The issue they then faced was one of designing and managing appropriate relationships with their customers. As their European Vice-President stated:

The customer intelligence we can now bring to one place means we can take conscious decisions about the relationships we have with customers. For us the challenge is making just the right amount of investment in time and effort for each relationship.

The focus of the first stage of their CRM programme was on the development of the system and the associated hardware required to support organisation-wide intranet access. A main aspect of investment of the CRM project was in staff training and development in two areas. First, they provided a programme of user system training. Second, GPI recognised that they needed to make a significant investment in the development of the organisation's strategic account management capabilities. To this end, a series of internal workshops and executive development programmes were commissioned to provide the support for the effective deployment of the CRM system. Furthermore, the active involvement of their largest eight customers was solicited in the development of their CRM plans.

Fulfilment

Fulfilment refers to customer service processes involving physical distribution. According to a number of authors including Marshall Fisher (1997) a critical determinant of the form of fulfilment strategy adopted is the profile of market demand. Fisher's framework identifies two polar forms of demand profile – stable (or “functional”) and volatile (or “innovative”). He contends that there are two generic forms to the supply chain, efficient or responsive, similar in concept to the notions of lean and agile supply chains. He further argues that the design of the fulfilment process should align efficient supply chains to functional demand patterns and responsive supply chains to innovative demand patterns. Functional fulfilment focuses on cost minimisation, while responsive fulfilment focuses on responsive customer service. Figure 1 illustrates the characteristics of Fisher's framework.

Expanding on Fisher's framework, the work of Abernathy *et al.* (2000) contends that the choice of fulfilment policy has a profound effect on the profitability of an operation. They underline the implications of demand profile for fulfilment planning, highlighting the trade-off between customer service level (i.e. percentage of orders fulfilled on-time) and inventory costs. In particular, where a supply chain handles high volume and low volume products, there is often either a high inventory cost for low volume products, or conversely a low customer service performance for high volume items. To align the supply chain to customer market demand there is a need for effective forecasting and collaborative planning and replenishment (Lee *et al.*, 1997).

The challenge for fulfilment strategy is to reconcile the inherent trade-off between forecasting accuracy, inventory exposure and supply chain configuration, illustrated in Figure 2.

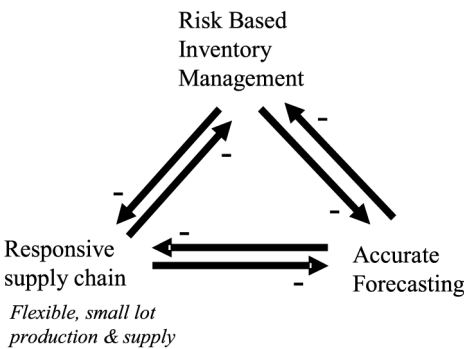
In this figure the negative (-) signs indicate the impact of an improvement in one area of fulfilment activity on the corresponding fulfilment activities. For example, an improvement in forecast accuracy will reduce the need for a risk-based inventory strategy. In this illustration, a risk-based inventory strategy refers to the implications of the risk of stock-out – so more accurate forecasting reduces the risk of stock-out

		Functional Products (e.g. continuity products)	Innovative Products (e.g. Seasonal or promotional)
Efficient Supply Chain	Fast response.....Low Cost Low T/P Time.....High Utilisation Deployed InventoryMin. Inventory Flexible Suppliers.....Low cost suppliers	Match	Mismatch
Responsive Supply Chain		Mismatch	Match
		Predictable.....Unpredictable Few Changes.....Many Changes Low Variety.....High Variety Price Stable.....Price mark downs Long lead time.....Short lead time Low Margin.....High margin	

Figure 1.
Marshall Fisher’s
framework

Source: From Slack and Lewis (2002)

Figure 2.
The trade-offs in
fulfilment planning



when demand exists for an item. (The italicised point it critical – a stock out is only important if there is unsatisfied customer demand as a consequence). Likewise, the adoption of a responsive supply chain configuration reduces the need for accurate forecasting and also reduces the risk of stock outs.

Fulfilment is thus one of the key customer service processes in the supply chain, yet only 36 percent of the respondents were undertaking development to their fulfilment processes. Of these, all stated that they were intending to deploy an “E-fulfilment” approach. Table VII indicates quite clearly a divergence between large and small companies in terms of their development of a fulfilment strategy.

Of those respondents undertaking fulfilment developments, exactly half had completed the implementation of e-enabling their transport management and warehousing. Among the technologies being deployed, global positioning and order tracking systems were the dominant technologies associated with e-fulfilment.

A number of benefits and barriers to the adoption and implementation of a fulfilment strategy were identified. These are outlined in Table VIII.

Significantly, respondents saw the adoption of fulfilment systems (GPS, workflow systems) as an important element of their supply chain integration, yet as we saw in Table III such systems were only evidenced in 22.9 per cent of our respondents.

The findings relating to fulfilment strategies underline the trade-off between service and costs. While at this stage it is not possible to impute the nature of the trade-off, it does seem clear from the comparison of benefits and barriers that the very tangible nature of the (predominantly cost) barriers could have a significant impact on the decision to progress fulfilment strategies.

Procurement

One of the main paradoxes from our analysis was to find that while a large number of organisations were involved with the adoption of e-procurement, less than half of those believed that procurement had a strategic function. The cost benefits of e-procurement were widely accepted, but there seemed to be limited evidence that there is a clear understanding of the nature of the mechanisms required to achieve such cost improvement (Table IX).

	Current fulfilment strategy (%)	No fulfilment strategy (%)
Total sample	36.1	61.4
Less than £50 million p.a.	5.6	94.4
Greater than £50 million p.a.	46.0	54.0

Table VII.
Incidence of explicit
fulfilment strategy

Benefits of fulfilment strategy	(%)	Barriers to fulfilment strategy	(%)
Improved customer service	62.5	Development costs	38.8
Improved information flow	36.5	Systems integration "culture"	31.8
Financial benefits	34.1	Development time	11.8
Enhanced customer satisfaction	30.6	Security concerns	7.1
Improved communications	29.4		
Better understanding of the market and customer	25.9		

Table VIII.
Benefits and barriers to
fulfilment development

Benefits from e-procurement implementation	%
Financial performance – including external (prices) and internal (transaction and process costs)	58.8
Improved information flow	45.9
Improved internal and external communications	41.2
Improvements in planning and control	40.0

Table IX.
Benefits expected from
e-procurement
implementation

Despite the importance given to the financial benefits of e-procurement, it was not generally believed that the financial benefits of e-procurement would meet the widely “hyped” benefits promoted in the press. Consequently, targets and financial justification for e-procurement implementation were based on “more conservative” expectations. In 22 cases we were able to examine further the financial criteria for e-procurement projects, with payback period being the dominant method employed to justify investment. The range of payback period was between two-and-a-half and three years.

We also identified impediments to e-procurement implementation first using an open question – simply “what, if any, do you consider to be the main barriers for your e-procurement implementation plans?” From this we further interrogated all respondents by asking for their opinions of the importance of other impediments. In presenting the data in Table X we highlight the level of agreement and disagreement with the five impediments identified. Only in the case of the first item – development costs – did we find a lack of disagreement with the criteria identified as an impediment.

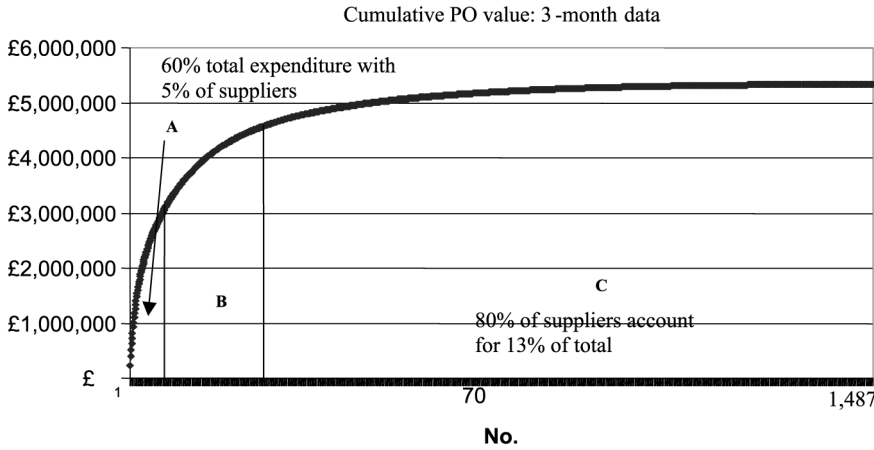
A procurement case example

In one of our case study participants, a UK public sector body, we were able to undertake a detailed and extensive analysis of their procurement process. In Figure 3 we present the profile of their cumulative expenditure, supporting a Pareto distribution in which 60 per cent of expenditure was accounted for by only five suppliers, while 80 per cent of suppliers account for only 13 per cent of the organisation’s total expenditure.

Table X.
Nature of impediments to
e-procurement
implementation

Impediment	Agree (%)	Disagree (%)
Development costs are a barrier to adoption of e-procurement	49.4	
System integration is a barrier to e-procurement implementation	35.3	27.1
Culture is a barrier to e-procurement adoption	34.1	28.2
Development time is a barrier to e-procurement adoption	22.4	38.8
Security issues are an important concern in e-procurement adoption	16.5	44.7

Figure 3.
Pareto distribution of
purchase expenditure



We further mapped the procurement process for a range of purchases across five departments within the organisation, including all stages in the process from user request through to receipt/installation and payment. Costing the total process involved translating processing times into the organisation's standard rates for the level of staff employed at each stage. While this ensured consistency across the departments, it is acknowledged that there is an underlying question about the feasibility of using such data for interorganisational analyses. However, Table XI presents a comparative analysis within the organisation. It is significant to note here the high ratio of process costs to order value for department H, which typically processed low value orders but employed a manual and fragmented process. It was also significant that sourcing strategies seem to have an impact on process costs, since departments I and W had long-term contracts with few suppliers, while departments A, and C had multiple suppliers for their main requirements. This is an important area for future research into total cost of acquisition.

Summary: the evolution of e-supply chains

From the analysis of our survey and case data we found that e-business developments in supply chain management follow a number of distinct phases of evolution. We were able to group progress and evolution into five groups or clusters, first through sorting responses by the scope of e-business systems in use (i.e. simple "counts" of the number and range of systems in use) and then by using SPSS discriminant analysis with this segment of the data to test our clustering using a simple 1-5 count as the relevant "cut-off scores". Our clustering was also reviewed in the light of previous research into the development of e-business in support of supply chain management (Chandrashekar and Schary, 1999; Marchewka and Towell, 2000; Frohlich and Westbrook, 2001; Lancioni *et al.*, 2003). We thus feel that our framework provides an appropriate and valid representation of e-business practices applied to supply chain management.

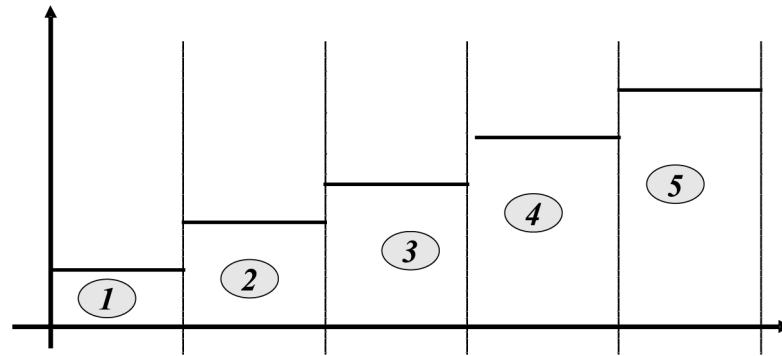
We have summarised our findings into the impact of e-business developments on supply chain management as a five-stage evolutionary model summarised in Figure 4 below, which indicates a shifting orientation, or "focus" in e-business strategy from the early adoption phases 1 and 2 of B2C (business to customer) and B2B (business to business), followed by internal integration involving process re-engineering. Phase 4 represents the linkage to horizontal and vertical (typically external) exchanges (B2X) to the final, fifth, phase providing integration across the total supply chain.

Each of the stages in this normative model represents cumulative development and implementation towards integrated supply chain management.

Stage one. We classified as "customer acquisition", typified by the use of standard e-business protocols such as e-mail and web sites with the primary objective of gaining improved access to customers and markets. This carried with it expectations of

Department	Average order value (£)	Process cost (£)	Process cost as % of order value
A	250.00	97.60	39.04
C	166.66	104.62	62.78
H	58.60	104.38	178.12
I	980.00	150.00	15.31
W	1,069.83	118.17	11.05

Table XI.
Comparative analysis of
purchase transaction
costs



Focus	B2C'	B2B'	Re-engineering Process	B2X'	Pipeline Transparency
Systems	Email, Web, EDI	CRM	Resource Planning	E-Procurement	E-Fulfilment
Processes	Sales to Payment	Relationship Management	Process Planning and Control	Supply Base management,	Integrated Logistics
Strategies	Sales growth	Strategic Account Management	Operations Improvement	Procurement	Supply Chain

Figure 4.
E-business in the supply chain – five phases of evolution

enhanced sales, better control over revenue flows and exploitation of standard web-based infrastructures. In our study 84 per cent of all respondents demonstrated the characteristics of this stage.

Stage two. We classified as “customer management”, representing an increasing emphasis on the management of customer relationships supported by use of CRM systems and internal customer intelligence. In our study, 54 per cent of respondents evidenced deployment of CRM and supporting systems and the characteristics of a stage two organisation.

Stage three represented the utilisation of e-business systems to support operations process management, typically ERP (enterprise resource planning) systems. Here, 37 per cent of our respondents had evolved through the first three stages.

Stage four emphasises a move towards integrating supply-side activities, typically illustrated by the deployment of e-procurement systems in support of greater management of the total costs of acquisition. Of our participants, 29 per cent had evolved their supply chain development to incorporate stage four.

Finally, *stage five* represents integrated e-supply chain management and typically involved the use of e-business platforms such as e-fulfilment, global positioning and order tracking in order to improve materials management. Only 12 per cent of our respondent sample evidence deployment to stage five (Table XII).

Future research

This study was an extensive, but exploratory study into the nature and processes of e-business developments in supply chain management. It is apparent that to validate our evolutionary model a more longitudinal analysis is required to follow the

	<i>Stage one – customer management</i>	<i>Stage two – process management</i>	<i>Stage three – procurement</i>	<i>Stage four – supply chain integration</i>	<i>Stage five – customer acquisition</i>
Primary objective	Improve access to customers	Segmenting customers	Operations coordination, planning and control	Supply management	Integrated materials management
Information focus	Channel technology	Customer intelligence	Process and product data	Procurement procedures	Logistics co-ordination
Dominant infrastructure	Web site, payment and e-mail	CRM	ERP Knowledge networks	E-procurement Supply information	Order tracking Global positioning
Operational focus	Customer access	Limited customisation	Process efficiency	Total external expenditure control	Systems transparency and integration
Main process imperative	Cash flow	Customer portfolio	Operational costs	Total cost of acquisition	Responsiveness
Typical occurrence (%)	84	54	37	29	12

Table XII.
Progress in the five
phases of evolution

development path of individual organisations to build on the hypothesis developed from this primarily cross-sectional analysis.

Second, the diversity of industries represented means that this study has enabled us at best to identify some general trends, rather than industry-specific patterns of behaviour. Consequently, we are now undertaking further research that involves a series of longitudinal case studies to monitor and evaluate the developments in a range of organisations from just two sectors: the public sector and manufacturing.

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