The Need for an Electronic Document Exchange Infrastructure for Supply Chain Management

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The Need for an Electronic Document Exchange Infrastructure for Supply Chain Management

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Abstract

Established supply chain management techniques such Just-In-Time inventory (JIT), Quick Response (QR) and Efficient Consumer Response (ECR) have proven that re-organising a business' processes to take advantage of the characteristics of electronic information exchange can yield significant results. IT support for these approaches is critical, and has traditionally focused on the exchange of standardised business documents. As the internet and other proprietary and organisational networks expand, however, organisations are now seizing the opportunity to use this enabling infrastructure to exchange other, more varied, types of information. With this proliferation of document exchange types and mechanisms comes the need for a supporting technological infrastructure, which will facilitate the rapid development of systems which support these supply chain management and business process reengineering initiatives.

This paper contains a descriptive exploratory case of a large Australian organisation, which has undergone the process of developing an electronic document exchange (EDE) strategy for supply chain management across all its divisions. We present an initial requirements framework for EDE derived from this case study, covering success and failure constraints, as well as business and functional criteria. The importance of internal application standards is addressed.

Introduction

Organisations are under increasing pressure to reduce costs and to improve internal and external efficiencies so that they can remain competitive (Chatfield and Bjorn-Andersen 1997). These inefficiencies associated with intra- and inter-organisational trade can often be attributed to delays and errors in the exchange of the business documents and information associated with the goods and services being produced and traded (see, for example, Wenninger 1999). Electronic Data Interchange (EDI) provided the impetus during the mid-1980s to 1990s for approaches which enable the automation and streamlining of internal and external information flows, including:

- supply chain management (SCM), which focuses on upstream or downstream integration of systems and business processes between all organisations along a supply chain (Gattorna and Walters 1996; DeCovny 1998); and
- business process reengineering (BPR), which involves streamlining an organisation's value chain (Davenport and Short 1990; Hammer and Champy 1993; van Kirk 1993), which also includes the reengineering of processes between the company and its suppliers and/or customers (Swatman *et al.* 1994; Clark and Stoddard 1996).

Numerous examples of mostly large organisations which have implemented successful EDI projects have been reported over the last decade (see, for example, Rochester 1989; Emmelhainz 1992; Swatman 1994; Shaw 1995; McMichael *et al.* 1997; DeCovny 1998). Despite the ability of EDI to reduce operating costs and lead times, the full potential of EDI for many users has not been realised because small and medium enterprises (SMEs) in particular have resisted calls to become EDI capable (Steel 1996; Parker 1997; Wenninger 1999). EDI users have often found it necessary to operate both their EDI systems and their traditional paper-based processes to support their trading partners (Farhoomand and Boyer 1994; Iacovou *et al.* 1995), thus reducing the effectiveness of their reengineering programmes (Wenninger 1999).

These difficulties are being further exacerbated by the growing need for organisations to undertake more complex Electronic Document Exchange[1] (EDE) than the frequently cited purchase orders and ASNs. For example, companies are trying to utilise their internal databases to provide trading partners with information-based products such as order tracking for customers (Rayport and Sviokla 1995; Baker 1999) and forecasting details for suppliers (Baljko 1999). Other organisations are streamlining their product design process through the electronic exchange of design specifications with trading partners (McCubbrey and Schuldt 1996).

And all of these EDE alternatives must be achieved in an environment where trading partners often have quite different levels of eCommerce sophistication (including EDI, Web, email or even just facsimile capability). While increasingly more small businesses are making use of Internet or Web commerce (see Department of Foreign Affairs and Trade 1999; Poon and Swatman 1999), it appears that it might still be some time before all of an organisation's trading partners are Internet capable (Andel 1998). For this reason, many large organisations are investing in eCommerce gateway solutions (see, for example, Chan and Swatman 1999; Mak and Johnston 1999) which support this range of EDE technology support.

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[1] In searching for a term which covered all types of document exchange between organisations we failed to find one in use. Consequently we have coined the term Electronic Document Exchange (EDE) to refer to the electronic exchange between trading partners of both standardised and ad hoc business documentation.

According to Broadbent *et al.* (1999), there is growing evidence that organisations implementing BPR require a basic level of IT infrastructure (see also Caron *et al.* 1994; Dixon *et al.* 1994). Indeed, EDI has often been seen as a necessary precursor to the successful implementation of BPR and SCM projects, due to its ability to integrate intra- and inter-organisational systems (see, for instance, Swatman *et al.* 1994). It is our contention that EDE, which includes the electronic exchange of EDI, order tracking, product design and a plethora of other document types, will also be an important component of such an enabling IT infrastructure for BPR and SCM.

What appears to be lacking in the eCommerce academic literature, however, are frameworks or models intended specifically to help organisations identify their EDE infrastructure requirements which might serve as an enabler of future BPR and/or SCM initiatives. This paper therefore presents an initial EDE Infrastructure Requirements Framework which evolved during our study of a large Australian paper product company (which we will call PaperCo) and its supply chain. The paper will discuss:
- the research methodology employed;
- the environment leading to PaperCo's decision to investigate its EDE infrastructure requirements;
- the process PaperCo undertook to identify its EDE infrastructure requirements; and
- the EDE Infrastructure Requirements Framework resulting from this study.

Methodology

In selecting a research method appropriate to both the research situation (Antill 1985) and the type of research question(s) being asked (Galliers 1994), we were guided by the lack of existing studies in this area, and a desire to focus on organisational issues in their real world setting.

We were interested in an exploratory study of the issues associated with EDE implementation currently facing organisations, and were therefore looking at a contemporary setting where we would have no control over behavioural events. We chose a single, revelatory (Yin, 1992) case approach, therefore, which would allow us to gather in-depth information in a realistic setting.

Research Design: PaperCo and its Environment

PaperCo is one of Australia's largest producers of corrugated cardboard boxes, which are made from 100% recycled paper. Founded nearly 50 years ago, it is a privately owned, Melbourne-based international manufacturing company group which employs 3500 people worldwide and has Group sales of over $1 billion. The company has three main operating divisions, in addition to a head office:
1. A recycling division collects waste material (primarily paper) for recycling
2. A paper products division takes the recycled waste and makes packaging paper
3. A box division makes corrugated boxes from the recycled packaging paper.

Representatives from each operating division were interviewed via two person interview teams. The IT manager for each division was interviewed, as well as a member of the middle management team from each division. In this way both business requirements and rules, as well as IT considerations and capabilities were gathered. Additionally, where they had been identified, we interviewed employee 'champions' who had identified process improvements

which required some kind of EDE support. An interview template was prepared for use, but it was broad in its focus: our approach to the case was exploratory. Secondary data sources such as PaperCo's web site and business document templates were also used.

Value and Supply Chain Interactions within PaperCo

Although the three divisions of PaperCo are part of the same group of companies, they are effectively separate organisations which trade heavily with one another. Much of the product produced within each company is sold down the supply chain to other divisions: the paper products divisions, for instance, sends 80% of the paper it manufactures to the box division, and sources 50% of the raw material produced by the recycling division.

In exploring the possible future applications of EDE that PaperCo might implement to gain either production efficiencies or generate value added products, it became quickly apparent that PaperCo's value and supply chains are not separate, in terms of information flow, but rather quite interconnected. This makes them inter-dependent, as changes to document types and flows within a single division will affect the others.

The communication between the three divisions is a combination of intra-organisational documents such as memos and general ledger transactions (the company group has centralised financial systems) and inter-organisational documents such as invoices and purchase orders. The processes, and consequently the information systems, which support these document flows are both intra- and inter-organisational systems.

PaperCo had already been using EDI to exchange a few documents with some trading partners, but the scheme had been deemed unsuccessful because of a lack of internal integration and a lack of interest from the majority of their trading partners at the time. At the commencement of our study, however, the company was facing increasingly more complex EDE requirements from its trading partners, both in terms of the quantity of documents requested and in terms of the variety of documents needed. This increase in EDE interest from trading partners has been due in part to the advent of and interest in the Internet. PaperCo was also simultaneously looking at its intra- and inter-divisional processes, in addition to their links with trading partners, with a view to streamlining them. A further driver for change was the result of an independent survey, which suggested that PaperCo's customers were interested in value added services that would modernise their supply chains, centred around the increased provision of documents and information. This survey identified:
  - lack of customer information
  - poor delivery performance
  - long quote cycle times
  - average/poor service performance
as issues in customer service management which needed to be addressed. The suggested changes included a number of issues which were relevant to the EDE investigation, including:
  - visibility of customer information across the group
  - improved reporting of delivery performance
  - ability to assess lead-time/availability
  - a simplified/automated quote process
  - a consistent customer management approach.

The types and quantities of the potential documents to be exchanged, both internally and externally, were diverse. The recycling division, for instance, had approximately 15,000 active customers, all with similar needs – while the box division had approximately 8,000 active customers with diverse needs and differing levels of technical sophistication. There was also a variety in the identified uses for document exchange within divisions. The box division, for instance, had begun to implement electronic exchange of box design and art work files, greatly speeding job turnaround time, while the recycling division saw potential in providing customers with an automated facility for querying recycling pickups over the web.

EDE Infrastructure Requirements

PaperCo therefore saw a need to identify requirements for a flexible EDE infrastructure which could support their existing and future EDE needs. The procedure for investigating these requirements undertaken by PaperCo was quite typical and involved:
- establishing the constraints on and the success factors for the SCM project;
- analysing their internal and external environment to identify opportunities for streamlining business processes using EDE techniques; and
- determining functional criteria on which to base their selection of an EDE solution.

We were primarily interested in EDE-specific aspects of these three phases, especially when compared to more traditional EDI based projects, which would inform the development of our EDE Infrastructure Requirements Framework.

Success Factors and Constraints

A range of factors were identified which were believed to be essential to the success and effectiveness of the EDE-based SCM project. These success factors matched the conventionally acknowledged factors suggested for any strategic IT initiative (see, for instance, Galliers *et al.* 1995; Chan and Swatman 1998; see also Frank 1997), and do not relate to PaperCo alone:
- without top management commitment, no major technological innovation can be successfully adopted by an organisation of any size (let alone an organisation as large and diverse as this one);
- equally important was the issue of trading partner commitment, as successful SCM initiatives tend to have a cooperative focus;
- top-down implementation was required to ensure that all parts of the organisation install and use the chosen solution in the same way;
- since innovation cannot be effectively implemented without a common strategy, top management support for EDE innovations is clearly required;
- because of the complexity and variety of business documents being exchanged throughout the company, implementation teams would need to include both business people and technical experts;
- a pilot study of one application within one division to identify and scope the technical and organisational difficulties which are inevitable with such a major change to operating procedures was recommended;
- once the pilot study was successfully completed, a phased implementation of the complete EDE programme was recommended to ensure that sufficient time and effort is given to each part of the group; and
- finally, training was needed for both internal staff and for those trading partners using the

new systems.

The SCM objectives with which the EDE infrastructure was to be aligned were also identified from the outset of the project:

- to reduce direct and indirect costs by means of EDE, including reductions in document processing errors;
- to optimise internal and external document flows using EDE to improve their SCM;
- to improve trading partner relationships (for example, by enhancing customer service) through their use of EDE
- to support the varying types of document exchange requirements by trading partners and by their internal supply chain, including a flexible EDE approach which could support future EDE requirements.

Having identified these success factors and EDE objectives, PaperCo then set about determining the most pressing constraints which were to be placed on the EDE infrastructure:

1. outsourcing;
   The EDE infrastructure developed needed to be both flexible and modular, in order to support the rapid and spontaneous development of supporting IT systems once BPR/SCM initiatives had been identified and selected. This was particularly important because any such development was likely to be outsourced.
2. archiving;
   Many of the documents PaperCo were intending to exchange with trading partners were associated with box work designs, which would be stored on an intranet accessible to their trading partners. The number of documents involved was substantial, and the EDE infrastructure was required to cope with this, as well as possible future policy changes regarding external access to data.
3. staffing implications;
   PaperCo wanted a solution which would require a minimum number of new staff: where possible, retraining of existing staff was preferred.
4. common approaches to trading partners;
   PaperCo wanted a consistent approach to trading partner exchanges, to minimise staff impact and maintenance, and to facilitate the easier development of future BPR projects.
5. future scalability and maintainability;
6. support for internal (as well as external) work flows;
7. to avoid having separate strategies for internal and external EDE;
8. assessing the security implications of the Internet as an EDE architecture.

During the process of interviewing staff and observing processes throughout PaperCo's operations, however, it became clear that a number of additional constraints were at least (if not more) crucial than those initially identified. The first was to consider the appropriateness of using an ISP to carry commercial-in-confidence information. PaperCo did not make significant use of the Internet, apart from email messaging and from the recycling division providing marketing material on the web, which was accessed primarily by school children (and thus low in commercial confidentiality). Interviews with IT personnel across the company, however, made it clear that there was considerable demand to extend Internet usage beyond this level, to include confidential information. With an ISP no longer an appropriate intermediary, staff with specific Internet skills would have to be hired to build and maintain the new Internet site. The EDE solution chosen therefore needed to minimise the number of additional staff required.

These constraints (and indeed objectives) might arise in any organisation, and are not PaperCo specific. We would argue that, with the possible exception of the outsourcing constraint, all the constraints (in addition to the success factors and SCM objectives) would be largely consistent, and therefore relevant to all companies which might be considering the development of an EDE infrastructure?

Determining EDE Opportunities

Opportunities for EDE within PaperCo and with its trading partners were determined using two main approaches:
- a conventional analysis of existing document flows both internally to and externally with the organisation to identify opportunities for streamlining these flows using EDE; and
- a study of its trading partners to determine their EDE capabilities and requirements.

The trading partner analysis was seen as especially important in the context of EDE, because the outcome of the study allowed PaperCo to ascertain the breadth of document types which would ultimately need to be supported by the EDE infrastructure. For this reason, the trading partner analysis for this EDE project was more complex than for traditional EDI projects, which tend to focus on such operational issues as (see, for instance, Shaw 1995):
- the type of business document(s) to be implemented through EDI; and
- the possibly different EDI standards which might have been used by the trading partners.

The analysis identified the following EDE types which would need to be supported:
- facsimile – including e-fax capabilities, but also support for clients with traditional fax;
- email – especially for the attachment of other electronic documents;
- Web – material made available by the company for customers/clients to download as they require over the Internet. The documents or information are therefore pulled by the client, where control over the access varies with the sensitivity of the data;
- e-forms – company-developed structured input forms which are available to customers via the Web and which provide direct data input to PaperCo's software (which in some instances would be turned into EDI documents first); and
- traditional EDI.

Results from the trading partner analysis also suggested that customers were interested in value added services which could modernise their supply chain relationships. The value added services identified as desirable to their customers involved increased document and information provision and would therefore need to be supported by the EDE infrastructure.

An investigation of these potential value added services, along with the internal document flow analysis, identified a number of opportunities for further EDE use within the different divisions of PaperCo:

Recycling Division

EDE use within the recycling division was limited to fax and email exchange, and the provision of recycling information on the Web. The primary users of Web material were schools, and customers seeking information. Future plans included the listing of catalogues and product information on the web; the use of e-forms to structure requests/enquiries; EDI for exchange of invoices, purchase orders etc with trading partners; and increased use of email and e-fax to send/receive orders.

The most significant way in which a new EDE platform would affect the recycling division therefore would be in the ability it would give them to handle a wider range of document types, which matched its diverse customer base. It would allow them to provide commonly-requested information to the community via the internet, supporting an online marketing presence. Most additional document exchange types would centre around providing electronic (more formalised) responses to customer requests such as for scheduling and pickup information. Planned developments included the integration of recycling pickup requests submitted via the web site with the scheduling system for the recycling fleet.

Historically, although they had a web presence established, the recycling division had not been proactive in pursuing opportunistic uses for IT. This was largely because they had few people within the division with knowledge of how IT might be used; the IT requirements of the division were handled by the primary IT department of PaperCo, which is contained within the box division.

Paper Products Division

Within the paper products division there was less variety in the uses seen for EDE, but higher volumes of a small number of document exchange types. Their document needs were based around standard business documents (invoices, orders, end-of-month statements) exchanged with a stable, smaller group of trading partners. The area of EDE expansion with the most potential was therefore EDI, as their trading partners are large organisations with relatively homogeneous needs. Again, as with the recycling division, few employees with IT expertise and no exposure to the possibilities offered had resulted in minimal awareness of the diversity of electronic exchanges possible. There was an understanding of the potential of EDI, which was expected given the EDI trial which had been conducted, but the lacklustre performance of that pilot had certainly not inspired enthusiasm, and may indeed have negatively affected the generation of process change ideas within the paper products employees.

Box Division

The box division had the most potential for diverse EDE types. Their current use is focused on fax for sending/receipt of orders, but has recently widened to cover the use of fax/email in the new product design cycle (exchanging artwork and box designs with customers via email), and also on marketing opportunities similar to those of the recycling division.

The box division had a more extensive history with eCommerce via the EDI pilot, and had had the greatest number of requests for support from trading partners, with a resulting higher level of awareness of EDE opportunities. This awareness was generated primarily through individual - non IT related - employees who understood their areas well and saw the possibility for process improvements in their domains. These individuals had been pursuing their ideas separately, and independently from top management or the IT department. In several cases PaperCo's central administration discovered the existence of these division-based approaches only when they themselves began to look for document exchange opportunities. This knowledge and enthusiasm generated by "champions," coupled with the variety of document types they could support via EDE, meant that the box division had gone further than the other divisions in identifying opportunities to reengineer internal business processes, having established potential for redesign in the following areas:

Order Forecasting

It would aid pre-planning of factory schedules if the company knew when their customers would be placing orders. This information could be obtained by accessing customer databases directly (raising the issue of confidentiality), or by having the customer send a message with the time the order is required. Such a message could be automatically produced by the customer's internal systems, or sent manually in the form of structured email template. Structured email would reduce rekeying within the company, and could be replaced with EDI in the future for EDI-capable customers.

Order Placement

At present orders are taken via fax, email and EDI (EDI messages are then printed and rekeyed). Further development of the company's web site would enable e-forms to capture and structure this information. The installation and integration of an updated EDI gateway package would allow EDI messages to be input directly into in-house systems, and eliminate the rekeying.

Order Confirmation

A variety of confirmation types were being used within the company for different customers, from functional acknowledgments to full Purchase Order Acknowledgments (POAs), although the responses in place are not flexible. The company wished to be able to offer the same transfer mechanisms for confirmation as for placement (i.e. fax, email, and EDI) and allow trading partners to receive confirmations via a medium they can support.

Job Tracking

PaperCo was considering altering internal job progress processes to provide customers with job tracking facilities. Information on when an order placed will be ready would be advantageous to customers engaging in tightly-timetabled production schedules, and hence provide competitive advantage. The company was weighing this advantage against the loss in flexibility in job scheduling.

Delivery

Delivery of orders was an obvious application for Evaluated Receipt Settlement for the company. ERS would allow the company to eliminate invoices; customers would read/scan the pallets of bar-coded goods as they arrived, triggering an EDI acceptance message. An EFT payment would then be generated and sent to the bank. In general, the company operates on terms of 30 days. As invoices are generated at end of month, the average payment return is 47 days. ERS has the potential to save the company $140,000 per month. For EFT-capable customers, the company would need to negotiate with their bank regarding detailed remittance advices associated with each electronic payment made to the bank, to ensure an adequate audit trail. For non-EFT-capable customers invoices would still be issued (either by email or EDI).

Functional Criteria for EDE Infrastructure

Given an understanding of both the EDE types and processes (both current and new) to be supported, the company then examined a set of architectural solutions compatible with these new requirements and their existing business practices. The solutions assessed were then ranked both by the functional criteria of the vendor solutions offered, and non-functional company criteria. The functional criteria were as follows:

- *supports VAN based EDI*
  the company has existing EDI enabled trading partners using VANs. The solution chosen had to provide connection and support for VAN based EDI messages
- *supports internet EDI*
  many of the company's smaller customers or suppliers have access to the internet but would be reluctant to pay for VAN services for relatively few transactions. Increasingly trading partners were demanding internet EDI
- *supports email*
  many transactions with customers already occur using email, and its use will increase substantially as an exchange mechanism for binary files, particularly for off-site sales staff who will be able to cut the iterative product design development process from several visits down to one. This is a significant benefit in the case of country customers, when the sales reps can spend days driving to site
- *supports e-forms*
  the company expects to use e-forms to structure standard transactions involving the web site, such as queries for marketing information, and intends to expand these services to provide additional value added information, such as updated or confirmed delivery schedules for recycling trucks
- *supports WWW access*
  the company required a web server integrated with the gateway solution as a whole. The web server enables outside access to material on the web site, such as marketing material, and will also be connected to internal systems which generate the information. Placement of the web server is expected to be on an extranet, which would enable better control over confidential information while ensuring security
- *supports e-fax*
  access to fax machines across the company is sometimes variable, and many faxes are electronic documents which have been printed for transmission. E-fax will allow all employees with access to the network to send faxes from their PCs
- *supports binary file exchange*
  business documents exchanged by the company are no longer solely text based documents. The increased exchange of documents such as art work design or palette specifications require binary file support.

It is interesting to note that these criteria go well beyond the capabilities of traditional EDI systems, so that the traditional EDI software selection criteria were insufficient for EDE. Rather, corporate gateway systems are increasingly available from eCommerce software vendors (for example, Sterling Commerce, GE Information Services, Harbinger) or are being developed in-house by organisations (see Chan and Swatman 1999; Mak and Johnston 1999) to support the electronic exchange of the above document types.

In addition to the issue of whether each vendor could adequately support the functional EDI and internet requirements of PaperCo, the company also had a set of business criteria to consider which are largely consistent with the criteria considered for most IT projects:
- *adequate security*
  firewalls, extranets, levels of security and authentication, internet and EDI
- *installation costs*
  the company had set a relatively inflexible budget for any solution adopted, although the initial cost was of less concern than ongoing costs, and particularly possible additional staffing costs.

- *configuration costs*
  configuration costs of different solutions varied enormously, depending on the number of document mappings required for EDI documents to be used
- *ongoing costs*
  included ongoing vendor and network provider charges
- *staffing impact*
  including not just staffing costs, but an assessment of the change in work practices of employees
- *service and support*
  including cost and degree of service provided, and response times
- *Australian presence*
  given its commitment to the EDE strategy, the company saw local presence on the part of the vendor to be crucial.

These criteria were also largely in line with the EDE project constraints established earlier in the project, such as ensuring minimal staffing impacts.

Findings and Implications

The EDE opportunities PaperCo discovered have ranged from accepted supply chain initiatives such as ERS to less common ideas such as the electronic exchange of box art designs with customers or the provision of recycling pickup schedules over the web. The support of any of these ideas separately through IT will provide the organisation with a benefit. But if they can create an EDE infrastructure which allows easy future implementation of additional process change initiatives then they will have produced a knowledge-based resource (Miller and Shamsie 1996) of additional value to the organisation.

We have outlined a possible approach for establishing the requirements for such a flexible EDE infrastructure which we believe might also be applicable to many other organisations considering this approach to process redesign. While many of the elements of this approach are common to traditional IT or specifically EDI projects, our research has shown that an EDE project necessitates more detailed trading partner analysis in order to uncover the full potential of document exchange technologies and alternatives.

We investigated and have presented the issues which arose in the PaperCo case according to separate areas of literature and theory relevant to EDE. Initial investigations focused on strategic issues associated with SCM and BPR. The success and failure constraints derived for an EDE framework show alignment with the strategic IT literature, suggesting that existing frameworks and models in this area are applicable to (at least this type of) eCommerce. The business criteria PaperCo had for an EDE approach also corresponded closely to the criteria considered for most IT projects.

At a more operational level, our investigation of the possible application areas for EDE involved process examination across all divisions of the company, and revealed functional criteria which go beyond the capabilities of traditional EDI systems, on which traditional organisational eCommerce studies have tended to focus. These findings suggest that:
- At a strategic or managerial level, the issues associated with development of an integrated EDE framework or architecture may be adequately addressed using existing BPR and SCM approaches

- At an operational/functional level, the requirements of an EDE framework/architecture will vary from traditional EDI developments and will impact the systems development project(s) undertaken in implementing/integrating EDE, whether they are built or bought.

The findings of the PaperCo case are summarised below, presented as a framework of requirements for an overall EDE infrastructure (in terms of both data and process).

EDE Infrastructure Requirements Determination	Further Case Notes
Verify that success factors are satisfied - top management commitment to EDE - trading partner commitment to EDE - EDE team includes technical and business people - an EDE champion - a pilot study is established to identify possible technical and organisational difficulties - a common company-wide EDE strategy is needed	PaperCo only felt ready to approach the idea of EDE-enabled process redesign when they had internal champions and when their trading partners pushed for new ways of working together. Several PaperCo employees with ideas for process redesign, however, were almost to the point of abandoning them. It is therefore important for a firm to recognise its EDE readiness and act in a timely manner. The pervasive nature of a consistent EDE approach/architecture, and the degree of inter-divisional cooperation needed to develop and sustain an effective platform also makes management support and input at the highest levels particularly critical.
Devise company-wide high-level EDE strategies - reduce direct/indirect document exchange costs - optimise internal/external document flows - improve trading partner relationships - support all necessary document types	While these high-level EDE strategies were specific to PaperCo, we believe that these strategies (and others) will most likely be applicable to all organisations trying to streamline their internal and external supply chain processes using EDE.
Determine EDE project constraints - minimise staff implications - common EDE approaches to trading partners - future scalability and maintainability - support for internal work flows - no separate internal/external EDE approaches - EDE solution must be secure (e.g. Internet)	We believe that these EDE project constraints identified by PaperCo are likely to be the same as those imposed by other companies embarking on such a project. These constraints suggest the need for EDE consistency both internally and externally to the firm, and that the EDE infrastructure must be able to support future growth.
Analyse internal and external document flows - conduct a trading partner analysis to identify external EDE opportunities and requirements - study internal supply chain for intra- and inter-division document exchange process changes - identify value-added services which can be derived from information in internal databases - encourage EDE ideas from all parts of the company rather than rely entirely on a centralised EDE strategy planning team	EDE opportunities identified by PaperCo ranged from well known initiatives such as ERS and EDI, through to emailing box designs and artwork. By focusing broadly on EDE rather than on specific approaches such as EDI or the Internet, PaperCo was able to devise a range of EDE initiatives based on externally and internally identified requirements. Indeed, the idea of artwork exchange led to the idea of developing an extranet on which their artwork catalogue could be stored, for easy retrieval or update by customers.
Evaluate EDE infrastructure business criteria (e.g.) - adequate security - installation, configuration and ongoing costs - staffing impact - service, support and local presence	While these business criteria for evaluating EDE infrastructure solutions were specific to PaperCo, they are sufficiently general that they are likely to form the basis for any organisation evaluating their own solutions.

Evaluate EDE infrastructure functional criteria (e.g.) The EDE infrastructure must support VAN-based EDI, Internet EDI, email, e-fax, e-forms, Web access, and binary file exchange.	These functional criteria devised by PaperCo were intended to support existing and future EDE needs of its internal and external supply chain. A further criteria in the selection of EDE solutions is its extendibility to handle new document types not yet envisaged. These functional criteria would constitute most of the likely EDE needs of most firms.

Table 1: Initial EDE Infrastructure Requirements Framework

A further implication evident in the PaperCo case study is the increasing importance of using open standards within internal systems, and the "greying" of the line between internal and external application systems. Internal systems have traditionally been isolated from external connections, and the problems of translation associated with proprietary standards (whether document, transport, etc) has generally been addressed by the use of corporate EDI gateways. As business document exchange progresses beyond the standardised and largely static nature of EDI, however, the issue of standards is once more becoming critical With the identification of new, *ad hoc* exchanges of documents with trading partners, or between internal divisions, the number and types of document and application interactions will not only increase, but will be inherently unpredictable. The interconnectivity of internal systems with those of external partners will therefore become increasingly important.

Conclusions and Future Work

This paper has presented a case study investigating the requirements associated with developing an EDE infrastructure to support SCM and BPR initiatives, particularly those connected to supporting future systems development. Such an infrastructure must facilitate the rapid and easy development of new systems which cannot necessarily be predicted far in advance, and must deal with a multitude of new document types.

We have presented a set of functional and non-functional criteria useful to organisations wishing to support process improvement initiatives, or simply manage a diverse document exchange portfolio, by identifying the requirements of a comprehensive and extensible infrastructure for the exchange of documents both internally and across their supply chain. Such an infrastructure will allow a company to support the variety of current and future strategies which may be in use across the organisation in a consistent manner (for example, cost minimisation via EDI may be the focus of one division of a company, and reduced time to delivery via email exchange of acrobat art work files another).

In particular, the issues identified in the paper may be helpful for large, multi-divisional organisations with disparate document exchange requirements. These are the companies most likely to benefit from EDE, and also the most likely to be in the position of exploring process redesign initiatives both internally and across their supply chain.

Interestingly, the analysis undertaken to develop this framework is not unique to eCommerce but is an approach which has yielded benefits in many BPR cases (see, for example, Davenport and Short 1990). Clearly, while there are elements of eCommerce which are unique, much of the analysis of business processes can be undertaken in a way which is already familiar to most of the companies considering the benefits of EDE.

As a single organisation, the PaperCo example can only be a revelatory case. Planned future work includes validation of our findings against other organisations in a similar position, and the extension of the EDE requirements framework to address more systems development-focused issues such as data/information architecture requirements and methodological support for developing and maintaining such an infrastructure. The advantages of both the methodology and the concept of EDE need to be assessed against the broader canvas of medium to large corporate businesses. Government is already considering ways in which agencies can work together to maximise efficiency and minimise costs – EDE offers a potential way in which these goals may be obtained at comparatively minor cost.

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