

PLANNING FOR ELECTRONIC DATA INTERCHANGE

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There is an abundance of literature about the impact of the new electronic communications technologies and most of the authors attest to its value and theoretical benefits. Many organizations are working in this area and producing novel implementations, but for the general company there is little that is of help in planning for these systems. In order to overcome this deficiency, this article presents a detailed analysis of electronic data interchange (EDI) undertaken by a large number of U.S. companies. The results suggest a model of strategic implementation which illustrates how factors such as the nature of markets and distribution channels, organizational structure and process and buyer power influence the implementation of EDI with suppliers and customers. Five generic EDI strategies have been identified and the impact of market share and IT expertise on these are discussed. Finally, the authors give their views on some of the long-term issues and suggest some possible outcomes.

INTRODUCTION

The use of electronic transfer of data to make organizations more efficient has been a viable technology for many years. Recent developments in information technology (IT) are now making it much easier to do this across organizational boundaries and hence between companies. This has led to the concept of electronic data interchange (EDI). There is no exact definition of the term in this rapidly changing technological environment, but the following one will be used throughout this article:

Electronic data interchange: The exchange of information across organizational boundaries using Information Technology.

This definition does not attempt to precisely capture the technical aspects of EDI but stresses

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instead the conceptual importance of IT being used across organizational boundaries to facilitate the fast exchange of large volumes of information between separate organizations' computer systems. A sample of other definitions support this, for example the definition given by the U.K. Department of Trade and Industry (1989) is:

At its simplest, EDI is the process of computer-to-computer business-to-business transaction transfer. EDI involves the direct routing of information from one computer to another without interpretation or transcription by people, and to achieve this the information must be structured according to predefined formats and rules which a computer can use directly.

Cash and Konsynski (1985) define an 'inter-organizational information system' which the authors would contend is the same phenomenon as:

an automated information system shared by two or more companies.

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Walker (1988) gives a more technical definition of EDI but without reference to the organizational aspects:

the electronic transfer from one computer to another of computer processable data using an agreed standard to structure the data.

Although the technology now makes many things possible, for the majority of organizations the problems of what to do, when and how still loom large. The quote of Strassman (1985) seems to sum up the position:

The history of IT can be characterized as the overestimation of what can be accomplished immediately and the underestimation of long term consequences.

In this paper, we will present a strategic EDI model which should help management in their long-term planning of this activity. It is based on a detailed study of 18 large U.S. corporations from a cross-section of industries which are applying EDI, that is, information systems on an inter-organizational basis. In the next section the complexities of the problem will be highlighted.

THE PROBLEM

One of the major difficulties is that EDI applications are changing very rapidly. This tends to lead to a series of war stories and apocryphal tales which may miss much of the underlying richness and long-term developments and trends. There are very little case data on the progress in the field (Wrigley, 1991) but the original cases suggested that there was tremendous competitive advantage to be gained. We will not repeat the details here and the interested reader is pointed to Benjamin, De Long and Scott Morton (1984), Harris (1985), Rackoff, Wiseman and Ullrich (1985) and McFarlan (1984) for a fuller discussion.

Recently a number of articles have appeared that have conceptually taken the subject a little further. Johnston and Vitale (1988) suggest that competitive advantage can be created by using inter-organizational information systems. In essence they are redefining EDI by highlighting the organizational characteristics of EDI. Their

paper suggests how companies could search for EDI uses and what are some of the associated management issues. It is a stimulating theoretical paper but one which does not attempt to support the arguments with field studies. In another view Malone, Yates and Benjamin (1989) discuss the 'logic of electronic markets' and present a complementary opinion of the future of one aspect of EDI. Their conclusion broadly stated is that 'as electronic networks evolve market activity will replace vertical integration'. In essence they suggest that the future for EDI is mainly electronic markets rather than direct connection between organizations. They take a view that open competition will take place electronically. Again they do not base their analysis on much new field data but on the original classic cases. Cunningham and Culligan (1989) concur with this view, although from a marketing perspective. They comment that a number of favorable factors are needed to make the markets concept work, which include a critical mass of companies to start the process and cooperation between competitors.

Based on MIT's Management in the 1990s research, Benjamin *et al.* (1988) present some research based on three EDI case studies which highlights the organizational and competitive effect of EDI, which is in line with our own findings. Although cautious about reaching firm conclusions from a small sample size, they make an interesting assertion that EDI is becoming a prerequisite for competing in some markets and that the strategic benefits from such systems will therefore become more difficult to realize. Also from the MIT study, Venkatraman and Short (1992) provide an up-to-date analysis on American Hospital Supply Corporation (now Baxter Healthcare), which was one of the original cases. Their conclusion is that Baxter Healthcare has proactively developed its EDI strategy in the context of changing business relationships with their major customers. EDI therefore appears to be the start of a process of organizational and electronic integration rather than an end in itself.

Wrigley (1991) surveyed the literature on EDI between 1985 and 1991. Over 900 articles appeared in the main English journals and magazines worldwide. The results show that only 32 of the articles mention the word research and suggest that most of the literature is concerned with either technical illustrations or market

surveys. It is clear that our understanding of the effects of EDI on organizations is still at a rudimentary level and much more research needs to be done.

In summary therefore the future of EDI is still unclear. Many organizations are aiming to use it to connect by themselves to customers (for example, Shell (1989)) or suppliers, which suggests a market structure of electronic hierarchies. Others are using value-added-networks (VANs), for example Tradanet in the UK (Jenkins, 1988), which can support electronic markets or hierarchies. Quite clearly these different ways of operating have implications for implementation, management and competition. There are many intriguing issues which have not been discussed in the literature. This paper presents a view of the future based on a large field study of major U.S. companies who are at the forefront of the developments. Our sample is limited to such companies and therefore does not contain any 'failures'. However, they have encountered EDI project management difficulties that are similar to those associated with the implementation of Information Systems in general (Bjorn-Andersen, Eason and Dobey, 1986; Whisler, 1970) and this aspect of the research is addressed in a separate article (Holland and Lockett, 1990).

THE STUDY

The majority of the field work on which these ideas are based was done at the behest of Coopers and Lybrand (London). The brief was to examine the state of EDI in the U.S. and develop models which would be of help to the general company embarking on EDI. It was not to look for areas of strategic and competitive advantage, but to look at what companies were doing and were likely to implement in the future. Over 30 companies were contacted and 18 of them studied in depth using structured interviews backed up by observations of the activity and related documents. In nearly all cases access was given and no obstruction noticed. Most of the organizations wanted to discuss their activities and were prepared to disclose their future plans. Table 1 gives summary outlines of the overall range of companies and activities. Fictitious names are used but the details are accurate in all other respects.

Table 1. Case sample and EDI application areas

U.S. companies	Industry	EDI application areas
Instruments	Electronics	Purchasing, selling, production and CAD
Rail	Transport	Intermodal transport, distribution and electronic funds transfer
Steel	Heavy engineering	Production, distribution, selling and product information
Picture	Imaging products	Purchasing, selling and forward integration
Bank	Banking	Cash management
Hospital	Healthcare	Selling and EDI service operator
Petrol	Petrochemical	Selling, distribution and cash management
Chemco	Chemical	Vertical integration for product development and distribution
Diverse	Conglomerate	Distribution, production and selling
Transport	Distribution	Electronic funds transfer and distribution
Light	Manufacturer	Production, selling and forward integration
Electric	Power	Purchasing
Jeans	Apparel	Purchasing, selling and forward integration
Messageco	EDI Service	EDI service provider and financial services
Cereal	Food producer	Purchasing and selling
Snacks	Food producer	Purchasing, production and selling
Stores	Retailer	Purchasing, distribution and electronic funds transfer
Atomic	Energy	Purchasing

These cases show the wide range of activities that are taking place under the EDI banner. The problems that are being tackled are very different and the associated benefits vary widely. One point to note is that EDI is not limited to 'high-tech' industries and is being applied successfully in less glamorous businesses. Even though there is little apparent similarity between the cases, on analyzing the detailed case interviews with the implementers, some common themes do emerge. These were suggested by the majority of the companies studied as ways of encapsulating their experiences.

Our research suggests that EDI will be used as a competitive weapon and dominant firms will



choose to make alliances with a few suppliers rather than adopt an open markets philosophy. The decision of which type of telecommunications link to use is an economic one, so firms establishing very close links with a small number of suppliers may choose a VAN or a direct method of connection. The development of VANs such as IBM's Information Exchange, ICL's INS and ISTEEL does therefore not imply any particular form of market structure.

In the next section a model is proposed which is based on this case research. The model and associated factors should help an individual organization position itself with respect to EDI. It can aid an organization to understand better the overall impact that EDI can have on business relationships and should enable the development of a more focused EDI strategy.

PROPOSED MODEL

The general organization can cover the whole of the supply chain from raw materials to customers and for each industry sector the number of stages may vary. For example, Figure 1 shows the supply chain for the automotive industry. EDI may be used in many parts of the chain. For the purposes of this paper and to produce a general conceptual solution the number of stages has been aggregated to three main ones; supplier, internal and customer. This allows us to develop a generic scheme that management can apply regardless of their position in the chain. An organization should see itself as the internal section of the model. Their suppliers and customer components can easily incorporate more hierarchical links if necessary, without devaluing the overall model structure.

The proposed model is shown in Figure 2. As stated previously, it has three components dealing with factors which apply to suppliers, internal operations and customers respectively. It is designed to incorporate all the major factors but may not apply in its entirety in any one

organization. These factors have been the main ones that have been distilled from the case analysis. This research is still of an exploratory nature and rigorous statistical analysis on their validity has not been possible at this stage. There may even be overlap in some instances. However they are seen as an aide-memoire or check list which is a useful tool for management when attempting to apply EDI between organizations. It is important to remember that it can only be used successfully as part of an overall business strategy. (Although we have no formal proof, the organizations which had clearer business strategies were much surer of their strategic EDI direction.) Every situation may be different, and each company should use the model as a basis for analyzing their own particular environment. The components of the model will now be considered in detail.

Supplier-related

The strategic EDI model contains several factors which are important for planning EDI links with suppliers. Each factor is illustrated with applications from the case sample and examples from the general literature.

Buyer power

Buyer power is the influence which an organization can exercise over its suppliers. Companies with a dominant market share are able to impose trading terms on suppliers which include EDI arrangements. The trend in supplier relationships is to create very strong links with a few suppliers supported by EDI applications. This result contrasts sharply with those of Parsons (1983) which suggested that IT could be used as a competitive weapon against strong buyer groups, who, because of their dominant market position could reduce the profitability of an industry. Two specific methods were proposed; the first was to use IT to build in switching costs and the second idea was to use IT to support decision making

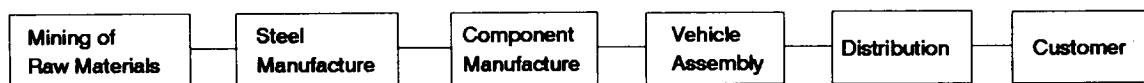


Figure 1. The supply chain for the automotive industry

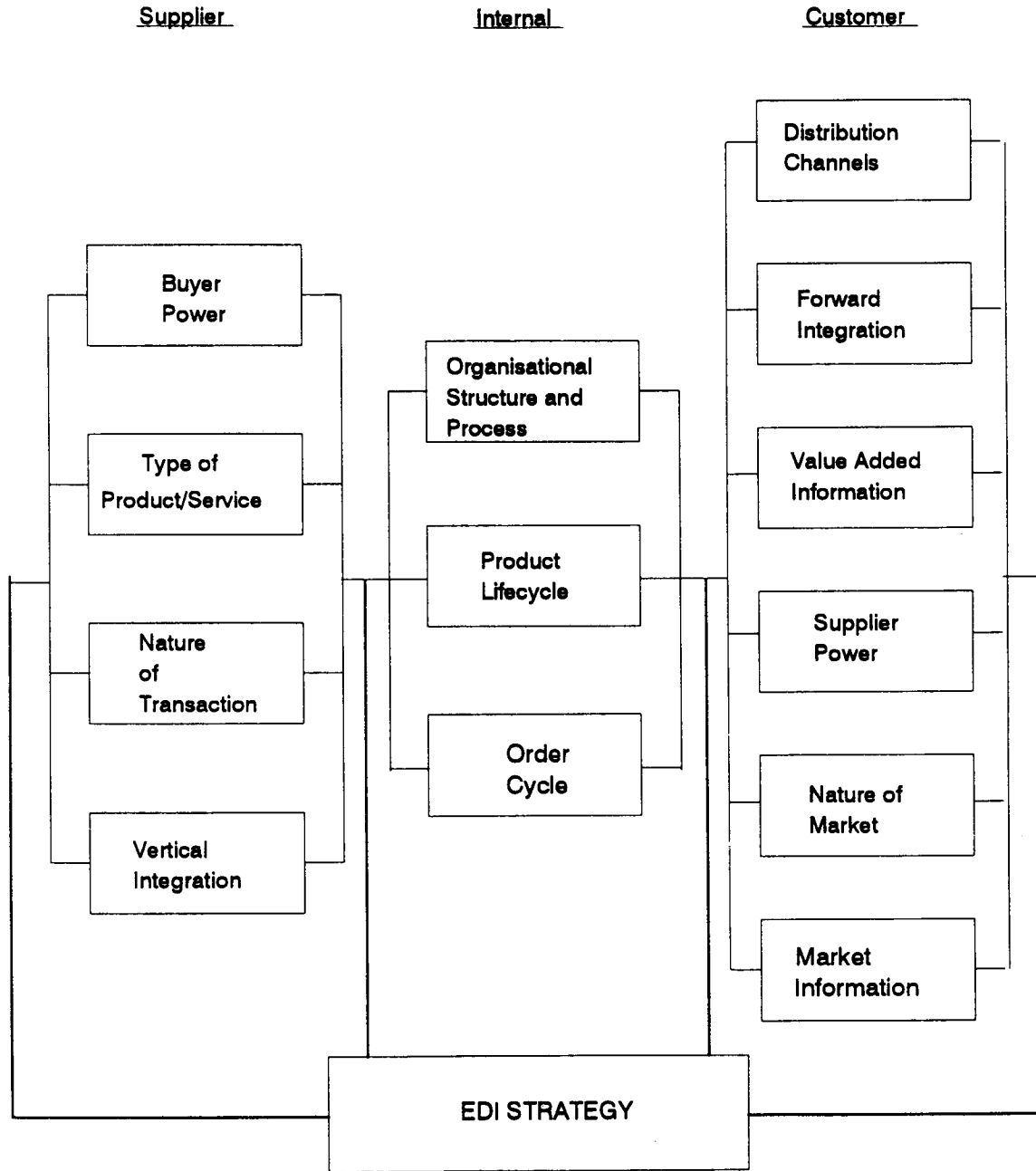


Figure 2. Strategic EDI model

when negotiating with powerful buyers. The first of these has happened in the automotive parts industry but the initiative has come from the powerful buyer groups. Rather than use IT to manage the complexity of a lot of suppliers, it has been used to encourage closer trading relationships with a smaller number of suppliers.

Of course, other reasons have influenced events such as quality and development time (Gooding, 1989). Although cost is still important, it is no longer felt desirable to trade suppliers off each other at the possible expense of other factors such as product quality, reliability and stability of relationships.

In an oligopoly the position is less clear, although it would appear that innovators are rewarded because suppliers are still willing to cooperate. One such example is Instruments, who have been using EDI since 1969. Over 600 of its first-tier suppliers use EDI links which are based on an Instruments-written EDI translator and gateway software. The company uses its own global communications network and several third party networks to provide telecommunications links between themselves and their suppliers.

In a fragmented market buyer power is dissipated amongst many companies and therefore little influence can be wielded over suppliers. The small retail customers of Picture were in this position and were forced to accept the solution offered to them because of their market position.

Type of product/service

The nature of the product or service being traded affects how EDI can be exploited because it impacts on the volume and type of information that is or could be exchanged. EDI can be successfully exploited with commodity products as well as proprietary and other non-standard products. An example of how EDI is used to differentiate a commodity product is Petrol in the wholesale oil industry.

Petrol first used EDI to improve the efficiency of trading with its customers. The exchange of orders and invoices is quicker and more accurate using EDI than the previous manual system. This was significant because of the large volume and frequency of trade. A further innovation was the provision of price information to customers and a direct ordering facility for large customers. The supplier (Petrol) and its customers both benefited from this arrangement but in different ways. The customers were able to plan more effectively because they had relevant, timely and accurate information. Petrol achieved a competitive advantage because its rivals did not have time to react and therefore could not bid for contracts. This is an example of EDI being used to differentiate a commodity product and of increased forward integration rather than market activity. The company is also implementing EDI for a global cash management system in an effort to improve the utilization of capital and uses EDI to coordinate and track the transportation of its oil products.

Nature of transaction

The nature of the transaction determines the importance of accurate and fast information exchange between firms. It depends upon the type of product being traded and the level of interdependence between the business processes of the supplier and the customer. Examples of EDI being used to manage high-volume transactions are manufacturer-retail links. For example, Picture uses EDI to collect information from its retail customers on high-volume low-cost transactions which are an inherent part of retailing. In the future, Chemco and an automotive manufacturer are planning to exchange high-complexity and high-volume information on a frequent basis in an effort to achieve 'just-in-time' (JIT) manufacturing. In the proposal a common computer system will be used for the planning and production schedules of both companies.

Vertical integration

Traditionally, vertical integration between organizations involved in successive stages of product manufacture, distribution and retail has taken place for a variety of reasons. These include ensuring the quality and security of supply, cost benefits and an improvement in market responsiveness. EDI links remove the constraints on volume and speed of information flows between separate organizations and therefore enable organizations to gain the benefits of vertical integration but without ownership (Konsynski and McFarlan, 1990), Johnston and Lawrence, 1988). In these close and integrative relationships decision making may also shift between organizations.

At the start of the supply chain a manufacturer could interrogate a supplier's computer not only for details of finished stock but also work in progress and production schedules. There is not only the potential for viewing the activities but also for influencing them. Chemco and a large automotive manufacturer are implementing a JIT trading relationship based on EDI and is an example of the trend to use EDI to increase vertical integration (without ownership) rather than to promote market activity. An example at the end of the supplier chain is the retail customers of Picture where the information in

the retail outlets is managed by Picture in an attempt to control decision making in areas such as ordering and product ranges in their favor.

Internal operations

This section concerns the implications of EDI with suppliers and customers on internal operations and how these can be exploited for the benefit of the organization.

Organizational structure and process

EDI links with customers and suppliers affect the nature of business relationships. Individual roles and tasks associated with managing customer and supplier relationships therefore change. In Picture, staff and cost reductions have been achieved in the purchasing department. Sales staff in Instruments have taken on a product advisory role since the implementation of EDI with customers. Previously, most of their time was spent taking orders. The initial effects of EDI are at the interfaces of the organization, normally the purchasing and sales departments. However, evidence from this study indicates that change does not stop here but permeates throughout the whole organization. The concept is not new and could simply be viewed as an extension of the value chain proposed by Porter and Millar (1985).

For example, Steels' customers use EDI information to help them plan their production schedules. A different kind of organizational change has been necessary in Instruments. Customers who traded with several divisions wanted to simplify electronic trading by treating Instruments as one organization instead of dealing with each division on an individual basis. This has forced Instruments to implement an internal Information Systems (IS) infrastructure to enable separate divisions to exchange data and cooperate closer with each other. An important corollary is that companies without an effective IS infrastructure will be unable to develop EDI on a company-wide scale.

Product life-cycle

In some industries, such as automotive and electronic, product life-cycles have become shorter. Japanese companies especially have

reduced the product development phase which enables them to launch new products quicker than their competitors. Intra-company computer networks have played an important role in integrating the internal processes of an organization, such as design and manufacture, in an effort to improve product development. The extent to which EDI can be used in a similar vein depends on the level of collaboration and interdependence between separate organizations for the development of new products. An early indication that EDI may be exploited in this way is Instruments exploring the possibility of exchanging CAD/CAM data with some of their suppliers.

Order cycle

A much vaunted advantage of using EDI is the reduction of stock levels and this has been supported by this study (e.g. Instruments and retail customers of Picture). EDI improves the quality and timeliness of information so orders can be placed more frequently and in smaller quantities. Instruments reduce their stock levels by encouraging customers to use EDI and the information is used in forecasting models to help plan production schedules.

The quality and ease of collection of the information make this possible. Another method to reduce the order cycle is to incorporate the distribution companies into the EDI system (e.g. Steel and Rail). The time it takes to complete an order cycle is being reduced and in some cases this is combined with electronic cash management in order to bring cash flows more in line with product flows (Bank).

Customer-related

The third part of the strategic EDI model focuses on marketing issues and on how EDI can be used to improve the market position of an organization.

Distribution channels

The length of the supply chain from producer to the end customer measured by the number of ownership stages determines the potential for applying EDI. If there is a high number of ownership stages then it is more likely that the

producer's market information is of poor quality and could therefore be improved. Light manufactures lighting products and has reduced its supply chain so that it now has the ability to remotely scan retail sales on a daily basis. In addition to protecting its shelf space in retail customers, it gains accurate sales data which is used to improve production planning and distribution. In industries where overproduction exists, distribution strategies are critical for managing market share and EDI is an important weapon for controlling distribution channels and locking out competitors.

Forward integration

Forward integration is the same concept as vertical integration with suppliers but applied to customers. For example, Rail has used EDI to integrate its activities with trucking and shipping companies so that it can offer an intermodal transport service to their customers. Similarly, Picture has taken over the stock ordering roles of their small retail customers to increase customer loyalty and lock out competitors.

Value added information

The advantage of adding or increasing the information content of a product is that it can differentiate it from those offered by rivals. Rail is developing its information systems so that it can give customers details of the location of shipments and expected time of delivery, which would not be possible without EDI. This will be a natural spin-off from the initiative to link electronically with shipping and trucking companies. Steel is operating in an industry where intuitively the scope for value-added information is negligible. However, the company is proactive in the use of EDI with customers and exploits the facility in a number of innovative ways. All of the production is to order only, so each product in the manufacturing process is 'marked' for a specific customer. The position of each order can be given to customers each day so that they know exactly what stage their order has reached and when it will be delivered. This enables customers to plan their own production accordingly. It is intended that EDI links will also be established with the company's carriers to improve distribution management. Steel also

transmits quality control test data direct to some of its large customers, which reduces the time between receiving steel products and using them in the manufacturing process. Although the product is still dominated by its physical content, Steel has demonstrated that EDI can be used to differentiate a product by increasing its information content.

Supplier power

Supplier power is the influence which an organization can exercise over its customers and is analogous to buyer power with suppliers. Buyer and supplier power may be different and therefore need to be considered independently, although large firms normally exert influence with suppliers and customers alike. Supplier power influences the type of EDI strategy which is feasible with customers. Picture has exploited its wide product range and brand image to implement an EDI system with small retailers. Similarly, Rail can implement EDI systems with other transport companies because of its large market share of the railroad industry.

Nature of market

Market characteristics affect the importance of EDI for collecting market data. If the market is unstable then market information would be valuable for aligning new products to emerging markets and also in leaving shrinking markets at the appropriate time. It is also necessary to be able to react to changes fast enough in order to take advantage of them. Instruments competes in the rapidly changing global market of semiconductors. Its global semiconductor production facility uses market information collected through EDI to change and plan its production and is a good example of the strategic use of market information.

Market information

In addition to making it possible to collect information quicker and more accurately, EDI also enables the collection of large volumes of information on a frequent basis that would not be an economically feasible choice using other methods. An example is Light, which has direct access to retail sales data from its large retail

customers. However, the value of the information still depends on the nature of the product, in particular the product life-cycle, market characteristics and an ability to react to the information in some way. In heavy engineering, say the manufacture of locomotive engines, the product life-cycle is very long so time advantages in the collection of market information are irrelevant. The market for semiconductors changes quickly and product life-cycles are short; this makes market information valuable to Instruments because it can also react by operating a flexible, global manufacturing process for semiconductors.

The above model incorporates the main factors that affected the EDI strategies which the businesses pursued. Our case analysis leads us to a series of distinct strategies that can be adopted. In the next section we outline these ideas and illustrate them with details from the cases.

GENERIC BUSINESS STRATEGIES

Companies have always exchanged information about their activities with suppliers and customers through business meetings, documents, telephone, telex and newer mediums such as facsimile. However, EDI is fundamentally different because it allows large volumes of information to flow across organizational boundaries in a moment. Because of this, EDI has the potential to transform the relationship between trading partners by bringing them much closer together. The planned common computer system between Chemco and the automotive manufacturer, the shared computer-aided design (CAD) system proposed by Instruments with its suppliers, and Picture controlling the retail management information systems in many of its customers are all examples of closer relationships. EDI also makes it possible to enhance products through value added information (Rail and Steel) and launch completely new ones as Bank has done with its cash management system.

The choice of strategy is largely determined by buyer and supplier power. The importance of a company measured in market share terms relative to its competitors determines whether or not it can be proactive with EDI. It is clearly not feasible for a minor company to impose EDI initiatives onto trading partners. However,

although a high market share is necessary it is not sufficient because a high level of IT skill is also required. The situation can be summarized in Figure 3.

Rail had a large market share of the rail freight industry and also had knowledge and skills in telecommunications from its own business. It was therefore in a position to initiate an EDI development with trucking and shipping companies. Compare this with the small retail companies, who, while not being forced into using EDI systems from Picture, could certainly not influence events and chose to follow the lead set by the supplier.

Our study and subsequent analysis suggests that there are a number of generic business strategies based on the model. They are a valuable management aid to understanding the complex organizational and technical changes associated with the implementation of EDI and should be considered when discussing business plans based on EDI. Each of the strategies are discussed in detail.

Follow

Companies that have low market share, e.g. the small retail customers of Picture, have no choice but to follow the lead by suppliers and/or customers. It is a reactive stance and little control can be exercised over the trading terms and hence the type of EDI link. Companies with high market share and low IT skills are in a stronger negotiating position but may have to accept the type of EDI links offered by trading partners. Another option for these companies is to increase their IT skills but this takes a lot of time and effort.

		MARKET SHARE	
		High	Low
IT SKILL	High	Very Proactive	Not Able to Influence
	Low	Able to Influence	Very Reactive

Figure 3. Level of proactivity

New roles

EDI can be used to take on new roles in the supply chain. Light has extended its activities beyond the manufacturing and distribution of products into retail stores. The company has exploited EDI to transfer large volumes of data at speed from geographically disparate sites. A similar example of a new roles strategy is Rail's EDI links with trucking and shipping companies which enables them to offer an intermodal transport service to its customers. This circumvents the transport broker because Rail can manage the complexity of the information flow themselves.

New products and services

This strategy centers around the innovative use of information. Steel enhanced their products by improving the service to customers through the addition of information in its products. American Airlines sells marketing information about travelers to competitors (Feldman, 1988). The volumes of retail information of this nature no longer pose an impossible management task. Another example here is Bank, who uses EDI to offer a cash management product to large corporate customers. This is an interesting case compared to Merrill Lynch (Harris, 1985), who used an intracompany network to link separate functions within the bank to offer a new product to retail customers. Bank has extended this concept to exploit an information system that extends beyond the organizational boundaries of the bank and links directly into customers. There is also a spin-off effect of winning new customers in other areas of the bank's operations.

Tie-in

This is almost an inevitable consequence of using EDI with trading partners and the implications should be known even if it is not explicitly chosen as a strategy. An organization can tie-in its trading partners by linking electronically with them. Picture offers its retail customers a management information system which covers areas such as stock management, electronic ordering, financial analysis and other applications. By installing a personal computer-based system in the stores it is able to gain shelf space in the

retailer by influencing management decision making. The Picture system is deliberately designed to make it impossible to order its major competitor's products. This is a lock-out as well as a tie-in system. A disadvantage of this type of relationship, which applies to all EDI systems, is that a company can become dependent on another one. In this and similar cases, the retail companies will depend on their suppliers not only for products but for management expertise as well.

Time-based competition

This is a central theme to the model and the essence of it is to outperform competitors using time as a basis for competition. Different examples from the study will illustrate the idea. Instruments uses EDI to collect market information that helps it reduce manufacturing lead times and react quicker to changes in the semiconductor market. (Of course, this does not preclude them from a more proactive stance through the launch of new products). Similarly, large customers of Steel can use their EDI links with the company to receive production data and incorporate this information into their own material requirements planning (MRP) systems. To improve cash management in large corporations Bank is implementing EDI cash management systems to link the financial systems of separate companies much closer together. The long-term aim of some of its customers is to achieve a neutral cash balance at the end of each day's trading compared with current time scales of the order of weeks.

DISCUSSION

The strategic EDI model and generic business strategies are based on a sample of leading firms and are therefore representative of best current practice. They generalize the EDI strategies of firms in the case sample and provide concepts which are useful for other organizations planning EDI systems. The long-term impact of EDI on business strategy and competition is still little researched but from the work described here some tentative hypotheses are outlined.

As electronic trading becomes the norm EDI will become a competitive necessity for the

exchange of trade data (Keen, 1991). For most organizations the simple economic benefits of reduced costs and streamlining of administrative systems will make EDI worthwhile. However, the organizations that benefit most are those which incorporate EDI into their overall business strategy. This has been demonstrated by several companies in the study, e.g., Bank's cash management product, Steel's use of value added information and Picture's tie-in strategy.

Organizations are using electronic links to form closer ties with trading partners, which indicates the evolution of electronic hierarchies (Johnston and Vitale, 1988), rather than open competition based on electronic markets (Malone *et al.*, 1989). It is therefore a strategic necessity to join electronic trading groups now because it may become more difficult to do so in the future once a company has fallen behind in this area. Some of the issues associated with long-term relationships and competition have already been explored from different perspectives, e.g. marketing (Thorelli, 1986) and strategy (Harrigan, 1988; Nielsen, 1988; Jarillo, 1988), and may be helpful in understanding the competitive aspects of EDI.

CONCLUSION

The implementation of EDI with trading partners poses difficult and complex managerial problems for organizations and it appears that EDI is becoming more important to the extent that it may become a prerequisite for competing in most markets. Indeed, some large companies are already hinting to trading partners that EDI will be an essential basis for future trade. So far, there is little hard evidence on the current practice of EDI. The cases and analysis presented here are a contribution to the subject and illustrate the current use of EDI by leading U.S. companies.

A number of models are proposed which are intended to help managers understand and exploit the phenomenon of EDI. The strategic EDI model (Figure 2) identifies the important factors that should be considered when planning for such systems and provides a structured method for discussing the issues and opportunities. It is taken from the perspective of the central organization in relation to suppliers and customers and can be applied at any point in the supply chain to

guide the planning process. Building on the strategic EDI model, generic strategies have been identified which are consistent with actual events. An important result here is that relative market share and expertise in information technology (Figure 3) constrain the choice of viable strategies.

There appears to be a first mover advantage in offering EDI services to trading partners for the companies who have sufficient market share and information technology expertise to implement such systems. EDI can affect all parts of a business from supplier relationships to product markets. The companies who are doing well have strong central coordination of this activity and incorporate EDI as an integral part of their business and IT strategy.

Long-term implications are still unclear but specific issues are surfacing. The effect of EDI on the nature and extent of links between separate organizations has not been fully explored and the concepts are new. The idea of the boundary of an organization becoming 'blurred' because of links facilitated by information technology is happening and possible consequences of this need to be considered. EDI is also having a major effect on competition. There has been limited debate about this in the academic literature and there is no single consensus of opinion.

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