New Collaboration between Firms: The Role of Interorganizational Systems

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Abstract

Interorganizational systems (IOS) can play an important role in stabilising the relationship between firms. More recent evidence suggests that such systems can also facilitate new collaboration between firms in strategic areas. However, successful inter-firm collaboration depends not only on the technological support of IOS, but also on a wide range of other, non-technological factors. Using recent evidence gathered from six intensive case studies and the result of a survey in the UK, this paper illustrates some new strategic collaborations between firms, and examines the role of IOS in these processes. In particular, the paper will conceptualise the main technological and non-technological barriers to the success of IOS in a three-layered model, and discuss some key lessons emerging from the study. Three themes for further research will also be highlighted.

1. Introduction

Across the world collaboration has been in fashion in the business community over the past two decades. Interorganizational systems (IOS) have been said to play an important enabling role in many cases. By facilitating the cost-effective diffusion of information between firms and the development of ‘common knowledge’, such systems can reduce the co-ordination costs associated with the marketplace and permit increased collaboration between firms [9, 10]. The rapid development and diffusion of computers and telecommunications in the last few years have further increased business and academic interests in this area.

Today, it has been widely publicised that competing firms in certain sectors have collaborated to provide the common communications infrastructure (IOS) for essential services. Examples include the LINK network among banks and building societies in the UK (a network of cash dispensing machines) [31]; the on-line seat reservation and ticket booking network among major airlines in the USA [45]; and other smaller, less well known examples such as Demepool in France – an information exchange network created by a group of independent transportation firms for the exchange of jobs between them and for avoiding the running of empty vans on returning trips [8]. More importantly, it is widely accepted that IOS can serve to stabilise existing relations between suppliers and buyers, and raise entry barriers for competitors [19, 28, 42, 47].

The origin of IOS could be traced back to the 1970s when some large firms placed computer terminals in their customers' offices and offered these customers direct access to certain information (such as stock availability and price) held on their central computers [28, 31, 42]. However, until the late 1980s, the development of such IOS had been slow and fragmented both in terms of the sectoral coverage and in the range of applications they supported [42, 45]. It was only since the early 1990s that such systems began to diffuse rapidly into an increasing number of sectors [7, 14, 42, 49]. More recent evidence suggests that as firms strive to exploit new opportunities afforded by information systems, new forms of inter-firm collaborations based on IOS have emerged. This paper intends to use recent empirical evidence to illustrate the change, discuss related issues and highlight the main lessons that can be learnt. In particular, the research has found that although IOS are essential to these new inter-firm collaborations, the role of other factors can not be ignored, and the latter have been proved to be much more difficult barriers for firms to overcome. A main contribution of this paper is to conceptualise these technological and non-technological barriers in a three-layered model. The empirical evidence has been drawn from six intensive case studies from the car manufacturing and retailing sectors; and a survey of 74 electronics firms in Scotland. More details will be given later in the paper.

In the next section, the paper briefly reviews previous studies in this area. Then a framework will be outlined to classify IOS into three categories. Following that the paper illustrates the emergence of new collaborations between firms in a number of sectors, and
examines the role of IOS in the process. The main barriers to the success of such applications are identified, and some key lessons emerging from the study will be discussed. Then three themes for further research are highlighted.

2. What are IOS?

IOS refer to the computer and telecommunications infrastructure developed, operated and/or used by two or more firms for the purpose of exchanging information that support a business application or process. These firms can be suppliers and customers in the same value chain, or strategic partners or even competitors in the same or related market [14, 20, 31, 42]. Such systems are sometimes called inter-firm networks or inter-firm information systems. IOS can take many different forms, ranging from dedicated, closed group IOS; via semi-closed group networks based on value added network services (VANS); to completely open systems based on open mediums such as the Internet.

The first category IOS are built with interface proprietary to a particular group of firms. As such, firms wishing to join the network often need to invest in the special hardware and/or software for the system. The reasons for adopting this type of IOS are divergent. In some cases, they were intended by some firms to lock in customers and lock out competitors. In others, it was because common standards were not available when these networks were first introduced, or because available open technological solutions cannot provide the sophisticated communication services required by the partners for particular applications. There are many advantages with this type of networks, but problems have also been increasingly recognised. It is also interesting to note that some new strategic collaborations (e.g. the joint design and development of new products between firms) developed in the last few years are often based on this type of IOS.

The second category IOS, currently the most widely used form, are based on standard, common purpose computing facilities and communication protocols, very often, but not always, using VANS. VANS describe the electronic communication services provided, usually by a third party, to two or more trading partners that not only establish an information link between the participants but also assist and add value to the communication process in some way. One of the most widely used standards for VANS is EDI. So far, EDI has primarily been used in the sub-contracting area and has been proven most effective in supporting operational level applications, mainly because of its limited technological capabilities and the existence of multiple standards. In order to support more complex and strategically more important applications, some firms have preferred to maintain dedicated data links between their computer systems by themselves, using various interfaces and communication protocols capable of handling more sophisticated forms of information exchange, i.e. the first category IOS discussed earlier [9, 31]. However, the rapid development of the Internet and related services may change the situation in the future.

In both categories of IOS discussed above, all parties involved in the systems are predetermined and all participants have agreed to exchange information electronically. These types of IOS are sometimes referred to as ‘electronic alliance’ [27]. However, new developments such as the Internet have now opened the possibility - in theory, and to a limited extent, in practice - for instant encounter and trade between unpredicted members [6, 48]. By using the World Wide Web (WWW) browser, any person on a networked computer can now access servers anywhere in the world. A firm wishing to offer its products and services can now simply store an electronic catalogue on its server for the world to look at. It is now also possible for any firm to establish electronic communications with any other firms at very low costs. This third category of IOS are sometimes referred to as the ‘electronic market’ [27, 48].

Clearly it takes more than just the technological possibility to make such open trading and communications work. On the one hand, some firms may not be interested in electronic market, because dedicated IOS using proprietary interfaces, and indeed, even networks based on VANS, can lock in customers and lock out competitors. On the other hand, most commercial transactions between firms are based on trust which is currently lacking in the electronic market [21]. Kokuryo & Takeda [27] proposed the establishment of the so-called ‘platform businesses’ - organizations similar to credit card companies in retail markets - to tackle this problem. However, the difficulties and uncertainties involved in the process are enormous. International, or at least regional, efforts are needed to overcome the extremely difficult barriers. Some recent, large scale schemes, such as the United Nations backed ‘Global Trade Point Network’ and the ‘Tradecard’ project set up by the World Trade Centres Associations, may overcome some of the barriers and provide the basis for global electronic commerce in the near future.

3. IOS and changing inter-firm relations: a brief review of previous studies

The rapid development of IOS has had profound implications for inter-firm relations and for the future form of organizations. In recent years, an increasing number of
studies on IOS have been published. Some studies illustrated how IOS can give firms (particularly the large ones) multiple benefits - lower costs, shorter lead-time, lower stock levels, and improved cash flows, for example [16, 17, 28, 31, 34, 40, 42, 49]. For small firms, the benefits and danger of being lock in and lock out such systems were also highlighted. However, many of the visions on inter-firm collaboration based on IOS were unsubstantiated by empirical evidence, or were based on evidence from a handful of case studies whilst implying that their findings were widely applicable. It was only since the early 1990s that some studies began to systematically test hypotheses about, for example, the use of EDI and changes in buyer-supplier relation, often using quantitative survey data from particular sectors in particular geographical areas [22, 36, 38, 49].

In the last few years, a growing interest is also forming around concepts such as the virtual organization and electronic commerce based on projections about the future development of the Internet [5, 6, 13, 21, 27, 37 41]. Such interest - although largely speculative - represents a particularly broad perspective on computer networking both within and between firms and their implications for the nature and future form of firms and markets in the information economy [10]. However, it is our view that it is still too early to make any concrete conclusions on how the electronic market based on open mediums such as the Internet will evolve, let alone their organizational and market implications, because there are still too many uncertainties involved. Some of the non-technological barriers involved are extremely difficult to overcome.

It is therefore not surprising that until recently, most studies have focused on the role of closed and semi-closed IOS (i.e., electronic alliance) in changing inter-firm relations. Electronic alliance - that is, IOS with predetermined participants - has been particularly developed between firms along value chains, and such systems are sometimes referred to as centred (inter-firm) networks [8, 20, 31], or electronic hierarchies (to distinguish from electronic markets) [48]. These IOS are usually initiated by the large firm at the centre of the trading network in order to interact electronically with regular suppliers or/and buyers. The main purpose was typically to reduce the transaction cost, stock level and lead-time. In some cases, these systems have been developed through the natural extension of the centre firm's internal computer and communication systems. The development of such IOS often entails the extension of the centre firm's internal gains of computer networking to its suppliers or/and customers, in order to reduce the total cost of the final products and to improve the responsiveness of the value chain to market changes.

Sometimes, such systems are imposed on trading partners by the large firm at the centre. The costs to each firm are normally paid back by productivity gains, increased sales or secured long-term contacts, and sometimes the development is directly subsidised by the centre firm [31].

Previous studies have found that electronic alliance can stabilise existing relations between suppliers and buyers, and raise the entry barriers for potential competitors [19, 28, 42, 47]. This is because setting up and maintaining IOS require close co-operation between participating firms, which helps them to forester a closer partnership and encourage the sharing of information. The use of such networks can also contribute to the removal of barriers to co-operation by reducing errors typical of paper-based communications; and should any errors happen, these networks can also facilitate problem resolution, because the problems can be more easily traced and be dealt with more quickly and effectively. In addition, introducing IOS requires both time and money, and their maintenance often requires special skills, and there are also security and reliability concerns. Switching partners (suppliers or buyers) would therefore by definition be costly and time-consuming. All these factors serve to stabilise existing inter-firm relations and improve inter-firm collaboration.

4. Inter-firm collaboration through IOS: the empirical evidence

Using the evidence gathered from six case studies in the UK and the result of a survey in Scotland, this paper focuses on the role of closed and semi-closed IOS (i.e., electronic alliance) in new inter-firm collaborations. The six case studies have been drawn from the motor-manufacturing and the retailing sectors, and semi-structured interviews were conducted with both IT and non-IT managers in a large Japanese car manufacturer in the UK and two of its suppliers; and a large British retail chain and two of its suppliers. Documents from various sources including company annual reports and press releases, newspaper articles and published research notes were also carefully studied. At least two interviews were conducted in each company, and each interview lasts for at least an hour (with some of them being considerably longer). The car manufacturer is among the top ten in the world and interviews were conducted with its managing director, information systems director and operations manager in charge of logistics in the UK. Two of its suppliers are also studied, one supplies car seats and the other supplies braking systems to the car manufacturer. The retail chain is one of the largest in the UK with an annual turnover in excess of £7 billion in 1997, and its
group information systems director and a store manager were interviewed. The two suppliers to this retail chain are both large companies – one with over 3000 employees and fifteen factories in different parts of the UK, specialising in the designing and manufacturing of quality clothes; the other a diversified multinational company with strong business interests in textile. These case studies have revealed a number of important tendencies in new inter-firm collaborations based on IOS. The evidence gathered from a telephone based survey of 74 firms representing 15% of the electronics and support firms in Scotland (a randomly generated sample from the Directory of Electronics and Support Firms in Scotland) will be used to reveal to what extent the tendencies identified from the case studies exist in this sector of the Scottish economy.

The evidence from our research has generally confirmed the findings from previous studies but several new tendencies have also been identified. Our case studies suggested that inter-firm collaborations based on IOS are progressing beyond electronic trading and routine transactions to strategically more important processes. In particular, once two firms have established a successful IOS at the routine transaction level, new applications based on the same or more powerful links are often developed. A particularly interesting tendency is the development of new collaborations in strategic areas, such as the joint design and development of new products between suppliers and buyers. Although this tendency was not confirmed by our surveys, our survey of the Scottish electronics industry did suggest that whilst 32% of the firms surveyed used some form of IOS, 18% had two or more different types. This result perhaps indicates that some firms have begun to appreciate that a single class of inter-firm links can only play a limited role. Another issue emerged from the research is that although IOS have played an important role, the most difficult barriers to successful inter-firm collaboration are often non-technological in nature. This has been confirmed by both the case studies and the surveys.

4.1. From routine transactions to strategic applications: the case study evidence

The development of inter-firm collaboration in strategic areas is clearly reflected in the large retail chain and its regular suppliers of quality clothes in the UK. In the late 1980s, an IOS was developed between the retail chain and some large suppliers, using third party EDI on Tradanet for electronic ordering and invoicing. The general benefits from the development included improved communication, reduced administration costs for all participants (less paper work handling and less relaying), closer co-operation, increased business volume and improved quality of services to final customers. However, it is interesting to note that in some cases, after the electronic trading became operational, applications beyond basic transactions have been developed - either using the same IOS or by installing new and more powerful links.

An interesting application was developed between this retailer and a regular clothes supplier. The EDI link between them was not only used for electronic trading, but also for exchanging the supplier's latest designs. Using local software at both ends of the link, each design can be coded into a series of digital figures representing the particular patterns, materials and colours of the new design. These figures can be transmitted to the retailer via EDI and then decoded, so the retailer can modify the design before issuing orders. This system is extremely important to both firms because the supplier can frequently send its latest designs to the retailer, and in turn, the retailer can respond to the supplier more frequently and quickly, and inform the supplier of its latest demand, and order more frequently. The business volume between them has since increased considerably, and the buyer-supplier relation is consolidated by the network.

In the case of the retailer and a very large supplier, some more interesting inter-firm collaborations have been developed after the EDI network became operational. Being a large firm itself, the supplier took the initiative to set up a more powerful communications network with the retailer in order to capture the latest market information (the latest customer preferences in terms of colour, materials, and styles, for example) from the retailer's stores all over the UK. The information is then incorporated into the supplier's latest design and production activities. The network is also used for the exchange of colour pictures of the supplier's latest designs (rather than technological designs as did by the other supplier illustrated above), which the retailer's purchasing staff can view and modify before issuing orders. This network has served to strengthen the relationship between them, giving this supplier a unique advantage over others.

Similar evidence has been found in the manufacturing sector. We examined the experience of a Japanese car manufacturer and regular suppliers in the UK. The car manufacturer only started production in the UK in the mid-1980s, and by the early 1990s it employed a total of 4500 employees in the UK, making well over 100,000 cars a year. In 1992, the manufacturer imposed electronic trading on all regular suppliers. The benefits to all suppliers included early delivery requests from the car manufacturer, which can help the suppliers to minimise inventory holding and achieve better production scheduling; and by interfacing EDI data with the suppliers'
internal IT systems, administration costs can also be reduced. Because investments in EDI by the suppliers did not have to be dedicated, the car manufacturer only invested in the extensive facilities necessary to support the data transmissions but required all suppliers to fund their own link. Similar links with sub-suppliers (suppliers’ suppliers) were also made possible and actively encouraged by the car manufacturer.

The success of this electronic trading network opened up numerous opportunities for new application development. The first application is the implementation of the so-called ‘synchronous supply’ with some local suppliers, and some components (e.g. car seats) are only delivered to the car assemble lines by the suppliers - with the right variants and specifications - twelve to fifteen minutes after the car manufacturer issues the order. Apart from the locational proximity between them and the convenience of electronic ordering based on EDI, one key to this application is that the suppliers are granted direct access to production planning and forecasting information stored on the car manufacturer’s mainframe computers, so the suppliers can plan their own production before receiving orders. Otherwise, this application would have not been possible. For suppliers in other parts of the UK and in Europe, the lead-time from order to delivery has also been reduced dramatically. By the mid-1990s, the car manufacturer shaved the average inventory and stock holding for European originated parts to less than one day. Essential to the improvement is the sharing of business information between business partners via the IOS.

The second application was in the area of interactive, joint development of new products. The car manufacturer is currently working with the technically more competent suppliers for the development of the next car. So far, few suppliers have the technological capability to supply a complete product unaided (as a ‘black box’), but the car manufacturer is developing what was described as a ‘grey box’ solution. In this approach, the car manufacturer supplies CAD data on the space the component occupies and its technological specifications; the supplier will then begin to design the component, passing it back to the car manufacturer via IOS for feedback. Through interactive communications, any problems caused by the relative lack of sufficient engineering skills in the suppliers can be resolved. Essential to this application is the support of broadband communication networks between their computers.

The third application is in the area of manufacturer-dealer relations. Whilst the in-bound material flows in this car manufacturer is of world class standard, its out-bound logistics is similar to most European car manufacturers. Inventory level for finished cars currently are two and half to five months of production (even in Japan the best figure for leading companies is still as high as two months). The working capital tied in the finished car is huge and the potential for improvement is enormous. The key to improving the inventory level of finished cars is to improve the relation between dealers and manufacturers and by-pass the distributors, so the manufacturer can cut the scheduling and delivery time. More importantly, the support of sophisticated IOS and the sharing of a wide range of business information between the car manufacturer and the dealers and between the dealers themselves are essential. Dealers using the system need to be able to monitor the stock movement of other dealers and to check production-in-progress in the factories, but many firms are currently not prepared to share such information with competitors! The non-technological barriers to this application are extremely difficult to overcome and thus, the success of the application may take a very long time to achieve. The Managing Director of the Japanese car manufacturer suggested this could be a ‘twenty year job’. This application also suggested that non-technological barriers are probably the most difficult to overcome both in developing IOS and strategically important applications based IOS. In particular, firms may have to change their basic assumptions about the nature of firms and markets in radical ways before such strategic collaborations can become feasible.

These case studies also indicated that developing successful routine electronic transactions between firms is probably a necessary first step for them to develop strategic collaborations based on the same or more powerful IOS. Apart from the enormous technological difficulties involved, numerous non-technological barriers have to be overcome before the full potential of IOS can be exploited. Similar evidence was found in a number of other case studies.

4.2 A survey of inter-firm networking in the Scottish electronics industry

Although inter-firm collaboration in strategic areas was identified from several case studies, our survey of Scottish electronics industry did not reveal widespread development of such applications. Nevertheless, the surveys suggested that the primary objective of firms in developing IOS is not to improve the efficiency of existing information processing activities, and there is a recognition of the value added that information can contribute to the business. For example, only 27% of firms highlighted reduced costs as a very important consideration when installing an IOS; while 86% were motivated by the potential to access greater quantity of
better quality information. Almost every firm considered the ability of IOS to supply more information or improve the quality of information already communicated to be an important influence on their decision to introduce them.

Despite such encouraging intentions, however, once one looks in more detail at how firms are using IOS, it becomes apparent that most firms are using the technology to support existing patterns of activities and organization, rather than facilitating new forms of collaboration or collaboration in new areas. Firms appear thus far to have focused attention on improving access to information but insufficient attention was paid in considering how to innovatively apply that information to improve their business. In particular, most firms still essentially associate a given piece information with a particular task, and there is limited realisation that as well as such standard usage the same information re-analysed or re-formatted might be of value elsewhere in the organization. 69% of the surveyed firms suggested that the introduction of IOS had facilitated closer working relations with trading partners, but trading patterns remained virtually the same for 71% of the firms, and essentially, IOS were only being used to support established businesses rather than to help the firms to generate new business opportunities or to support new collaborations.

The majority of survey respondents were of the opinion that IOS are mainly suited to the communication of hard or factual information, because electronic communication is typically bereft of many of the contextual clues that attend more personal communications. However, nearly 50% of firms have substantially reduced their use of traditional communications media such as postal services and telephone following the introduction of IOS. Thus it can even be questioned whether the introduction of IOS is leading to enriched communications between firms.

4.3. Discussion: key issues emerged from the study

The empirical work discussed above has highlighted at least four issues. First, contrasting results have been identified from the case studies and the survey. Second, different types of IOS are perhaps needed to support different inter-firm applications. Third, IOS may significantly reshape the internal activities and processes of the firm. Finally, the successful collaboration between firms requires more than the exchange of information.

First, whilst the case studies suggested that some firms are increasingly exploiting the potential of IOS by developing new collaborations in strategic areas, the survey revealed that most firms in the Scottish electronics industry are not using IOS to their full potential. The reasons for that can be very complex. One is that most firms are probably still experimenting with IOS and they have not yet progressed beyond basic level applications such as straightforward transactions. Indeed, even at this level, many firms are experiencing serious technological problems, particularly in terms of system reliability and in managing incompatible standards and networks. A survey respondent pointed out that its suppliers were connected to different third party EDI networks, and there was limited interconnection between different networks. In particular, issues relating to message audit trails and the allocation of responsibility for lost messages remained unresolved. The reliability of EDI is also problematic, and there is insufficient trust by some firms to allow EDI data to be fed directly into production schedules or computer controlled machines. In many cases, the use of EDI was merely restricted to peripheral areas such as processing financial transactions, and messages were invariably pulled off the machine and manually checked. Such technological problems may have prevented some firms from developing new collaborations in strategic areas.

The second issue highlighted by the empirical material is that different applications may require the support of different types of IOS. Many firms have placed emphasis on providing a ‘single solution’ to all inter-firm communication needs, and they often fail to understand that they need to access a variety of communication capabilities so the most appropriate can be used for a given task. A further problem is that firms are at different stages of IOS development, so a common timetable for developing strategic collaborations based on such networks can prove problematic as each firm may want different things from the network.

The third issue concerns the reshaping of internal organizational processes (decision-making processes, organizational structures and behavioural norms) by IOS. Today, problems of organizational and technological adaptation within the firm still represent considerable barriers to the effective use of even simple services based on EDI, which undoubtedly constrains the ability of the firms to use IOS for restructuring trading relations or developing strategic collaborations. EDI-based transactions often interface with a wide range of activities within the firm, including the information networks and hierarchies within the firm responsible for processing data on production components and specifications, on production planning and scheduling, and on pricing and accounting. More importantly, the use of IOS - even if via human interfaces - implies that the firms are essentially sharing information previously held back for internal use with each other. So questions about the nature of inter-firm relations, power, control and quasi-integration are
which all firms operate, and indeed, on changes in the institutional framework within which organizations operate - the so-called 'rules of the game' [9, 29]. Over time an institutional framework evolves to support and promote particular production structures and inter-firm relations. However, radical innovations in ICTs and telecommunication services may challenge the very basis of that structure and relationship, and the existing institutional framework may have to be fundamentally overhauled [10, 30, 31]. In many cases, ICTs based innovations are changing the rules of the game, which may be particularly the case in the area of inter-firm relations. Many firms may yet not be ready to accept such radical changes.

According to Peter Drucker, although the firm was only invented because it was perceived to be a useful 'tool' in the economy, it is now considered to have inherent values. The challenge is to change that perception - to recognise that too much emphasis is being placed on the importance of the individual firm. The norm is for firms to see their future as being dependent on their own actions. The possibility that trading partners could help build that future is largely ignored by all but a small proportion of firms today. Where firms claim that they are collaborating, the intention was often to make the suppliers be more responsive to their needs or to cut costs rather than to design more effective relationships.

Many firms are so preoccupied with supporting their individual businesses that they are failing to recognise that perhaps an alternative way to achieve this would be to work to increase the effectiveness of the entire value chain by helping each other. Many firms simply want finished products from their suppliers, and they have little interest in tapping the suppliers’ expertise to see if the effectiveness of that product could be improved. Equally, suppliers often simply respond to the demand of their customers, rather than helping to define them [9]. As the survey result shows, the majority of firms appear willing to pay lip service to inter-firm collaboration so long as it does not call into question of the underlying basis of their businesses. Thus, the development of inter-firm collaboration in strategic areas may to a large extent depend on changes in the institutional framework within which all firms operate, and indeed, on changes in people’s basic assumptions about the nature of firms and markets in the information economy. A recent study by McKinsey concluded that due to rapid development in ICTs and telecommunications services, transaction costs are going to decrease dramatically, which may force firms to reconsider fundamental issues about the nature and boundary of firms and markets [10].

To sum up, innovative collaboration between firms base on IOS requires not only the development of an appropriate technological infrastructure, but also a recognition, understanding and acceptance that the role and structure of the firm and its boundaries need to be radically re-considered. Information should not only be seen as a static, stand-alone asset typically associated with a pre-defined application. Firms need to genuinely recognise the contribution that information can make to their businesses. The changing nature of the economy and the rapid development of ICTs are changing the rules of the game in radical ways [26, 29]. Many prevailing views and business visions existing in today’s organizations may be the biggest barriers to the development of innovative collaboration between firms in strategic areas.

5. Main barriers to inter-firm collaboration through IOS: A three-layered model

The study has highlighted several barriers to the future development of IOS. There are not only serious technological barriers but also cultural and political barriers which are extremely difficult to overcome - such as sharing sensitive business information with suppliers, customers and even competitors, the integration of business processes between firms, the control of one firm by another, the co-existence of competition and collaboration, and many other related issues. Many of these barriers have to be overcome before inter-firm collaboration in strategic areas can be developed. In fact, the full potential of IOS probably cannot be achieved without radical changes in the institutional framework in which most firms operate, and in the perception and assumptions of business leaders about the nature of firms and markets in the information economy.

The main barriers to the future development of IOS exist at three levels. At the bottom level, there are technological barriers that firms have to overcome - particularly in terms of system reliability and in managing incompatible standards and networks. Such technological problems - and the lack of trust of such systems - have prevented some firms from developing new collaborations in strategic areas. Although recent developments in technology, infrastructure and services have significantly relieved this problem, technological barriers will continue
to constrain the development of IOS and new applications based on such systems.

A more difficult barrier exist at a second level, which require radical changes in the understanding of the nature of firms and markets and the new rules of the game in the information economy. Issues such as sharing sensitive business information (e.g. stock availability, forecasting and production planning data) with suppliers, buyers and even rival companies still worry some business leaders. However, if such issues are not resolved, many strategic inter-firm collaborations are simply impossible to develop and the full potential of IOS cannot be achieved.

Even when firms are prepared to share certain business information with each other, the success of inter-firm collaboration based on IOS is still not guaranteed. Successful collaborations between firms require more than the exchange of information. As has been argued earlier, differences between the collaborating firms in terms of aims, culture, structure, procedures, professional and natural languages, accountabilities, and the sheer time required to manage the logistics of communication often mitigate against success. Of particular importance for the effective collaboration between firms is perhaps the development of 'common knowledge', which is an extremely difficult endeavour. As such, the success of inter-firm collaboration through IOS is much more difficult than many people have perceived. That to some extent explains why the enormous technological potential of IOS has not been fully exploited so far.

6. The main lessons from the study

What is evident from the empirical material discussed in this paper is an evolutionary path for the development of IOS and inter-firm collaborations. Although, as the survey result suggested, most firms still used IOS primarily for routine transactions, the case studies clearly indicated that IOS can be used effectively to support collaboration in strategic areas. In particular, the study has found that once two firms have established an IOS for routine applications, new and more powerful applications are often developed between them. This evolutionary path, however, does raise important questions about IOS, including that the potential benefits are often not distributed proportionally between the participants; the geographical conglomeration tendency associated with the development of IOS and the long-term commitment implied by such locational adjustments; the existence of alternative channels of communications to IOS; and the danger of system failure with inter-firm applications and their business implications.

Several important lessons can be learned from this research. First, in order to develop inter-firm collaboration in strategic processes, a necessary first step is perhaps to develop routine applications with IOS, which can provide important learning for the firms involved and nurture the development of trust between them. Only when firms have benefited from these routine transactions and learned to trust and work with each other via the electronic medium that some of them are prepared to explore the possibility for more complex and strategically more important applications.

Second, IOS can often serve to stabilise existing relations between suppliers and buyers, and raise the entry barriers for potential competitors. The co-operation between participating firms involved in developing IOS can often help them to foresee a closer partnership and encourage the sharing of information; and switching partners can be both costly and time-consuming. However, although IOS are effective in reducing transaction costs, stock level and lead-time, the overall benefits from IOS are often distributed unevenly among the firms involved, and sometimes the benefit to one firm is achieved at the expense of others (such as push stock holding to suppliers). Such inequality may in the long term be detrimental to inter-firm relations. The future development of IOS will to a large extent depend on to what extent people's perception of the nature and boundary of firms and markets will change. Further studies in this area - the new rules of the game in particular - are clearly needed.

Third, although many firms have placed emphasis on providing a 'single solution' to all inter-firm communication needs, an increasing number of firms have realised that different applications may require the support of different types of IOS. It is also interesting to notice from the survey that the primary objective of firms in developing IOS is not to improve the efficiency of existing information processing activities, and there is a recognition of the value added that information can contribute to the business. Such positive signs clearly indicated that people's understanding of IOS are changing. High quality academic studies can play an important role in shaping people's views.

7. Future research

Given IOS are a rapidly evolving phenomenon, more systematic studies are clearly needed. We believe three types of studies are particularly useful. First, continuous efforts are needed to identify new inter-firm applications based on IOS. The results form such research are important, because both the technological capacity of ICTs and our understanding of ICTs in the business
contexts have been improving rapidly. Powerful innovations that can bring about radical and rapid improvements in the efficiency, effectiveness and flexibility of inter-firm relations are continuously being developed. It is important to identify and conceptualise such innovations as soon as they are developed, because many of them have the potential to diffuse into the wider economy. Business leaders need to understand the potential benefits and pitfalls of these innovations before introducing them. So the commercial interest in such studies is enormous. Such research can also inform policy makers at various levels of the government when formulating industrial and regional policies as well as policies and regulations governing the development of the telecommunications infrastructure and information services. A particularly important focus might be the Internet, which certainly has the potential to support radical changes in firms and markets, although the realisation of this potential depends on a wide range of technological and non-technological factors.

Second, there is a need to examine the diverse applications and development trajectories of IOS in order to formulate a more systematic analytical framework. Information systems are highly flexible, and one system often allows firms to undertake radically different actions for fundamentally different purposes, such as, the contrasting use of IOS to strengthen inter-firm relations against increasing competitive positions in the market. The advantages of such studies will not lie in their use to test whether new tendencies identified in leading firms are being taken up in the wider economy.

Third, because of the rapid development and proliferation of ICTs and the radical change in the nature of the economy, IOS and the changing inter-firm relations need to be examined in a much broader context incorporating both the inside and the outside of the firm. In fact, inter-firm innovations are often closely related to organizational innovations within the firm, such as corporate restructuring, business process re-engineering, lean production and just-in-time. The development of these inter- and intra-organizational innovations is often accompanied by the adoption of new business philosophies, missions, strategies and objectives, together with new requirements for new skills, new patterns of responsibilities, new management orientation, new methods of control and co-ordination, and new organizational culture. These changes are happening in a rapidly changing business environment. As has been briefly discussed earlier, the rules of the game may be changing, and understanding the emerging institutional framework is essential for developing strategic applications based on IOS. All these changes call for intensive and extensive research - not only along separate themes, but also examining the relationships between them and identifying the underlying principles behind these divergent phenomena. In other words, inter-firm innovations need to be seen as part of a new generation of theories on organization and market in the context of the information economy.

References

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