The Impact of Electronic Commerce

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Abstract

The development of electronic commerce offers a promising way for business to meet challenges of the ever changing market. The fast advancing information infrastructure makes the connectivity possible to reach almost everywhere in the world, but it does not ensure a successful business process. The main challenge comes not only from technology, but also from the people who do the business and the social environment. Social and human functions are still the key issues of business. In this paper a two-dimensional framework is presented for describing the impact of electronic commerce on companies and society from the view of technology and human aspects. The relevant issues in each field of the framework are discussed.

1. Introduction

The fast advancing global information infrastructure, e.g. information technology, computer networks and telecommunication systems, enables the development of electronic commerce (EC), which offers tremendous opportunities to do business electronically, such as in the case of electronic data interchange (EDI). Business is now operated at a global level, and may cross several sectors, not only for big corporate but also for small and medium size firms (SMFs).

Today's technology connects every part of the world. Organisations can connect directly to customers and trading partners through Internet, value added networks, and EDI. Internal organisational functions can be interconnected with client-server, groupware; and Intranet tools are used to distribute data, processes, and user interfaces to make possible the widest use of all organisational hardware. But the connectivity does not ensure a successful business through electronic means. It does not ensure companies who do business electronically reap the real benefit. Business is a human activity. It relies on people, organisations, and our society. We recognise it as intrinsically a human information function. The challenges of electronic commerce come not only from technology, but also from how the human information function is carried out.

We need to know the impact of EC before we can develop an organisational strategy to meet the challenges of the information society, to ensure EC is applied properly and reap

the real benefit from it. Within organisation, computer systems have to be integrated; business processes have to be re-designed; people have to be re-trained and re-allocated. Externally there are requirements for standards, security, and new interactions with partners and potential partners, and the requirements for our society to adapt to and protect the new way of doing business.

In this paper, we present these impacts from technology and human information aspects. Section 2 introduces the concepts of reach and range of information systems. In section 3 a two-dimensional framework is developed to model the aspects of electronic commerce. The relevant issues of electronic commerce related to each field of the framework are discussed in section 4. The same framework is employed in section 5 to discuss the impacts of EC from the security angle. Some conclusions and remarks are presented in section 6.

2. The Reach and Range of Information Systems

Keen (1991) takes a technical view on the functionality of information systems. He argues that the business functionality of the corporate IT platform can be defined in terms of reach and range (Figure 1, reproduced from Keen 1991). *Reach* refers to the locations a platform is capable of linking, ideally connecting to anyone, anywhere, just as the phone system reaches across the world. The development of the information infrastructure allows different systems to interconnect much as different telephone systems do today. *Range* refers to the degree to which information can be directly and automatically shared across systems and services. The ideal here is that ideally any computer-generated transaction, document, message, and even telephone call is able to be used in any other system, regardless
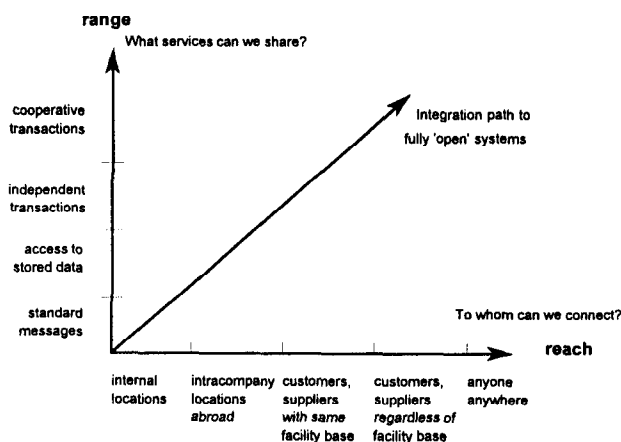

Figure 1: The reach and range of the IT platform

of hardware or software base.

The combination of reach and range determines the functionality of a firm's IT platform. These are determined, in turn, by the standards on which its technical architecture is based. To realise openness, the reach and range should develop coherently. Extending reach alone does not compensate for lack of range nor vice versa, just as direct dial is not the same as direct communication. "Extension of reach does not solve the IT equivalent of talking to a German when you only speak English. That demands additional range, which is often impractical to provide or even infeasible, just as today there is no automatic English-to-German translation system (Keen 1991)." Only by combining, or co-ordinating the development of reach and range, can information systems be integrated to a fully "open" system.

The reach and range concepts provide valuable dimensions for analysing the impact of electronic commerce. Reach is the connectivity, which the development of information technology today provides the possibility to connect to anywhere in the world. The challenge is mainly on how people use the technology (the reach) to do business in the right way (the range). We discuss these issues in next section.

3. The Two-dimensional Framework for Electronic Commerce

We say electronic commerce is still a human activity, just as in usual business. However, the tools or technology we use provide new options for carrying out the activities. Obviously, a purely technical solution alone is not sufficient for a successful EC. We need to bring human information functions as well into consideration. A two-dimensional framework is developed (Huang 1996) to model these two different aspects (Figure 2).
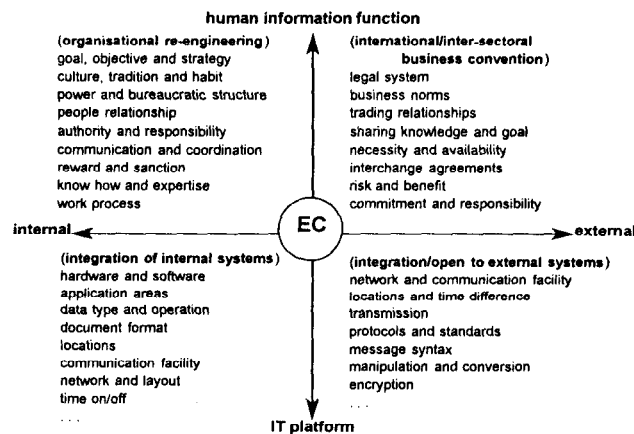

Figure 2: The two-dimensional framework and the relevant issues of EC

The reach of electronic commerce can be found in two directions: reach to external systems as well as to internal systems. First of all, electronic commerce is based on some inter-organisational systems, e.g. EDI, to link organisations, such as customers and distributors, for exchanging information between them. The system should be able to reach any part of the market. At the same time, the system should be able to reach any system inside the organisation. If it cannot reach to the internal systems, the gains from electronic commerce are

elusive. Companies cannot afford to develop IT strategies in isolation from their existing range of hardware and software. An organisation should be able to use a single system for many different trading partners. So the system which EC is based on bridges the internal systems and the external systems. The greatest benefits from EC are obtained when integration of computer applications is achieved over a network of companies and also within those companies.

The range of electronic commerce should be also in two directions: information should be shared directly and automatically across systems and services not only in computer based systems, but also in human activities. Electronic commerce is an exercise of employing the computer-based, networked systems to conduct business according to certain socially agreed norms. It can help companies to handle more efficiently and effectively the different cultures, customs, conventions, and legal aspects of different nations and business sectors. Human functionality is crucial in business processes. As any information system is actually composed of a technical, i.e. computer-based part, as well as a human, or organisational part, EC system is inevitably built on these two foundations. We need to bring the technical platform and the human functions together within a business context. The range in this aspect is the integration not only of the IT platform, but also the human information function. Without the integration of the human information function, EC cannot be successful. The human functionality is what has been lost and neglected in practices today when we consider information systems.

By developing reach and range coherently can we realise an open system environment (Huang 1996). Only by combining reach and range can we develop a real system of electronic commerce.

4. The Relevant Issues of Electronic Commerce

Now we can use the two-dimensional framework as a "lens" through which to view the impact of electronic commerce. The relevant issues in each field of the framework are identified in Figure 2 and discussed below.

4.1. Integration to external systems

Let me start from the familiar domain of EC. In the field of "external - IT platform" dimensions, most of the emphasis and efforts of electronic commerce focus on how to connect IT systems to the external world, just as in the case of EDI. Many people treat electronic commerce in the narrow sense in this quadrant.

The impacts from this aspect are the selection, development, utilisation, and management of hardware platforms, computer networks and telecommunication facilities, transmission protocols and standards, locations and time differences, software packages, message syntax, manipulation and conversion of messages, and encryption techniques, etc.

At this technical platform, our solutions are distinguished by being formal, precise and standardised. We can find the solutions in three different levels (Stamper et. al. 1994b). Physical level solutions are implemented in the form of interconnecting networks of telecommunication devices and computers. We can be almost certain when these are correctly established and when they break down, thus the quality of the physical systems can be

assured. At the empiric level we use various standard communication protocols (such as OSI and the CCITT series) to exploit the physical devices. These take care of encoding, switching, error detection and correction, the confirmation of transmission etc. They are established globally, as the physical standards.

The syntactic level is also formal and precise, but here it is more difficult to establish global standards. In the case of EDI, the EDIFACT Board (1993), for example, produces standard forms of messages for an enquiry, an offer, a delivery advice, an invoice and so on. Although standards have been established, it is difficult to agree on global solutions and the standards tend to be modified at the local level according to the business norms of the industry or country.

The problems at the syntactic level can be explained by the need to encapsulate within the message syntax solutions to problems concerning the human information functions. The design of a message format is an attempt to accommodate what we know about the meanings of the elements in a message, the function of the message, and the norms that govern conduct of business. The problems at the syntactic level would be easier to solve if we also had separate standards solutions for the human aspects (Stamper et. al. 1994b).

The development of Internet technology provide a promising, cost effective platform for EC today. Companies can easily set up such facility within weeks or even days. Available software packages are not very expensive. Many companies treat EC in such a simple way, but they have left the most difficult organisational functions for human being to solve in a very expensive way.

4.2. Integration of internal systems

If we look at the field in the "internal - IT platform" dimensions, the main challenge of electronic commerce comes from the integration of internal systems. Although the development of information technology i.e. the new connectivity such as Intranet, provides great potential for companies to integrate their IT systems eventually, the efforts for companies in this dimension are still a long way off.

The reality today is one of multiple, incompatible systems, fragmented and isolated in pieces within and between companies. "Many firms have no IT platform because information technology remains dominated by incompatibility between vendors' products and no one supplier can meet all or most needs equally cost-effectively (Keen 1991)." The incompatibility in vendors' hardware, software and in telecommunications facilities that prevent common-sense linkages is the barrier to the integration. Today many companies spend large sums to hire system integrators to link incompatible systems, but it is not an easy choice and a simple job, as the major technical and cost barriers, as well as many technical uncertainties they face are formidable.

In order to carry out electronic commerce, many companies just buy an EDI software package and then look how to integrate it into companies' in-house system. The current standardisational approaches put a lot of effort on the details of syntactic structure of the messages. These approaches tell us nothing about what and how business is being conducted. Neither do these approaches help to integrate EDI fully with other systems. On the contrary, they create another isolated island in computer applications. That

is why EDI is still peripheral and functionally disintegrated (Vervest 1993) so far.

The integration of the IT platform is essential for successful electronic commerce. Companies should "insist on the creation of a shared platform based on what is practical now and incorporating standards that facilitate more open systems." "These determinations should be based on business, not technical, considerations." (Keen 1991)

4.3. Organisational re-engineering

We have emphasised that electronic commerce is not a purely technical issue. It is about people who apply new information technology to carry out business in the new way. The success of electronic commerce depends on how people use the technology correctly to serve their business strategy. To understand the impact of EC, we need to consider the human activities, i.e. the human information function.

Let us look at the field of "internal - human information function" dimensions. Here we are mainly concerned with how EC can fit and best serve the organisation's goal, objective and strategy; how culture, tradition and habit are influenced by the new kinds of transaction; what power and bureaucratic structure should be changed to meet the new challenge; how human relationship changes; how to re-allocate authority and responsibility; how to improve the communication and co-ordination between staff; what kind of know-how and expertise are needed; what reward and sanction system should be introduced; and what work processes have to be redesigned. All these aspects are about organisational re-engineering.

Electronic commerce is not a simple tool that can be isolated from business and organisations. The advantage from EC is gained by the way it is used, not by the technology itself. Just as Leyland (1994) states for EDI: "Unless you have decided on the best way of using EDI for your business, you will not know whether the decision you are making is in your interests or not." If we want to reap the real benefits, we need to tackle the more challenging but potentially more rewarding problems of improving the conduct of business. These efforts are achieved in practices through organisational re-engineering.

EC induces and enables an organisation to redesign its business processes and the related organisational structure to meet the required new way of co-ordination with business partners, and face the challenge from the competitive market and dynamic business environment. The full understanding and knowledge of using EC in a strategic way, and the firm commitment to the new way of doing business with EC, from the top executive down to operational staff, are the only path to realise the successful EC from the organisation point of view.

4.4. International business convention

Electronic commerce cannot be realised in one organisation. It should be implemented within the network of companies and their social context. The impacts of EC come from international or inter-sectoral convention as well. These are the issues in the field of "external - human information function" dimensions.

The social context is the essential element to realise EC. Trading relationships, competition in the market place, logistic processes and business norms, etc. all need to adapt. In this respect, legal systems, which are essential for a successful

implementation of EC, are very slow to respond to the change of the new business practices. The conflict between security and flexibility of the transactions is not handled well by the current legal systems. This makes electronic commerce more risky than the conventional practice.

The impact of EC to legal systems is much greater and more important since its linking is international and intersectoral, with minimal or zero human intervention. People are trying to minimise this impact by using interchange agreements between partners. But such an approach is very time-consuming and costly. It imposes a great barrier for EC development. (See the research of Lee and Bons 1995, Mitrakas 1995 in this area.) The sharing of business goals and knowledge, benefits and risk, and the commitment to the new business norms are essential for an open environment. But the legal systems need to adapt to the new requirements to ensure the change in business practices.

Re-designing the logistic process and re-structuring the market place are other efforts to improve the social context of EC. The role each party plays in the venture is being re-defined. The conventional view of banking, vendor, retailer, or competitor and partner, etc. is no longer fixed by the current situation. The meanings of terms in use are changing from time to time, from place to place. Our system needs to meet this change. If system is designed based in a static, technology oriented way, it cannot open for others. If we only conduct research into an unwisely restricted range of technical issues, we too often deliver systems of low quality (Stamper 1995).

While a purely technical approach to EC enables us to deal with problems of improving efficiency, or how to do business the same way but faster and more cheaply, the human information function to EC helps us to tackle more elusive problems of effectiveness, or how to do business better in new ways. These are two aspects of an integrated problem domain. We are relatively well practised at solving the efficiency problems, but we need to do more on the effectiveness aspects if we want a truly EC system.

5. The Security Issues of Electronic Commerce

One of the major concerns in EC is the security problem. The risk in business, i.e. the chance of getting no pay, or no goods, or the interception, modification and loss of the message, either in electronic commerce or in conventional (paper based) one, has always existed. However, because of the nature of the electronic form and the lack of protection from legal system, the risk in electronic commerce is expected to be higher and causes a serious concern in practice. If the security problem cannot be almost totally solved, the dream of EC could only be a beautiful fantasy.

Again, the focus in this aspect in practice is too narrow to meet the requirement of business. The common exercise is combining purely technical solution, i.e. encrypting technology, and trusting third parties to keep records for arbitrary purpose (see Bons, et. al. 1995 for example). There are many aspects, such as the semantics of messages, the intentionality and the responsibilities of the participants and the legal function, etc. that need to be handled properly in order to have a reliable security mechanism. We apply the same framework to view the impacts of security, inside and outside of organisation, from the aspects of technology and human information function. Some related issues are showed in Figure 3.

5.1. Security in communication

In the dimensions of "external - IT platform", we deal with the issues of security in communication between trading partners. We have to make sure that the computer network and communication facility are physically secure; the transmission of messages is completed and reaches the desired destination safely, without being intercepted, modified, or lost; the communication protocols and standards meet the requirements and are properly handled. We want to have confidence that the messages we received in the state of non-repudiation, authentication, confidentiality, and integrity. These issues have to be handled in a secure way.
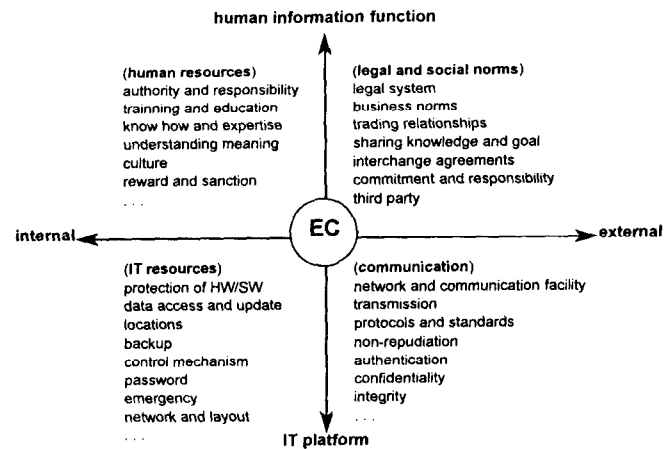

Figure 3: The security Issues

Main concerns of security in electronic commerce are in this field. Technology available includes monitoring mechanism for protecting the physical facilities; applying encryption technology in messages by using the public key of the receiver for confidentiality and the secret key of the sender as authentication or digital signature; implementing smart card technology to physically erase the original when a document is sent; etc.

All considerations in this field are purely technically oriented. For the requirements of a secure electronic commerce, a technical solution alone is not sufficient, especially when disputes occur. People are now looking for an organisational solution for the security issue. We address this aspect below.

5.2. The protection from legal systems and social norms

Electronic commerce is a new human activity. It is an exercise in employing the computer-based, networked systems to conduct business according to certain socially agreed norms. The social environment where EC develops and is employed is crucial for security concern. They are the issues in the dimensions of "external - human information function".

Outside organisation, the sharing of business norms and the trust between participants are important. Electronic commerce will inevitably change the relationships between trading partners and their way of conducting business. Security comes from the joint effort of all the parties in the venture. The necessary

knowledge and goal for security should be shared by all the participants. The commitment and responsibility for security should be properly set up and discharged. The interchange agreement is one of the examples to settle this concern.

The legal system should aim to provide enough protection to insure the new business environment. Unfortunately, laws are too slow to respond to the new development. In order to cope with the problems in law, the solution currently taken involves the introduction of a trusted third party to keep records for auditing and arbitration purposes when disputes occur.

5.3. The security of organisation's IT resources

When an organisation concerns itself about the security of electronic commerce, the security of its own IT resources should not be forgotten. In the dimensions of "internal - IT platform", we discuss these issues.

The measures that can be considered include: the selection of the location for IT resources, the design and layout of the network, protection and control mechanism of hardware and software, the rules of data access and manipulation, backup regulation, and the measure in case of emergency occur, etc. All these are parts of the security issues of electronic commerce. Reliable technology should be employed for this matter, but organisational policy should clear the responsibilities towards security.

5.4. Organisational coherence

Organisational coherence is essential in security. How the whole organisation joins together to do the right thing at the right time in the right manner determines how good the security is. This is the concern in the dimensions of "internal - human information function".

Meanings should be shared by participants to understand intentions and take proper actions to prevent any mistake. This is the biggest security insurance. The proper allocation of authority and responsibility, and a clear control mechanism, the reward and sanction system, inside company is necessary for a secure system. All these have to rely on training and education of the people and to create a sense of security of the organisation.

6. Conclusions and Remarks

The development of information infrastructure makes it possible to realise electronic commerce. It also presents new challenges. The impacts of EC come not only from technology alone, but also from human activities, the human information function, and its social context. It requires organisations to develop and apply new technology for improving business efficiency; it also demands organisations to adapt to new ways of conducting business for improving business effectiveness, and to construct new norms and laws for its development. If we want to meet the challenges of the information society, we need to solve the organisational issues as well as technical problems.

Our research in University of Twente is focusing on the business aspects of electronic commerce. Research topics include the legal framework, the simplification of standards by operating with semantics rather than syntax (Huang *et. al.* 1996, Stamper and Huang 1996), the roles of participant organisations, etc.

Methods and tools are being developed to allow organisations to work entirely at the level of business problems, without having to engage with problems of the syntax and other technicalities. It will result in our attaining more rapidly the benefits of business effectiveness through re-engineering of operations, organisations and relationships along the value chain (Stamper *et. al.* 1994a).

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