Electronic Commerce: A Component Model

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Abstract

Electronic Commerce (E-Commerce) has become a popular topic for business and academic research since the early 1990's. Different researchers focus on different areas: applications, services, marketing, strategy, the Internet, extranets and technologies in E-Commerce, to name but a few. Yet despite this focus on E-Commerce, there is still confusion about just what it is. The aim of this paper is to investigate the still comparatively limited number of E-Commerce Frameworks/Models and to see whether it is possible to develop a truly dynamic model for E-Commerce researchers and practitioners. The model we have developed, which is based on theoretical research at this stage attempts to include all the components and extensions of E-Commerce thus far identified. This model is still at an early stage of development, and we will continue to modify it as empirical evidence adds to its completeness.

Introduction

Electronic Commerce (E-Commerce) has changed the ways organisations perform their activities. Swatman (1996) stated that

> *Starting in the 1970's, three quite separate trends (business document exchange, logistics management and global networking) came together to provide the infrastructure and techniques for what we know today as Electronic Commerce.*

This historical view of E-Commerce has been further extended by Zwass (1996) who stated that

> *Traditional E-commerce, conducted with the use of information technologies centering on electronic data interchange (EDI) over proprietary value-added networks, is rapidly moving to the Internet. The Internet's World Wide Web has become the prime driver of contemporary E-commerce.*

This view that the Internet (or, more properly, the World Wide Web) has provided an enormous boost to the growth and popularity of E-Commerce is supported by both academic and industry sources. For example, in an in-depth analysis of E-Commerce "The Economist" (1997) pointed out that:

> *The Internet has already connected 50m-60m of the world's people through a seamless digital network. Where they live and what time zone they are in makes no difference.*

Electronic Commerce essentially means the undertaking of normal commercial, government and personal activities by means of computers and telecommunications networks and includes a wide variety of activities involving the exchange of information, data or value-based exchanges between two or more parties. Clarke (1999), Hoffman & Novak (1998), Poon (1998), Riggins & Rhee (1998), Swatman (1996), Wigand (1997) and Zwass (1996) have all provided definitions of E-Commerce (which can be found on the E-Commerce education web site developed as part of this research project – see Chan, 1999).

Partly because of the still nascent stage of development of E-Commerce and partly because of the diverse opinions which exist on the scope of E-Commerce, many people are only aware that the areas/components involved in this new way of doing business are wide. In 1998, the U.S. National Science Foundation held a workshop at the University of Texas at Austin on Research Priorities in Electronic Commerce (National Science Foundation 1999). It provided a useful starting-point for serious academic discussion about the meaning and implications of this growing area, but was not able to come up with a definitive framework or model for researchers. Because there are so many different ideas on components of E-Commerce, this paper attempts to investigate some of the existing E-Commerce frameworks/models, with a view to developing a more dynamic model which can be used by the widest possible group of researchers and practitioners. We also hope that this model can assist in providing both researchers and the general public with a clearer concept of the full range of activities comprehended in the phrase "Electronic Commerce" – given the increasing belief by both public and private sectors that Electronic Commerce is merely the activity of *doing business through the Internet*. Unquestionably, Internet shopping is an important and growing area of business-to-consumer E-Commerce, but Electronic Commerce is also much, much more than this.

E-Commerce Frameworks / Models

Electronic Commerce tends to mean different things to different people (Electronic Commerce Innovation Centre 1996). Moreover, Electronic Commerce has so many different components that there is clearly a need to categorise them systematically. Models or frameworks offer greater clarity in the study of many areas of research. In the study of Electronic Commerce, however, it is common to find the words 'model' or 'framework' used in an imprecise way or when referring only to Internet-based Electronic Commerce (See The White House 1997; Philip Andreae & Associates 1998; ECnet 1999; Tan 1998 and Lubinsky 1999).

There are a number of existing models which make an attempt to provide a framework that can be used by others to define or understand the breadth and scope of E-Commerce. This paper begins with an evaluation of these models, explaining why we believe that none of them provides a complete framework within which all forms of E-Commerce can be included. We then introduce and explain our own model, attempting to show why we feel that it offers a richer explanation than those which have preceded it. Finally, we suggest areas in which we plan to expand the existing research base for our model.

Model 1 – Zwass's Hierarchical Framework

Zwass (1998) presented a very comprehensive hierarchical framework of E-Commerce, consisting of three meta-levels: infrastructure, services, and products and structures and seven functional levels, which range from wide-area telecommunications infrastructure to electronic marketplaces and electronic hierarchies.

Meta-Level	Level	Function	Examples
Products and Structures	7	Electronic Marketplaces and Electronic Hierarchies	Electronic auctions, brokerage, dealerships, and direct search markets. Interorganizational supply-chain management
	6	Products and Systems	Remote consumer services (retailing, banking, stock brokerage) Infotainment-on-demand (fee-based content sites, educational offerings) Supplier-customer linkages On-line marketing Electronic benefit systems Intranet- and extranet-based collaboration
Services	5	Enabling Services	Electronic catalogs/directories, smart agents E-money, smart-card systems Digital authentication services Digital libraries, copyright-protection services Traffic auditing
	4	Secure Messaging	EDI, E-mail, EFT
Infrastructure	3	Hypermedia/Multimedia Object Management	World Wide Web with Java
	2	Public and Private Communication Utilities	Internet and value-added networks (VANs)
	1	Wide-Area Telecommunications Infrastructure	Guided- and wireless-media networks

Table 1. The Hierarchical Framework of E-Commerce (Zwass 1998)

This model clearly builds upon the work undertaken by the developers of the various "layered network protocols" or "architectures", which have been developed to explain the inter-connection of telecommunications networking, such as the OSI Reference Model, or IBM's SNA model – which use a similar "layering" approach, where each layer has a clearly defined area of functionality. This separation of tasks means that a change at one layer does not normally affect the other layers, with significant positive implications for software developers. The use of a similar approach to analysing E-Commerce would have equivalent benefits in terms of separating out tasks and enabling solutions to be developed without impact on other E-Commerce activities. The disadvantage of this approach, however, is that there is less flexibility because of the sequence of the layers. Why, for example, are there seven layers? What are the implications of adding further layers? Most importantly, are these layers fully descriptive of E-Commerce in every area of activity and every opportunity?

We believe that the components of Electronic Commerce are constantly changing over time and as particular technologies are pressed into service. The layering approach, which works very well for networking, where the functions and activities can be fully described and do not evolve outside the limits of the model, are thus less applicable to the very mutable functions and activities of E-Commerce. The telecommunications infrastructure forms an important base for Electronic Commerce, but is not itself the whole of this field of study. We do, however, believe that this model has much to offer to those who are investigating the technologies of Electronic Commerce.

Model 2 – Kalakota and Whinston's "Pillars" Framework

Kalakota and Whinston have also developed a generic approach to providing a framework for Electronic Commerce (Kalakota & Whinston 1996). Using a very different scheme from that taken by Zwass, they use the metaphor of "pillars" (public policy and technical standards), to support four infrastructures (network, multimedia content, messaging, and common business services) on top of which they place E-Commerce Applications. These authors suggest that the elements of a framework for E-Commerce are a convergence of technical, policy and business concern. This model is simple to understand and visually attractive – but it lacks theoretical depth and is not particularly useful for researchers endeavouring to incorporate it into empirical research projects.

We believe that this model is useful for those who are approaching Electronic Commerce for the first time – but do not feel that it can be used as a foundation for more detailed analytical study.

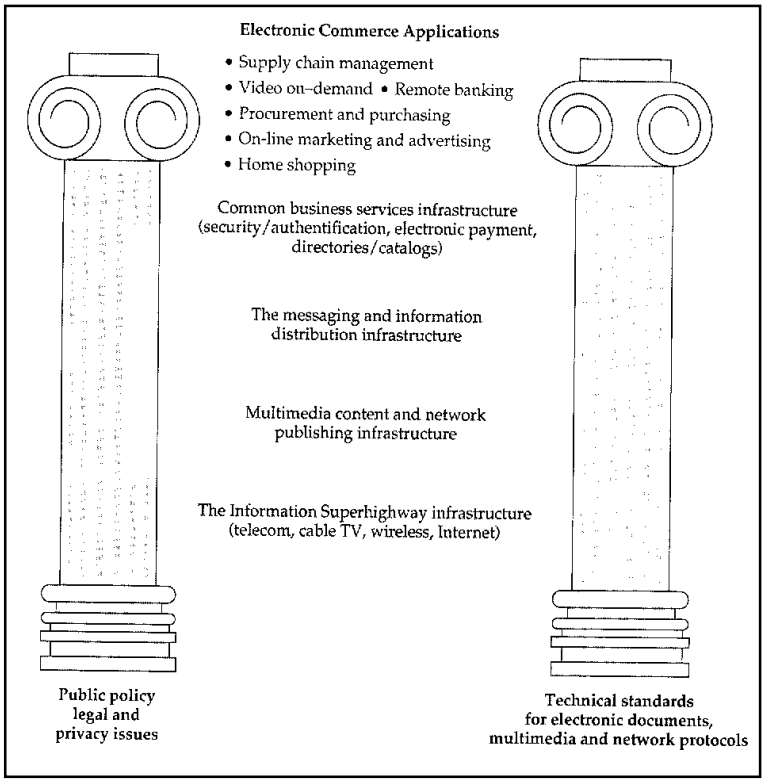


Figure 1. Generic Framework for Electronic Commerce (Kalakota & Whinston 1996)

Model 3 – Riggins and Rhee's Domain Matrix

Riggins and Rhee (1998) have used the Harvard matrix approach to identify a view of E-Commerce based upon type of relationship and internal/external focus. This descriptive framework takes as its axes the "location of the application user" and "type of relationship", thus essentially distinguishing between intranet-based applications and those which use either an extranet or the public Internet to provide access to the applications concerned. Such a model is clearly useful to companies which wish to classify their trading partners into internal and external and, within these, into new and ongoing relationships – it categorises E-Commerce applications into four categories which can be helpful in identifying relationships and technology needs.

Despite these useful characteristics, however, the model is limited in its identification of E-Commerce types being primarily focused upon trading relationships. It would be more difficult to use such a model in the development of, say, a government-sponsored virtual community – such as Victoria's Warrnambool on the Web project. (Warrnambool on the Web 1999)

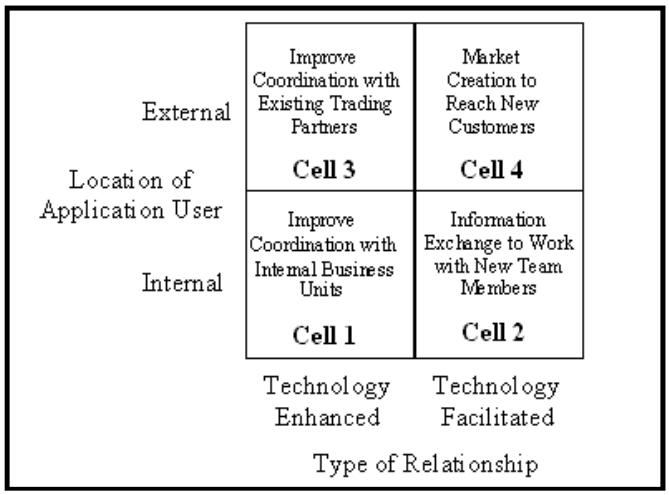


Figure 2. Electronic Commerce Domain Matrix (Riggins & Rhee 1998)

Model 4 – Clarke's Five-Phase Process Model

Clarke (1993) describes a five-phase process model of Electronic Commerce designed to support the different phases of a business transaction. Clarke notes that in this model, it is: *"difficult to have conventional tools of analytical research."* His model is an extension of an earlier, EDI-based model and is strongly focused on procurement (buying and selling) rather than on any of the other components of E-Commerce, which limits its general applicability.

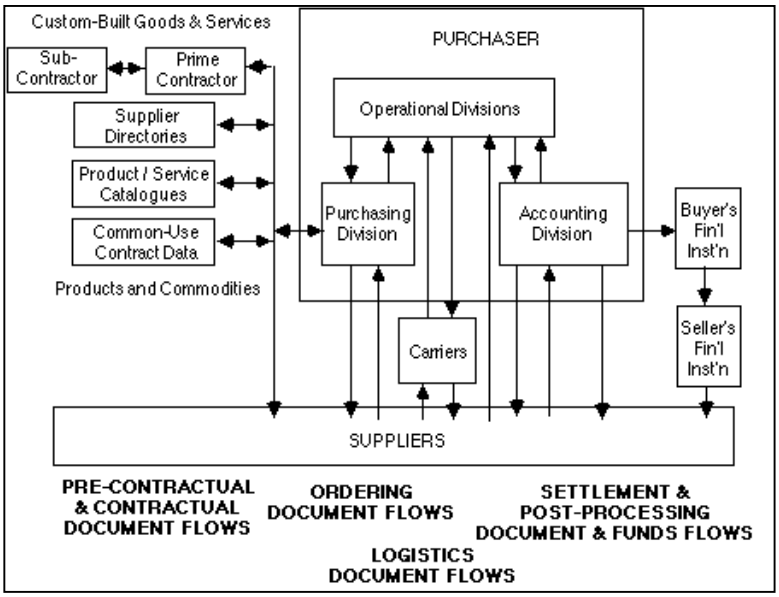


Figure 3. Phases of Electronic Commerce (Clarke 1993)

Clarke's model is well-designed for analysing the issues involved in procurement – both in terms of the stages of the purchase and the activities involved in the transaction. It does not, however, offer especially useful insights into the emerging "cyber-services" sector and is not designed for such E-Commerce activities as virtual communities or e-health (except where these broad areas involve purchase and delivery of physical goods and services).

Model 5 – Wigand's Typology

Wigand (1995) identifies a number of criteria which can be used to define a typology of Electronic Commerce. The components of this typology range from one-way teleshopping broadcasts via cable and satellite television channels, through automated electronic markets, to electronic shopping on the Internet and WWW, as well as catering for fully-fledged electronic commerce utilising an electronic market maker with a set-top box in the consumer's home. Wigand's Electronic Commerce Typology is mainly designed to categorise the "types" of Electronic Business on the basis of their electronic interactive capabilities and does not reflect the full range of Electronic Commerce activities. As with the other models mentioned, Wigand's typology does not allow for virtual communities and offers only limited usefulness to those investigating the various aspects of e-health service offerings.

Type of Electronic Commerce, by increasing electronic interactive capabilities	**Buyers' deliberate choice/ decision at time of transaction**	**Automatized buying transactions**	**Degree of interactivity**	**Buying choice/decision made by computer/software on behalf of buyer**	**Direct buying choice/ decision made by human**	**Potential for full-fledged electronic market**	**Role of market maker**
Teleshopping via television (e.g. QVC)	Yes	One-way only	Limited, one-way	No	Yes	High and successful but only partially electronic	High
Automated market(A): Simple, largely automated transactions (e.g. EFT, EDI, SWIFT, valued added services)	Yes and No	Largely yes	High	Largely yes	No	Limited, only transaction and processing system	Small
Automated Market (B): Simple transactions with some human choices/decisions required (e.g. SABRE, APOLLO, stock market transactions)	Yes	One-way only	High	Generally no	Yes	High and successful	Medium
Mobile and wireless cellular phone/PCS-based applications (e.g. construction industry)	Yes	No	High	No	Yes	High	Small
Electronic shopping (e.g. via Internet, WWW)	Yes	No	High	No	Yes	High	High
Full-fledged electronic commerce utilizing electronic market maker with market-choice box (e.g. available in the future via 500 cable television systems, phone, maybe wireless, etc.)	Yes	Mainly one-way only	High	No	Yes	High	Very High

Table 2. An Electronic Commerce Typology (Wigand 1995)

The Electronic Commerce Component Model (ECCM)

It is clear that, while all these models are useful in specific circumstances, none is capable of providing an inclusive definition of E-Commerce types, activities and capabilities. Yet such an inclusive model is clearly required for effective analysis of the range of Electronic Commerce activities in both product and service terms.

We have, therefore, attempted to design a more comprehensive model which will cater for the increasingly wide and varied types of E-Commerce available – a model which we call the Electronic Commerce Component Model. In this model we have included not only Internet-based E-Commerce, but also those primarily EDI-based business-to-business activities which preceded the commercialisation of the Internet and the rapidly growing virtual communities sector of the E-Commerce "market-space".

The first step in establishing a truly inclusive Electronic Commerce Component Model is clearly the development of a simple and lucid definition of Electronic Commerce. We therefore define Electronic Commerce in the following terms:

> ***Electronic Commerce involves the undertaking of normal commercial, government, or personal activities by means of computers and telecommunications networks; and includes a wide variety of activities involving the exchange of information, data or value-based exchanges between two or more parties.***

Zwass (1998) classified E-Commerce into 3 meta-level: infrastructure, services and products and structures. Kalakota and Whinston (1996) stated that Electronic Commerce are supported by four infrastructures: network, multimedia content, messaging and common business services. Adam et al (1999) stated that Electronic Commerce is an interdisciplinary field of technical, business and legal issues. Having considered their views, we derived our starting-point, i.e., the Electronic Commerce Component Model begins with the identification of the scope of E-Commerce, providing a "meta-view" of the E-Commerce world. We have identified three components at the meta-view level - illustrated in Figure 4 – legal, services and infrastructure.

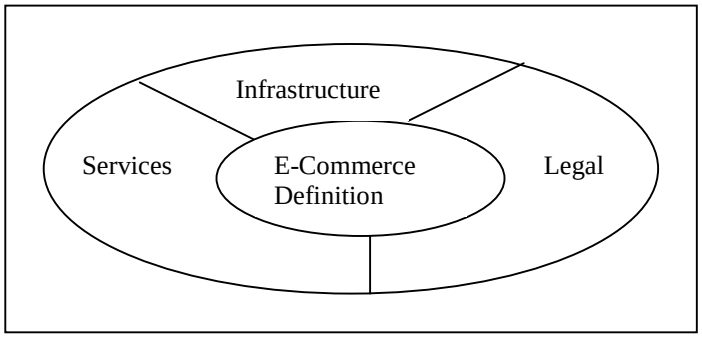
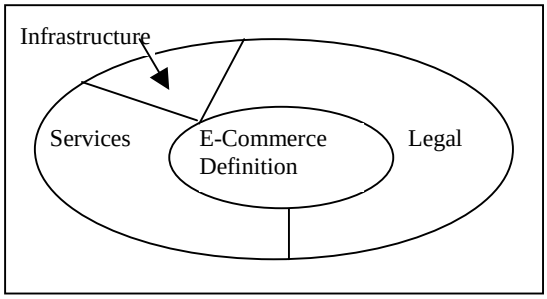


Figure 4. The Meta-View of E-Commerce

At the meta-level, these 3 basic components constitute the framework of E-Commerce – and their boundaries are determined by the parties to each transaction. As our definition has already suggested, these parties can include customers, business organisations, service providers, computer systems developers, marketing people, lawyers or, indeed, many other different groups or individuals. Different parties will set the boundaries according to their specific needs. For example, from a lawyer's point of view, the meta-view of the ECCM will be allocated as in Figure 5a. This allocation places very little emphasis on infra-structure, some on services – but the bulk of the emphasis is on the legal aspects of E-Commerce. This allocation is clearly the result of the lawyer's interest in activities such as privacy and government policy – and it is only in rare cases that our lawyer will be concerned with issues such as transmission media and bandwidth (perhaps when they impinge on a case relating to legal rights to equal access for remote regions of the country).

From the point of a computer network administrator, however, the greatest emphasis will be placed on infrastructure (which immediately affects every aspects of his/her job), with fairly important weightings on legal and services because they will affect aspects of the job – and thus the meta-view of the ECCM would be allocated as in Figure 5b.



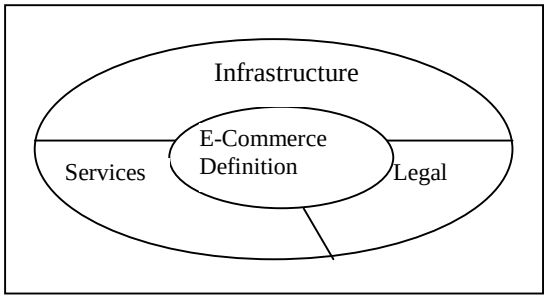


Figure 5a. ECCM for a lawyer **Figure 5b. ECCM for a network administrator**

Because Electronic Commerce means different things to different people, the meta-view can reflect the differing views of any number of E-Commerce users (or Parties). The Parties define the overall size and scope of their meta-view of E-Commerce for themselves – each meta-view is a composite of many objects. The following table identifies the objects, which might be contained within each component of the meta-view.

Meta-view level components	Objects within each component
Infrastructure (Technical)	• Telecommunications / Network technologies (wireless / wire transmission) • Multimedia applications • Internet / intranet/ extranet • Web page development (html, java, perl) • Web page browser (Netscape, IE, lynx) • Simulation

	• Data mining/warehousing • Security of Information • EDI • Database management • Client/server, web server maintenance • Internet Service Provider • Human Computer Interface • Smart card devices
Legal	• Government policy • Government regulation • Privacy • Intellectual Property / Copyright • Contractual and Legal Settlements • Ethics / Computer Crime
Services	• Internet Payment Systems (EFTPOS, EFT) • e-publishing • Procurement (e-catalogues) • Types of services (business-to-business, customer-to-business, intra-business) • Information kiosks (library, airline, weather forecast) • On-line Shopping • On-line Education • Other Internet Commerce activities

Table 3. Composition of the ECCM

Objects within each meta-view component can be added or deleted over time. For example, web pages are a common tool for displaying information on the Internet at present but, as time passes, other interfaces are likely to come into being – and, perhaps, become even more popular than the World Wide Web is today. If this should occur, the web page development object can simply be removed and a new object added in its place. Objects within each meta-view component are coherent, consistent and unique. Each object has an "absolute weight" at a particular period of time which determines its importance to E-Commerce. These weights can (and, indeed, almost certainly will) alter over time. For example, telecommunications technologies such as bandwidth and transmission rate are a major factor in E-Commerce efficiency today – largely because there is not sufficient bandwidth to cater for the needs of all users in all locations. Over time, however, we would expect that technology will resolve this problem.

As an example of the implications of such a technological change – in 1999 the telecommunications technology object might have a heavy absolute weight, such as **0.07** (here absolute weight means the weight of that object which is not affected by the meta-view at a particular period of time). Some years later, however, (perhaps by 2005), the bandwidth issues which are currently limiting E-Commerce activities are likely to have

been overcome by the introduction of new technologies. The absolute weight of this object at that particular time (2005) might therefore change from **0.07** to something closer to **0.02**.

The importance of each object contributing to E-Commerce is therefore determined by two factors: the relative importance of its component within the meta-view; and the absolute weight of the object itself.

Let us take this example a step further and look at how such a change would affect two different E-Commerce Parties from different market sectors:

- from a lawyer's point of view, the relative importance of the legal, services and infrastructure components of his/her overall meta-view of E-Commerce might be **0.6**, **0.3** and **0.1** respectively. In 1999, the absolute weight of the network technologies object (which falls within the infrastructure component of the meta-view) is **0.07**. The importance of the network technologies object to E-Commerce overall is thus **0.007** (0.1 x 0.07);
- from a network administrator's point of view, by contrast, the relative importance of the legal, services and infrastructure components at the meta-view level are **0.2**, **0.3** and **0.5** respectively. The absolute weight of the network technologies object is the same as before, **0.07**. The contribution of the network technologies object for our network administrator will therefore be **0.035** (0.5 x 0.07) – which is much greater than the lawyer's weight for the same object.

These two examples demonstrate that each of the components of E-Commerce at the meta-view level has a different degree of importance to different categories of E-Commerce participants / parties. Figure 6 shows the Electronic Commerce Component Model in its entirety.

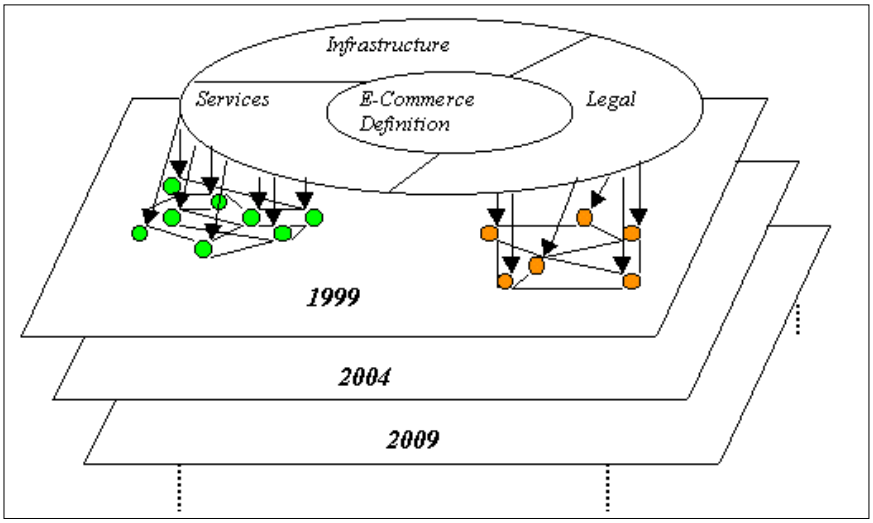


Figure 6. The complete Electronic Commerce Component Model

Our Electronic Commerce Component Model, which is based on existing concepts such as neural networks and object-orientation, is still in its infancy. It can (and will) be further refined as we gather empirical data to support or refute the assumptions on which it is founded.

Despite its limitations, however, this model is dynamic and allows for all the different types of people and activities involved in E-Commerce – and also caters for the inevitable changes which time and technology will bring to the development of E-Commerce. The components of E-Commerce can be easily added or deleted whenever necessary and the model's flexibility makes it useful for both cross-sectional and longitudinal studies.

The drawbacks of Electronic Commerce Component Model primarily involve the difficulty of calculating the weights to be applied to each object. The level of subjectivity involved is problematic and we are looking at ways in which we can introduce greater levels of objectivity into this process. Clearly, this aspect of the model will be our primary focus as we refine and extend the concept over the next few months.

Electronic Commerce is affecting (and certainly will affect) the whole gamut of business and government activities. It is therefore essential that researchers and users have access to a model to represent the full range of E-Commerce activities. Figure 7 shows the relations between the various components of E-Commerce – and allows for the variety of views which are a real part of our economy. While there is no doubt that Information Technology is a major factor in the development of E-Commerce generally (and the ECCM specifically), other business disciplines such as accounting, finance, law and management also provide an important part of the At present, research and practice in Electronic Commerce is tending to identify it as a separate area of study – but over the next few years, it will become more and more common to see instead a focus upon the E-Commerce aspects of the major business disciplines and the implications of E-Commerce for business reengineering.

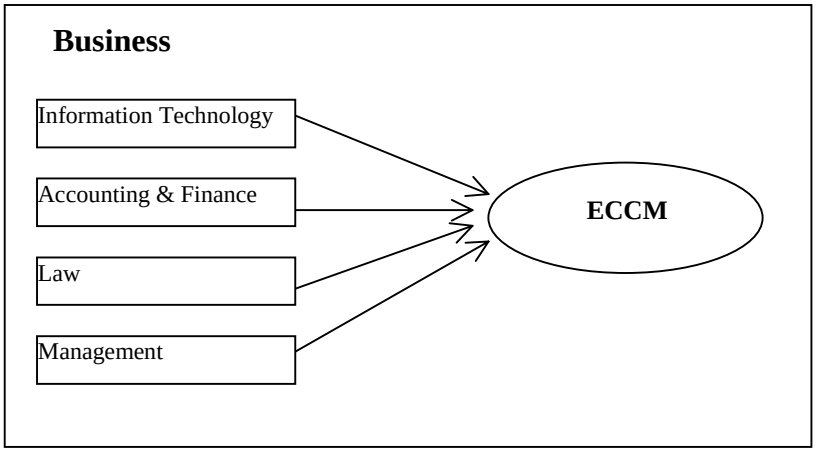


Figure 7. The influence of multiple business disciplines on the ECCM

Conclusion

Electronic Commerce is a very “hot” topic. Whether you are attending an IT exhibition or reading the computer column of a newspaper, IT magazine or web page, the term “Electronic Commerce” is included in the title of an increasing number of articles. As with many fashionable concepts, however, the very speed with which E-Commerce is accepted and discussed may mean that its real meaning risks being obscured – those who are most anxious to participate in the new order may well be rushing into something they have not bothered to understand.

The objective of this paper is to attempt to use a dynamic model to represent the full complexity of the context of E-Commerce. Many of the existing models, despite their undoubted value in particular instances, do not cater for the full range of E-Commerce activities and/or E-Commerce participants. We hope that, in the ECCM, we have developed the basis for a thorough and generally applicable framework within which E-Commerce research will be able to thrive.

We are well aware that the ECCM is still in its infancy and requires further study, but we believe that as Electronic Commerce itself matures, the need for multiple views of this central concept will become increasingly understood and agreed upon. The value of being able to see how one’s own specialty affects and is affected by Electronic Commerce will increase as more and more disciplines become involved in and affected by the business implications of what is today still seen as a predominantly technological phenomenon.

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