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Abstract:
The starting point of this paper is that the proper functioning of agent-based systems depends on the understanding of their societal effects on us. Only by understanding the inter-relationship between the agent-based systems and their resources can we ensure that such systems are not designed and developed in isolation of the social context in which they find their purposes. However, the consequences of deploying agent-based systems are not well defined in the current literature. The aim of this paper is to contribute to the understanding of this issue by investigating the possibilities of using the organizational semiotic framework which is founded on sound and theoretical underpinnings to structure our discourse of some of these consequences. The semiotic framework will help us to draw deep insights from the phenomena under examination.

Keywords: Agent-Based E-Commerce Systems, Social Consequences, Organizational Semiotics Framework.

1 Introduction

As the opportunities in e-commerce grow, competition is also growing. With millions of sites on the Internet, it is almost impossible and time consuming for potential customers to search and find a specific site that sells exactly what they want. A simple search using the term 'books for sale' generated over 33,900 sites and online bookstores. New technologies are therefore introduced to deal with the tasks that confront the customers. One such technology is software agent.

In the past few years, software agent technology, which is a new and evolving technology at the crossroads of many disciplines such as software engineering, artificial intelligence, psychology, sociology, and information systems, has caught the attention of system designers and developers of e-commerce systems. Software agents are actually software entities to which one can delegate some routine or time consuming tasks and offer a new way of software development. In our view, they can be viewed as a type of information systems, though they differ from traditional information systems in that they can be personalised according to individual preference, are semi-autonomous or even continuously running.

Software agents first appeared to automate some of the routine tasks, for example, filtering e-mail (Maes 1994), scheduling meetings (Mitchell *et al.* 1994), collecting

newsgroup articles (Lang 1995). With the rapid growth of the Internet, WWW and e-commerce, another class of software agents soon appeared. Software agents now enable the organisations to make their goods or services available to the customers by performing some of the tasks in the buying and selling process. Due to the unique nature that differs them from traditional information systems, it should come as no surprise that they are particular useful in e-commerce systems. Software agents in e-commerce can help customers to automate many of the routine tasks, such as information finding, information filtering and price comparison. In this respect, software agents are sometimes referred to as mediators in e-commerce systems (Guttman et *al*. 1998; Nwana et *al*. 1998). Agent-based e-commerce systems (ABEC) refer to any e-commerce systems that incorporate software agents. It is this notion of agent-based e-commerce systems that the rest of the discussion in this paper will be based on.

As the richness and complexity of the information available to the customers has grown, the need to deploy software agents in e-commerce systems has also grown. Currently, several implementations of ABEC systems are available on the Internet (e.g. *PersonaLogic* www.personalogic.com; *Goto* www.goto.com; *Kasbah* kasbah.media.mit.edu; *BargainFinder* www.bargainvillage.com/bargainFinder). Each of this system has its own merits, characteristics and limitations. Based on the trend of these ABEC systems, we might see a wider deployment of software agents for the following uses in the future:

➢ Software agents will help customers to identify and locate the products or services that they require.
➢ Software agents will help to keep track and inform customers of new offers that match their preferences.
➢ Software agents will help customers to negotiate electronically with the seller software agents in order to buy and sell goods or services that is in the best interests of both parties.
➢ Software agents, with the approval of the customers, will handle the payment of the purchase goods or services on their behalf.

ABEC systems hold the potential to reduce the transaction cost, thereby promoting the efficiency in the link between production and consumption. This efficiency is termed its first order effect (Heng & Xiao 2000). However, we feel that the biggest implication of ABEC systems on the human agents' lives is the higher order effects, i.e. software agents' ability to change the state of the social world of the human agents. In the context of this implication, the need for a framework with a sound theoretical underpinning to understand the higher order effects of using software agents in e-commerce with certain degree of coherence and structure has to be addressed. However, because the higher order effects through the use of software agents in e-commerce systems are not well defined in the current literature, the semiotic framework (Stamper 1973, 1998) in figure 1 will be adopted in this paper to provide a systematic analysis of this important issue. At a strategic level, the semiotic framework offers a powerful structure and an insightful guide in understanding how agent-based e-commerce systems function as part of the social systems of the human agents. This framework has proved to be very useful in the study of

IS-related activities such as business process redesign (Liu *et al.* 1995), e-commerce systems (Chong & Liu 2000a), HCI (Andersen 1997), Legacy systems (Liu *et al.* 1999; Alderson & Liu 2000) and Object Oriented information engineering (Liu & Ong 1999), just to list a few.

2 Semiotic Framework

The word 'semiotics' comes from the Greek word for 'symptom'. Semiotics as a formal doctrine of signs, was founded by Charles Sanders Peirce, who was primarily a logician (Peirce 1931/35, Locke 1960). A sign can be anything and carries meaning with it. For example, a 'red man' sign on a traffic light signifies that it is not safe to cross the road. There were three distinct fields of semiotics, known as syntactics, semantics and pragmatics. To these three headings, Stamper (1973) added three more, empirics, physical world and social world, as shown in the semiotic framework in figure 1.
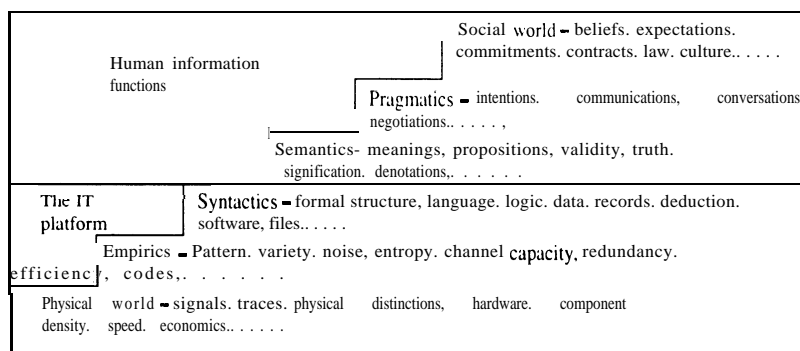

Figure 1. Semiotic framework (Stamper 1973, 1998)

These six levels show how information can be examined as a different aspect of signs at different levels. For illustration purposes, we provide a simplistic example of how a buying process can be successful through the conduct of telephone conversation Here, the semiotic framework provides a practical structure to diagnose the possible social effects through the use of the telephone. A successful booking of a travel package through a telephone conversation is determined by the factors in six semiotic aspects.

> ➢ At the physical level, the telephone must be connected through some service providers. It is the responsibility of the human users to ensure that they have the necessary devices to make and accept a phone call.
> ➢ At the empirics level, the signals have to be transmitted in the most efficient way. The clarity of the transmission of the signals depends much on the service providers. The effects on the human are obviously more visible when clarity of the message is affected through some reasons such as distances.

Though these two levels are the technical infrastructure and the transmission are usually not the direct concern of the users, we see that it has some social effects on them as well. Choosing the wrong service providers or using the wrong devices can delay their priorities in communicating an important message.

➢ At the syntactics level, the two people that are involved in the telephone conversation must speak and understand the same language, with the same grammatical rules for their e-mail messages to be understood.

➢ At the semantic level, the words, jargons, the technical and non-technical terms in the catalogue or brochure (e.g. **$30** pppn) have to be understood by both communicating parties for their communication to gain any value.

➢ At the pragmatics level, the intentions of both parties must be clearly understood in order to create an effect on the recipient. Sometimes, the intentions could be implicit and hidden beneath the surface of a message. However, the shared cultures and norms enable the recipient to recognise the hidden intentions. For example, A e-mails to B and says that "I will purchase the package if it is cheaper", A's intention will be to ask whether B can lower the price a bit.

➢ At the social world level, social commitments and obligations can usually be created as a result of the communication. Following the earlier example, if B says "I will give you a 10% discount if four or more people are travelling", there will be a social obligation for B to give a 10% discount if A is travelling in a group of 4 or more people. If the discount is not given, there will be an undesirable effect on A, in that B might take its business elsewhere.

3 Higher Order Effects

In this section, a discussion on the higher order effects through the use of software agents in e-commerce systems is given by organising the effects into a coherent structure using the semiotic framework. Note that it is a conscious effort of the authors to place the emphasis of the discussion on the upper three levels of the framework, which deal with the understanding of the social and cultural effects through the use of signs by software agents at different social levels. The technical problems that occur at the lower three levels may be solved without much regard for the relationship towards the signs and the people who use them and their intentions in doing so. A fuller semiotic analysis that covers all the six semiotic levels is unwarranted at this juncture and may be left for a future paper.

3.1 Semantic Level

Effects at the semantic level are concerned with issues related to the use of signs for meanings, propositions, validity, truth, signification and denotation. When an organisation uses information systems, it must in some way or other establish the meanings of the signals being processed electronically (Stamper 1987). These signals carry with them relevant information to be comprehended by the users. With any business transactions, there is always the risk of uncertainty that arise due to a lack of relevant information that matters (Bodie & Merton 1998). According to Heng & Xiao (2000), this kind of risk that we encounter in ordinary business transaction today is pretty similar in nature to the risk involved when our ancestors bought articles in pre-industrial societies. Without the information of where to buy the best shoes at a given price, they would reduce their risk by going to the shoe smith down the street. The extensive nature of e-commerce solves a major part of this problem. One great advantage of e-commerce is that it is based on a global network that is accessible to all, easy to use and inexpensive and is capable of communicating product information to potential customers in over **160**

countries worldwide (Barjis & Chong 2000). In fact, now the problem is in the opposite direction, in that there is a flood of information to be comprehended by the customers. A search for 'watch for sale' on the Yahoo search engine for example generated more than 173,000 entries. A large effort is needed by the customers to compare the prices and other features of the service or product in order to be able to make an optimal purchase decision. Software agents can essentially help to reduce the search costs for customers in terms of time, money and effort needed to gather price, quality and product features.

With the introduction of ABEC systems, customers no longer have to perform time-consuming task such as searching for product information (sometimes irrelevant information) across global network. The product information carries with them a variety of meanings (e.g. product innovation, low-price offer, promotional gifts etc.) and is the key to promoting potential business transactions. Today's ABEC systems are taking on a new role in the trading process. Customers simply need to delegate the duties of finding information to the software agents. Many software agents such as BargainFinder (www.bargainvillage.com/bargainFinder) and Ichoose (www.ichoose.com) are even developed specifically to provide the function of monitoring, comparing and grading the quality and prices of goods and services on behalf of the customers. This is an interesting parallel in nature to third party intermediaries before the birth of e-commerce. Travel agencies for example, have played and are still playing the role of helping customers to find their most ideal holiday packages according to their preferences, budgets and liking. In the new e-commerce era, software agents are designed to take over these intermediary roles.

These new roles that software agents take on have an immense effect on companies that are trying to exploit the benefits of e-commerce. The new roles have resulted in a more competitive market, which essentially drive companies to look for cost reduction in order to differentiate their services or products. Raising their prices would be harder when the customers can instantly compare them to everyone else. Furthermore, companies have to constantly keep track of innovation services or products that rivals are introducing. If raising prices is not an option, then companies at least have to differentiate their services or products in terms product innovation or quality. Related to this issue is the ability of software agents to store a summary of information on the sellers' profile. Unlike conventional trading, where it is impractical, if not impossible, to speak to everyone else whom you do not even know about their opinion on the service level of the respective companies, ABEC systems have successfully overcome this limitation. This is especially true in the case of agent-based auctioning systems such as e-Bay (www.ebay.com) or AuctionBot (Wurman *et al.* 1998), where potential customers are permitted to view the positive or negative comments from previous customers. These information about the sellers' profile can radically affect the customers' decision to go ahead with the buying process or discontinue their search and bring their business elsewhere. From the sellers' point of view, there is an increasing pressure on them to guarantee the satisfaction level that comes from the trading process is acceptable so that a negative feedback on them would be deemed unwarranted by the customers. This includes meeting delivery deadlines, ensuring that there is no substitution of inferior products without any notice,

ensuring that there is no hidden catch and so on. If there's anyone that gains from this, obviously it is the customers.

We foresee that the next generation of ABEC systems will open up the possibility of constantly updating the customers with the latest marketing and promotional information. Information about new product launches, special promotions, and low-price offers can be gathered by the software agents, without the direct intervention of the customers. Unlike conventional advertising methods on the Internet, TV, or newspaper, which carry advertising messages about products that may not appeal to all, the promotional messages supplied by the software agents usually prove to be more effective indeed. This is because the information is gathered based on the software agent's knowledge about the customers' preferences and would appeal specifically to their liking. In our opinion, such features of ABEC systems would even encourage impulsive buying behaviour. This issue will be further elaborated in the social world level.

3.2 Pragmatic Level

This level deals with the intentions, communication, conversation and negotiation of signs. Communication is a key word at the pragmatic level. Communication takes place successfully when a meaningful sign is given certain intention by someone and that intention can be unambiguously understood and reacted to by the recipient. One key feature that distinguishes them from traditional e-commerce systems is their ability to communicate intentions without the direct intervention of the human users. Agent-based systems are therefore, sometimes referred to as intentional systems. Related to this notion is the issue of trust. Customers must trust that the software agents would not make any mistakes and that the actions of the software agents made on their behalf will not contrast their original intentions. One must also trust that the other party is willing to bear any responsibilities due to the actions of the software agent. There is also a new need for companies to trust that the customers would actually pay. In our opinion, it is a worrying sign if the trend continues to build ABEC systems based on the notion of trust without providing any guidance on how to best build this trust, because in the sophisticated world of e-commerce, trust can never be guaranteed to occur to facilitate the impeccable functioning of ABEC systems. What is more important is to provide mechanisms to build this trust between the customers and the software agents. Obviously, we foresee that a business is created for banks with global spread, to play a role that has some similarity to letter of credit, to act as an intermediary as far as payment is concerned (Heng & Xiao 2000).

The first step to building trustworthy ABEC systems is perhaps to concentrate on developing software agents that would not behave unreasonably intentionally, given that one of the essential characteristics of software agents frequently contended by researchers is 'autonomous' (e.g. Singh 1998; Nwana *et al.* 1998; Shen & Norrie 1999; Jennings & Wooldridge 2000). In view of this, we think that the emphasis placed on the word 'autonomous' has effectively taken the human users out of the picture during the process of decision-making. In many definitions of sofware agents, many seemed to have viewed software agents as a replacement for human beings. Jennings & Wooldridge (1998) claimed that in e-commerce, some commercial decisions could be placed in the hands of

software agents. Nwana *et al.* (1998) even define software agents as 'software entities that have been given sufficient autonomy... to carry out tasks with little or no human supervision'. This raises serious question about the direction in which the research in ABEC systems should go. In the domain of e-commerce, this issue is sensitive and critical especially when money is involved in the process. There is a need to revisit some of these definitions when employing the use of software agents in e-commerce. This view applies well to companies that want to compete with traditional e-commerce retailers using software agents. Customers should always remain in control of the trading process, especially where money is concerned. When booking a place for a tour for example, customers would always like to be consulted before the travel agent makes any decision for them. Within this line of argument, the customers should always have to approve any purchase or agreement that the software agents made. No sensible customers would want a piece of computer software to make some decisions (hence money spending) for them without their approval, no matter how 'intelligent' or 'autonomous' the software is.

One important aspect is the means of transmitting digital signatures (an intentional sign) by software agents. There will always be someone giving the sign its intention and someone to react to that intention. The digital signature, being an endorsement of consent, effectively becomes a substitute for representing the intention of the customers. Ignoring the pragmatics aspect and stopping at how digital signatures can be efficiently transmitted is no longer sufficient in the study of agent-based e-commerce systems. All relevant human agents must know what the intention implies. In the context of this requirement, the customers who created the intentional sign are obliged to make the payment and the companies who should react to the intention should be prepared to have the goods ready for dispatch before the delivery deadline when the digital signatures are received. Only by understanding the pragmatic issues can we design effective agent-based e-commerce systems that ensure intentions in a communication are interpreted within the context of its original purpose and that the responsible human agent reacts to the intentions accordingly.

3.3 Social World Level

This level refers to issues related to beliefs, expectations, commitments, contracts, law and culture. An organisation using information systems will have the effect of establishing new commitments, relationships with customers and other companies. As was mentioned briefly, next generation of ABEC systems are anticipated to have the capabilities to gather promotional offers according to customers' preferences. Advertising messages gathered by the software agents may even encourage impulsive buying behaviour. New trading relationships and commitments between both parties that would have never occurred is now made possible when advertising messages are gathered according to the customers' preference. In essence, the use of software agents in e-commerce can establish or redefine new relationships and commitments between the customers and companies.

In a survey of existing ABEC systems conducted by Guttman *et al.* (1998), the categories of ABEC systems is organisied in the context of a Consumer Buying Behaviour (CBB) model (see table 1). The survey done by them proves valuable because it allows us to see the stages a customer can pass through when making a purchase decision and exhibits the

stages in which software agents relate to the customer purchasing experience. The CBB model lists six fundamental stages that guide consumer buying behaviour.

1. Need identification
This stage begins with the customers being aware of some need that is that fulfilled. This stage is also called problem recognition in the Engel-Blackwell model (REF??).

2. Product brokering
This stage is also called the information search stage. It comprises the retrieval of information to help determine what to buy. This includes the evaluation of available products based on some criteria.

3. Merchant brokering
When concluding what to buy from the previous stage, this stage help determine who to buy from. This includes comparison of available merchants based on some criteria (e.g. price, delivery time, warranty, reputation, brand, and so on).

4. Negotiation
The negotiation stage is introduced in their model since traditional CBB model do not deal with this stage explicitly. This stage deals with how to determine the terms of the business deal. The terms include the price, delivery time, discount, and so on.

5. Purchase and delivery
This stage is concerned with making the actual payment and delivery of a product. This stage usually signals the termination of the negotiation stage.

6. Service and evaluation
This stage is concerned with product evaluation, customer service, after sales service, evaluation of the satisfaction of the overall buying experience.

ABEC Stages	Personal logic	Firefly	Bargain Finder	Jango	Kasbah	Autionbot	Tete-a-tete
Need identification	,						
Product brokering	x	x		X			X
Merchant brokering			X	X	X		X
Negotiation					X	X	X
Purchase and delivery							
Product service and evaluation							

Table 1. Classifying ABEC systems using Consumer Buying Behaviour model (Guttman et al. 1998)

It was shown in the survey that most ABEC systems only support the product brokering, merchant brokering and negotiation stages of the buying behaviour. In our view however, we envisage that this will change in the next generation of ABEC systems. Software agents are more likely to influence the purchase decisions of a potential customer. We predict that as software agent technologies mature to better manage personalise preferences, complex needs and ambiguous content, they will be able to better support the need identification stage in the buying process. Software agents will have a knowledge base of the preferences of the customers while at the same time identifying

new domains that are of interests to the customers. In this stage, software agents will help to create awareness of the customers' need to purchase some services or products, thereby leading to the occurrence of the succeeding stages in the CBB model.

This will have an immense impact on the marketing strategy that the companies will adopt. Donaton (1995) suggests that the commercial success of a firm's e-commerce website depends in part on accurate information on customer needs. Before, companies need to develop a sound knowledge of the reasons why customers in a particular group buy its goods or services and to create marketing strategies and promotional plans that work. However, although the study on customer needs can identify particular groups of customers who display similar likings and preferences for their services or products, one cannot be 100% sure that each individual customer in a particular group will react to the advertising message in exactly the same way they anticipated. With the introduction of software agents, these uncertainties seem trivial. Such activities may even be reduced, if not eliminated. Software agents will automatically identify the preferences and requirements of each individual customer and influence their decision to purchase a service or product. Traditional marketing communication functions is known to perform three functions: to inform, to remind and to persuade (Anderson & Rubin 1986). These three functions are usually communicated to potential customers in an impersonalise style. With the introduction of software agents, marketing functions may be organised in entirely new ways, giving companies the opportunity to communicate personalised advertising messages to their potential customers.

At the social world level, we foresee that software agents will also play an increasing role in ensuring with precision that both trading parties know what their social responsibilities and obligations are. This process is critical especially in e-commerce, where trading constantly happens between two complete strangers. Furthermore, ABEC is used is to establish new commitments between both parties. Software agents will find that there will be a new need to firstly, remind the human users of their responsibilities that must be followed up (e.g. keep the reference number safe to facilitate future enquiry, deliver the product by the agreed date etc.). Secondly, to assure the human users that the other party is clear about the responsibilities and the consequences of not executing them (e.g. a penalty if the delivery deadline is not met etc.)

4   Conclusion

Software agents offer substantial benefits and risks to the business of a company. Because of this, their design must consider not only the technical details, but also the social effects on the company or the customers. A key to the understanding of the social effects of agent-based e-commerce systems must be structured on an organised framework. However, such an understanding is not readily available in the current information systems literature. In order to fill this gap, the semiotic framework was introduced. To this end, the framework has proved to be useful. This paper provides the insight for understanding the social effects at the upper three semiotic levels when one designs an agent-based e-commerce system.

The forte of the semiotic framework lies not only on its penetrating insight on agent-based e-commerce systems, but also on its sound and theoretical underpinnings in which a design and modelling method can be based on. It is worth mentioning that work on the development of a design method based on the semiotic approach has begun in Staffordshire University since 1998. Some results of the work can be seen in Chong & Liu (2000a; 2000b; 2000c), Barjis & Chong (2000). The proposed method takes into consideration the use of signs at the upper three levels of the semiotic framework and allows analyst to place more emphasis on modelling the social issues surrounding agent-based e-commerce systems, such as modelling the obligation of both the software and human agents. It is hoped that the design method will aid analysts in focusing on the social issues, in additional to the technical ones, when modelling agent-based e-commerce systems.

In order to advance our understanding on the profound nature of e-commerce and software agents, many areas of work are subjects for further study. Firstly, we need to structure our understanding of the problems that arise from ambiguous laws, new laws or inadequate laws using the semiotic framework. As an economic phenomenon, e-commerce forms part of the broader process of social change. "As both a product and manifestation of such transformations, electronic commerce is being shaped by, and increasing will help to shape, modem society as a whole. Societal factors will thus have a profound influence on its future development. They will also merit attention from a public policy standpoint, both to establish the social conditions that allow electronic commerce to reach its full economic potential and to ensure that its benefits are realised by society as a whole. (OECD 1999: 143). " It will be interesting to see how governments have to respond in view of the ever changing nature of e-commerce, especially with the introduction of software agents. Secondly, there was a remarkable development in the capital market in the last quarter of 1999 and first quarter of 2000. Apparently the market believed there were unprecedented growth potential and profits in dot.com companies, e-commerce companies and other companies in the new economy. The high evaluation given by the capital to such companies have forced the old economy companies to hastily announce their grand intemet and e-commerce strategies. Of course sanity has returned to the market, but the consequences of such perceived gold mines associated with e-commerce have yet to be studied properly. We hope to do this as a future research.

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