Using Intelligent Agents for Exportation of E-Services

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Abstract

This paper characterizes the complexity of a knowledge worker's environment in today's business enterprise. This environment, with its ever-changing landscape of tasks, processes, tools, and technologies are making prohibitive demands on the knowledge worker's time and attention.

To aid in the successful navigation of this complex environment, this paper examines usage of software agent for e-service

Software agent technology is still an emerging technology, although, agent based software design is still in its infancy. Software agents have just started to be used in the e-commerce domain, and they are already beginning to create a series of new possibilities for this field. Agents can be used to automate, as well as to enhance many stages of the traditional consumer-buying behavior process. This paper proposes a software engineering approach to the design of agent mediated e-commerce systems, through the definition of an object-oriented framework.

Keywords: agent technology, e-commerce, Service Marketing, Knowledge

1. Introduction

Today's knowledge workers are expected to carry out tasks and solve problems that facilitate the effective and efficient supply of their companies' services. These services must compete in an environment that has become increasingly global and unpredictable, with strong pressures for cost reduction and with changing preferences on the part of increasingly aware customers.

These changes in the business environment are having profound impacts on the work environment. First, they have increased the interconnectedness of knowledge workers within a company and blurred the boundaries between traditional functions such as: planning, finance, human resources, research and development, production, sales and marketing. Second, information technology (IT) has come to play a major role in enabling companies to integrate their value chains, become more agile, and transfer or share risk with other companies. Third, the time available to respond to changes in the internal and external environments has become shorter, and the time for exploration and experiment is limited. Fourth, the unpredictability of cascades of change has reduced the ability to specify and choose courses of actions, and foresee their consequences.

For a knowledge worker, time and attention have become the scarcest resources in this environment [1].

The issues, then, for management are how to manage and adapt its resources to help its knowledge workers manage their work more efficiently and more effectively [2].

This paper focus is primarily on knowledge work (the interactions between knowledge workers and knowledge techniques, tools and technology resources, because exportation of e-service means that exportation knowledge and knowledge workers.). Then this paper presents a framework for knowledge work that can provide for adaptive control by the company and its knowledge workers, and discuss technologies that offer the potential to implement that control.

2.Supplier information and computer services on the Internet

In the traditional approach to supplier information and computer services it is highly unlikely that every potential candidate supplier will be considered in the pre-negotiation stage. There are two main reasons for this. First, organizations do not have perfect market information and hence cannot be aware of all the potential suppliers who may be best able to fulfill a particular order requirement. Even if near perfect market information were available the process of manually selecting the most appropriate supplier from a pool of thousands

would be overwhelming. Second, there is a tendency for organizations to deal with suppliers with whom they have had satisfactory dealings in the past [1]. While this is understandable, it can mean that a more appropriate supplier for a particular need is overlooked. With customers demanding better quality, lower cost products, organizations must be prepared to be more dynamic in the process of supplier information and computer services if they are to remain competitive. There are, however, certain difficulties associated with this approach. First, there is the issue of training procurement personnel to navigate the Internet effectively. The most common way to find information on the Internet is to use one of the many search engines specifically designed for this purpose. To find relevant Web sites a user has to construct a string which is used by the search engine to examine its index of key words. In the case of supplier information and computer services such a string would typically include the type of product sought and the quantity required [2].

The problem can be partly resolved using a meta-search engine which is effectively a "search engine of search engines". These, however, do not guarantee 100 per cent coverage and many will still return duplicate sites. Even if it were possible to construct near perfect search strings and a search engine could guarantee 100 per cent coverage, there would still be practical difficulties. Thousands of potential supplier sites could be returned as the result of a single query, and finding the most appropriate supplier would be practically impossible, particularly if the buyer used multiple criteria to rank suppliers. It is in addressing these key issues that intelligent agent software shows significant promise.

3. Intelligent agents

The idea of software agents has its roots in artificial intelligence (AI). Software agent technology is promising because the open, dynamic and complex environment of the Web requires modular applications that are adaptable and flexible. An agent's ability to act on its own implies some sort of knowledge base and intelligence, but the level of intelligence may vary from the simple (e.g. instructions to run a procedure at a specific time) to the complex (e.g. flexible reasoning systems). It has been proposed that agents will likely develop from simple, understandable systems to more complex and intelligent systems as users become accustomed to delegating activities and develop trust in the agent's abilities. An agent is seen as a "helper", whereas an application is seen as a "tool" [1].

The Internet has provided access to far greater quantities of information than has ever been possible in the history of mankind. But the complexity of this new environment demands a new style of human-computer interaction where the computer plays an intelligent and active role, Interface agents are computer programs that employ artificial intelligence (AI) techniques to provide active assistance to a user with computer-based tasks. The agent acquires its competence by learning from the human user as well as from other software agents, with which it interacts, thereby acting as a type of personal assistant to the human buyer [3]. As with its human counterpart, the software agent becomes more experienced over time. As the human buyer grows more confident in the competence of the software, more responsibility for the negotiation will be delegated to it. Ultimately, some buyers may delegate the entire process to the software. The type of software agent which is able to perform supplier information and computer services must be both intelligent and mobile. The major characteristics of intelligent agents are [2]:

(1)***Autonomy:*** agents operate without the direct intervention of humans or others, and have some kind of control over their actions and internal state.

(2)***Social ability:*** agents interact with other agents (and possibly humans) via some kind of agent-communication language.

(3)***Reactivity:*** agents perceive their environment (which may be the physical world, a user via a graphical user interface, a collection of other agents, the Internet, or perhaps all of these combined), and respond in a timely fashion to changes that occur in it.

(4)***Proactiveness:*** agents do not simply act in response to their environment; they are able to exhibit goal-directed behavior by taking the initiative. Mobility refers to the ability of the agent to independently wonder the Internet searching for other agents or Web sites which can move it towards its goal. Also known as traveling agents, these programs will transport their being, code and state over the Internet. This often improves performance by moving the agents to where the data reside instead of moving the data to where the agents reside. To act as supplier information and computer services agents, the software needs to possess some degree of artificial intelligence. Although no agents yet exist for the specific purpose of

business-to-business supplier information and computer services, the technical infrastructure is already well established [3]. When selling an item, the seller creates a software agent and provides it with the knowledge necessary to negotiate a price, i.e. the selling agent is told what price the seller would like to get for the item, the minimum acceptable price, and some bargaining strategy for lowering the price over the course of a negotiation. Similarly, buyers create a software agent with its own strategies for finding the services they require and provide it with acceptable target prices. When created, these agents then exist in this virtual marketplace, seeking agents of other organizations who are buying or selling the required items and then negotiating. This initial phase of the negotiation process is completely handled by the buyer and seller agents and it is only when negotiations have been completed successfully that the human buyer or seller is notified [2].

Researchers have also tried to further specify the work done by agents. Miller's model describes an agent architecture which includes the four functions of observation, recognition, planning and/or inference, and action or execution, while Maes [3] states that agents can help users in a number of different ways:

. They hide the complexity of difficult tasks.
. They perform tasks on the user's behalf.
. They can train or teach each other.
. They help different users collaborate.
. They monitor events and procedures.

From the above description it can be seen that these agents have characteristics that are very similar to that required for establishing buyer supplier relationships in a business-to-business environment. A buyer would specify appropriate primary criteria, which a potential supplier must be able to fulfill. These would include the product required, delivery lead times and costs. Additionally the agent would be provided with a bargaining strategy. The agent would then search the Internet looking for suppliers that appear to be able to meet the primary criteria. Initial negotiations between the buyer and seller agents will result in the discarding of those sellers that cannot comply with the buyer's bargaining strategy. If the number of suppliers returned was still too great to be manageable, the buyer could define secondary criteria such as evidence of a total quality management policy and consistency of delivery performance [2].

By using intelligent agents for supplier information and computer services, the bulk of the effort in finding the most appropriate supplier for a given product or service at a given time could be delegated entirely to the software. The intelligent agent application would handle the tasks of finding potential suppliers and of ranking them against selection criteria as demanded by the customer. In this way, a buyer could be presented with an on-screen list of the most appropriate suppliers with minimum of human effort. Hence intelligent agents have the potential to automate the buyer-seller negotiation process. This can relieve a potential bottleneck in the supply chain as well as improving labor utilization rates [2].

The possibility of delegating most or all of the procurement process to software will impact greatly on the traditional relationships between human buyers and suppliers. In agent-negotiated relationships, the reliance on past experience, word-of-mouth recommendation, personal relationships and "gut feelings" will be replaced by pre-programmed negotiation strategies. It is not suggested that these human qualities always have a detrimental effect on the supplier information and computer services decision process. Undoubtedly, the tacit knowledge held by human buyers can and does have a significant impact on purchasing decisions [3].

However, the complexity inherent in many information and computer services decisions means that the selection process cannot be undertaken in a rational manner and buyers become subject to the phenomenon of bounded rationality. Bounded rationality means that decision makers are limited in their ability to make perfectly rational judgments by such factors as cognitive capacity, lack of perfect information and time constraints. The huge amount of data available over the Internet markedly increases the degree of information overload, extending the boundaries of the decision domain and increasing the complexity of the supplier information and computer services process. Bounded rationality theory suggests that in these circumstances the human buyer will become increasingly unlikely to make the optimal purchase decision. It is important, therefore, to examine the basis of buyer-supplier relationships and to determine where and how agent technology is likely to have most benefit.

4.Buyer-supplier relationships on the Internet

In the Internet-based approach to supplier information and computer services, a buyer has access to a far greater supplier base than is available using conventional information and

computer services techniques and suppliers could be located anywhere in the world.

While international supplier information and computer services is common, the intelligent agent is likely to identify potential suppliers previously unused by a buyer and negotiations between buyer and supplier will often consist of no face-to-face contact. This being the case, it is useful to examine the nature of the relationship between supplier and buyer in an agent enabled Internet environment. The procurement literature broadly defines two distinct approaches to supplier information and computer services:

(1) Adversarial; and

(2) Partnership [3].

At a minimum, the commerce process involves two participants, a buyer and a seller. Many descriptions of the commerce process take the view of only one of these participants. Marketing mix models examine the process from the seller's point of view, and buyer behavior models examine the process from the buyer's point of view. Nissen [4] proposes an integrated model of the commerce process showing what is exchanged between these two participants at each stage of the process (Figure 1). Nissen's model clearly shows that information exchange forms a large part of the commerce process. Because of the information rich nature of the Web, we will focus our attention in these areas. The Web relies on a "pull" model of information flow so the buyer is expected to drive the adoption of new technologies such as software agents. The starting point for the framework is therefore the buyer's information needs and decision-making process and discusses facilitating roles for sellers and intermediaries in the exchange of information. There are significant differences in how the commerce process is conducted within the business-to-consumer (B2C) and the business-to-business (B2B) environments. Because of these differences, the changes introduced by e-commerce are expected to vary across environments. Research in B2C marketing examines how an individual buyer behaves in the commerce process. Research into B2B marketing uses this same information about individual behavior, but incorporates organizational factors and group decision-making into the process. The adversarial relationship is an "arm's length" approach and is often described as a "win-lose" situation, characterized by lack of trust between the supplier and the customer. By contrast the partnership approach is based upon a strong bond of trust which is established over a long period of time and aims to bring about a "win-win" outcome. Consequently the adversarial approach is more typical in single transaction or short term relationships whilst partnerships are associated with longer-term strategic alliances. The benefits of partnerships approach have been well documented in the literature. Some buyer-supplier relationships that start as adversarial may mature into partnerships. An explanation as to how this process is accomplished is provided by Ellram who has applied the well established life-cycle model to the development of the buyer-supplier relationship [4].

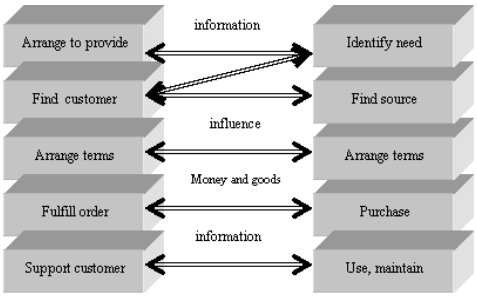

Figure (1): The Commerce Process (Nissen, 1997)

The development stage of a new relationship is characterized by frequent face-to-face communications and low levels of trust. As the relationship matures into the commitment stage, trust grows and there is less need for face-to-face contact. In the integration stage, mutual expectations are established and the relationship stabilizes. Finally the relationship may or may not dissolve depending on specific circumstances. In the agent-based approach there may be little opportunity for face-to-face contact and hence it will be difficult to move from the development stage to the commitment stage. Additionally, organizations may need to rapidly switch between suppliers so as to maintain a competitive advantage. This suggests that buyer-supplier relationships which are facilitated by agents are likely to be adversarial and, therefore, characterized by lack of trust. Consequently an examination of trust in buyer-supplier relationships will provide useful insights [5].

5. Intelligent agents in practical environments

A great deal of progress has been documented since the early study of the intelligent agent, and the professional literature is largely reflective of project-based exploration and research. The focus has gone from a rudimentary implementation of agents for the most basic tasks, to implementation of agent architecture to

support information processing in complex environments like E-Service market for exporting. There is a wealth of professional literature on the application on agent technology in highly specialized fields such as virtual automotive design, cost projections for state power distribution [6], and even weather forecasting [7]. Perez [8] discusses intelligent desktop (client) and web-hosted search agents, both designed to assist users in searching the web. Desktop meta-crawler agent software such as Copernic and BullsEye Pro, and web-based search agents like Dogpile and ProFusion use agent technology to categorize, sort, filter and report search results on behalf of the user. Perez [8] notes several differences between the results retrieved using normal search engines versus a search using intelligent agent software. First, the agent searches are "conducted specific to the searching logic and syntax of the various target search engines" [8]. The online shopping market is another area where a great deal of research is being done on the use of agent technology. In their study on the impact of Internet agents on the online shopper, Hostler et al. propose four different hypotheses. They assert that the uses of an internet agent will [9]:

(1)Reduce the amount of time end users spend searching for and selecting a service to purchase online.

(2)Improve the decision quality of online shoppers' purchasing decisions.

(3)Increase the user's confidence in their purchase decisions for online purchases.

(4)Decrease the amount of cognitive effort required during service search and selection in e-service marketing environments.

6. A frame work for usage of agent technology in the e-service market

The concept of agent technology has practical application within engineering and computing science, but it also has great potential to impact the way work is done in e-service market, as the goal of improving the research experience and search results for users is one shared by every information professional. Agents can negotiate and manage the transfer of information, and this ability makes them useful for certain computer-based. The agent allows users to get more specific answers to questions when searching the internet reveals too many results, and also allows users to ask sensitive questions that they might not otherwise ask a exporter.

Zick [10] indicates several areas where intelligent agents might be used in e-service market, including mediation between the user and information, virtual reference, automated serials processing, circulation and knowledge.

Glance [11] states that: . . . there are three main problems for users of Internet search engines: properly specifying their information need in the form of a query; finding items relevant to their information need, as expressed by the query; and judging the quality of relevant items returned by the search engine.

Although agent technology is a powerful tool for today's e-market, it has many limitations. Nardi and O'Day [12] define seven things that exporters can do that agents cannot. Agents cannot speak and understand, they cannot read and understand content, make connections across diverse sources, access paper sources not available online, evaluate the quality of information sources, or offer the "human touch"[12].

This paper suggests that, exporters can determine a functional version of the personalized environment by supporting a number of e-service tasks, including:

.Finding local resources;

.Finding non-local resources;

.Navigating online databases;

.Formulating good search queries;

.Sorting and prioritizing search results;

.Taking advantage of virtual on-demand "just in time" bibliographic instruction;

.Supporting compatibility between technologies and tools;

.Personal notification of new relevant resources and services;

.Finding material related to markets, such as electronic services;

In this model, interface agents would greet the buyer when they log on, and personalize the information on the screen according to the buyer profile information. What each buyer sees might be totally different: the college catalog and certain databases might be featured prominently for one buyer, whereas another buyer's interface might include the latest additions to the print collection in another service. Information agents might maintain a user profile database and be responsible for retrieving and storing relevant information from a variety of internal and external sources, such as circulation data, demographic information, and course registration information. Server agents might negotiate for access to various digital collections on behalf of the buyer, and facilitate requests for access. This type of integration would, for instance, support

direct links to the appropriate electronic reserves for a buyer based on the e-service market.

Incorporating an agent-based architecture as a core infrastructure for information technology enablers, this paper proposes the framework shown in Figure 2. In this framework, the agent architecture facilitates the incremental shift of direct interactions to IT-enabled interactions through:

•Integrating the IT enablers (knowledge techniques and tools, and knowledge sources) by establishing connections between them.

•Providing communication between people to ensure that they can contribute to common tasks; and between tools so that they can cooperate in performing tasks.

•Providing flexibility to shift interactions, as IT-enabled tools become available, or to replace existing tools, as better tools become available.

• Providing knowledge workers with the choice of what to do and how to do it.

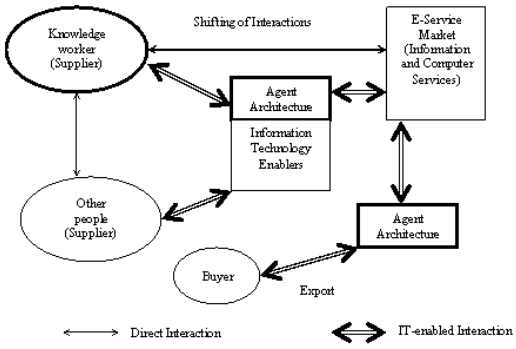

Figure 2: Agent- based framework

A major challenge in shifting direct interactions to IT-enabled interactions is the specification of vocabularies used in knowledge work. This ensures that there is an agreement about meanings of terms used in communication, and is a necessary condition for implementing an agent-based system where agents have to communicate and cooperate in performing tasks. Ontology provides such a standard vocabulary, and is useful for collaboration among interdisciplinary teams and inter-agent communication and for interoperation among distributed applications.

Ontology and workflows can be used to model the tasks in terms of interactions associated with knowledge work, but care should be taken to formalize only stable and sanctioned knowledge in order to avoid problems caused by premature formalization of organizational knowledge.

7. Conclusion

The use of agent technology in e-service markets do however present certain challenges, as there are both technical and social implications that are not easily addressed. Researchers and developers advance that e-service markets are a perfect match for implementing agents in any number of scenarios, but exporters involved with reference, systems, technical services and instruction must be able to first define their work, and then conceptualize appropriate uses of agent technology that will be of the most benefit to the end user. Development and implementation is another matter to be considered. The use of intelligent Internet-based agents for supplier information and computer services as discussed in this paper is entirely theoretical. The discussion presented here is limited in that risk assessment processes for Internet-based supplier information and computer services have not been considered. It has been established, however, that the technological basis for using the agent-based approach to Internet searching is well established in other fields. Hence, there is a need for applications to be developed for this specific purpose. It is hoped that this paper will stimulate research into the development of software agents for the specific purpose of supplier information and computer services. For maximum impact, agents will need to be developed for the needs of both the supply side and the demand side. It is recommended that research and development efforts should be directed at meeting these requirements. It is not suggested that intelligent agents will replace existing methods of supplier information and computer services, but rather that it will become part of the portfolio of supplier information and computer services methods available to buyers.

As increasing numbers of suppliers recognize the business benefits of having a Web presence, so the potential supplier base will grow. Because of the bounded rationality phenomenon, this is likely to increase the complexity of the information and computer services decision. In this situation, intelligent agents are likely to bring the following benefits:

.Evaluation of a wide range of possible alternative suppliers based on pre-defined quantitative selection criteria including price, availability and delivery;

.A reduction in time and cost factors by delegating part or all of the supplier information and computer services process to the software;

.Important information not being overlooked or ignored; and

.The impact of the limitations in human cognitive capacity being lessened.

Organizations adopting the agent approach as part of their procurement strategy are likely to enjoy a substantial competitive advantage over those organizations which do not.

This paper foresees several benefits resulting from this framework:

•Clarity of communication among knowledge workers, and expansion of their abilities to interact with knowledge techniques and tools through the use of formal vocabularies (ontology).

•Customization of their environment by knowledge workers to their personal work styles and needs through multimodal interfaces, and through facilities to manage cooperation and competition among agents without needing to have knowledge of computer programming. This would facilitate creativity and innovation.

•Viewing of knowledge in the context of the interactions – among knowledge workers and the company's and external resources – where the knowledge is needed, used, created and transferred. This would help in better management of knowledge resources.

•Potential for achieving a high degree of overall efficiency and coordination when interactions among knowledge workers are facilitated and increased to produce complex behavior – at the border of order and chaos.

• Reduced life-cycle software costs because agents can be added, replaced, modified and maintained individually at a fraction of the cost of large, tightly integrated systems. (Interactions with agents through formal vocabularies would practically eliminate the need to retrain knowledge workers when tools are replaced or upgraded).

This paper suggest that a combination of forces such as maturity of software development tools, availability of network infrastructures and the need for flexibility in the use of knowledge tools and techniques will make systems like the one proposed here as ubiquitous as the Internet.

References

[1] Bradshaw, J.M. (Ed.) (1997), Software Agents, MIT Press, Menlo Park, CA.

[2] Bradshaw, J. (Ed.), (1999) Software Agents, MIT Press, Menlo Park, CA, pp. 109-44.

[3] Maes, P. (1994), ``Agents that reduce work and information overload", Communications of the ACM, Vol. 37, July, pp. 31-40.

[4] Nissen, M.E. (1997), "The commerce model for electronic redesign", The Journal of Internet Purchasing February, http://www.arraydev .com/ commerce/JIP/ 9702-01.htm

[5] Park, S., Lee, J. and Shin, B. (2005), "Introduction to development of e-engineering framework for the automotive module design", Proceedings of the 9th International Conference on Computer Supported Cooperative Work in Design, Vol. 1, pp.146-151.

[6] Jansen, B. and McNeese, M. (2005), "Evaluating the effectiveness of and patterns of interactions with automated searching assistance", Journal of the American Society for Information Science and Technology, Vol. 56 No. 14, pp. 1480-503.

[7] Lee, R. and Liu, J. (2004), "JADE Weather MAN: a weather forecasting system using intelligent multi agent-based fuzzy neuro network", IEEE Transactions on Systems, Man and Cybernetics Part 3: Applications and Reviews, Vol. 34 No. 3, pp. 369-77.

[8] Perez, E. (2002b), "Web search agents: one-stop shopping for researchers", Online, March/April, pp. 21-5.

[9] Hostler, E., Yoon, V. and Guimaraes, T. (2005), "Assessing the impact of internet agents on end users' performance", Decision Support Systems, Vol. 41, pp. 313-23.

[10] Zick, L. (2000), "The work of information mediators: a comparison of librarians and intelligent software agents", First Monday, Vol. 5 No. 5, pp. 1-14, available at: http://firstmonday.org/ issue5_5/zick/index.html (accessed 20 January 2006).

[11] Glance, N. (2001), "Community search assistant", Proceedings of the 6th International Conference on Intelligent User Interfaces, pp. 91-96.

[12] Nardi, B. and O'Day, V. (1996), "Intelligent agents: what we learned at the library", Libri, Vol. 46 No. 2, pp. 59-88.