PERSPECTIVES OF AGENT TECHNOLOGY IN E-PROCUREMENT

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Abstract: - The procurement of goods and services in the industrial marketplaces for manufacturing industries usually involves complex decision making techniques. Many E-Procurement suites have been developed to make the Procurement process easy. However, there is still a need for incorporating efficient decision support techniques to make the procurement process a successful one. Intelligent agents or multi agent systems are designed among others, to assist buyers in making their purchase decisions. Many Web sites adopt agent technology, for example to speed up the search for lower priced products. Although agents contribution in facilitating the shopping process is recognizable there seems to be some limitations. This paper presents an early attempt to qualitatively investigate the extent to which intelligent agents assist users in an e-procurement process as well as the drawbacks of this system.

Key-Words: - E-Procurement, Agent Technology, Industrial marketplaces, Negotiations, E-Catalogs

1 Introduction

E-Procurement is a new buzzword in the enterprise world these days. E-procurement solutions are directed at improving performance for each of the five rights of purchasing; at the right price; delivered at the right time; are of right quality; of the right quantity and from the right source. In today's dynamic environment, enterprises no longer operate within their four walls. In order to gain competitive advantage, companies form alliances with other enterprises globally and are becoming a networked enterprise. With the rapid development of Internet technologies, a manufacturing enterprise usually finds it difficult to directly control and asses the performance of its hundreds and thousands of its suppliers from different geographic locations and the industrial marketplaces. E-Procurement solutions have a broader appeal to the networked enterprise because they not only span geographic locations but also span industrial marketplaces. These solutions enable organizations to automate their purchasing process and reduce their costs considerably.

An E-Procurement system built into the collaborative supply chain helps the organizations in building a structured, operational environment thus reducing unnecessary costs. But most of the E-Procurement suites developed are information driven rather than knowledge driven. The information is stored in data warehouse and is analyzed using the decision making tools which are not capable of building new knowledge. Hence the knowledge gained during each procurement cycle becomes tacit [2]. Therefore the software does not exhibit a human like behavior in managing the E-Procurement activities like searching, negotiation and auctioning. With the above motivation as the backdrop, we envisage the need for developing an efficient knowledge-oriented platform which is capable of storing and sharing the tacit knowledge of the E-Procurement processes, to cope up with the dynamic environment of the businesses.

Multi-Agent systems may to certain extent, provide better solutions in solving the issues that rise with E-Procurement as illustrated above. A good agent is a one that can make good quality decisions. The quality of decisions that an agent can make is clearly dependent on the quality of information available to it. Intelligent agents are able to perceive their environment and respond in a timely fashion to changes that occur in it in order to satisfy their design objectives. Intelligent Agents also can learn from their experience and behavior and formulate new rules for the environment that

work on. In this paper, we aim to make a headway in this direction by reviewing existing literature and presenting the implications of an agent based system that can seamlessly support the strategic E-Procurement needs of an enterprise.

2   Issues in E-Procurement

E-Procurement comprises of the following activities: searching for the products or services, choosing the right suppliers through negotiations and auctions, and awarding contracts to the chosen supplier. Most of the E-Procurement solutions tasks halt at the activity of awarding contracts. Hence the knowledge gained in finding the right supplier becomes a tacit knowledge and is little shared. Let us now analyze the issues faced in each of the activities in the E-Procurement.

2.1   Searching for the products or Services

Most of the B2B companies are forced to search through the electronic catalogs manually which is a time-consuming task. Finding a right supplier by looking onto the e-catalogs requires many constraints to be considered while searching for example, product price, product quality, supplier's constraints etc. Some E-Procurement suites employ search engines which do consider these attributes while performing a search for the supplier. Unfortunately, most of them result in 'empty result effect' [9]. Due to these problems a purchasing staff with a deep knowledge in acquiring products for the company should be employed for searching the right product and the right supplier. This knowledge is gained only through many years of experience.

2.2   Choosing the right suppliers through Negotiation and Auctions

Negotiation is a key procurement activity carried out in most of the companies. A negotiation usually starts with the preparation of a request for proposal form (RFP).Procurement activities between buyers and sellers require negotiation to match the requirements specification of the buyer with that of a seller [8]. Industries make the negotiation process more transparent so that the buyer power according to the Porter's Five Forces Model is increased, and therefore the buyer has more options to choose from. The sourcing of multiple goods and services involves more complex negotiations, because the buyers will have to specify the constraints for each item, and usually buyers will opt to buy different

products from different suppliers in different quantities. Adding to the above, the suppliers also may have different constraints [4] while they sell their product e.g. suppliers may offer the product at a particular price only if a certain quantity is purchased.

These procurement platforms enable buyers to have a wide range of suppliers to select from and hence the competition becomes fierce. This puts up an immense pressure on the potential small and medium sized companies, who with little experience in auctioning becomes a victim of the winner's curse phenomena [6]. Eventually a buyer may prefer to employ the negotiation phase to initially select the better quality providers, and may invite them to participate in a reverse auction, with the objective of lowering the price while increasing the quality of service [1]. However a problem occurs when two or more bidders are qualified. There occurs a need for winner determination from the equally qualified bidders.

2.3   Evaluation of supplier performance

Manufacturing companies need to continually access their supplier's performance and have to store this knowledge in order to build a strong relationship with their suppliers. The feedback information on quality of goods, on time delivery, possibility to track the goods once they have been shipped, reject rate in the order-fulfillment process, transparency in the supply chain, current market conditions will have to be stored and continuously monitored in order for the organization to select its best suppliers. The supplier case should be updated to the knowledge base for every procurement cycle in order to be accessed. [2]. But this phase of the E-procurement is skipped by most E-Procurement suites.

3 Solutions to the E-Procurement Issues by Employing Agent Technology

In this dynamic world, the market rapidly changes, the price fluctuates and hence simple mistakes made during procurement can be very costly to the enterprises. The impact is high, for a large networked enterprise which purchases huge quantity of expensive goods. Therefore there arises a need to automate and to retain the knowledge of an enterprise for a strategic procurement. A knowledge based system is much needed for expediting

knowledge acquisition and sharing with its supply chain partners [2]. However, most of the enterprises gather the information and store it in the database and decision making tools are employed to analyze the information which does not cater effectively to the strategic needs of the organization. New knowledge cannot be derived from the existing database which is the most important need for a strategic E-Procurement [2]. The valuable knowledge becomes implicit and is retained with the purchase staff as his/her experience. The knowledge (experience) is not shared because this becomes the factor for incentives given for the purchasing staff. There has been quite a lot of research work done emphasizing knowledge based agent systems for the past years. There has been quite a different agent based knowledge models built up for E-commerce users and automated negotiations. [10]

3.1 Agent technology in Searching E-catalogs

E-Catalogs are at the center of an E-Procurement system where the buyers and sellers transact. Implementing and Managing the E-Catalogs by itself is a big business process. Most of the E-Procurement standards are mostly XML based. 'COSIMA B2B 'is a sales automation tool for E-Procurement that employs x-path search engine to search XML-based product catalogs. This tool makes a search for the best candidates for suppliers by using linguistic terms for example sufficient, acceptable, perfect, good etc., instead of numerical scores and thus avoiding the 'empty result effect' [9].Even if there is no perfect match, instead of an empty set, best-alternatives are offered. Another solution is the broker-assisted search in e-catalogs using a tool called 'OFFER'. OFFER is a CORBA - based object framework which has the ability to search in underlying electronic catalogs [5]. Multi-Agent Systems can be used effectively to search through the electronic catalogs. SMART SHOPPER is an agent based web mining software tool developed for customers who are looking for cheapest, best quality product. These agent systems use a fuzzy neural network to tackle the uncertainties in the shopping activities, such as consumer preferences, product specification, product selection, price negotiation, purchase, delivery, after-sales service and evaluation. The fuzzy neural network provides an automatic and autonomous product classification and selection scheme which can help the manufacturing industries to best select the product, based on several constrains [3].

3.2 Agent technology in Negotiations and auctions

Recently Multi-Agent systems have proven a major success in solving the co-operation and winner determination issues in negotiations and auctions. The ability to reach agreements is a fundamental capability of an autonomous agent. The capabilities of negotiation and argumentation are central to the ability of an agent to reach an agreement. The negotiating agents must be able to obtain the best outcome in practice [7]. The negotiating agents perform the following tasks like, collecting the set of quotes in response to the RFQ s submitted, analyze the quotes with respect to multiple attributes, select the qualifying set of proposals and negotiate with the qualified set of suppliers in reaching an agreement [10]. These negotiation scenarios will be governed by a particular mechanism, or protocol. The protocols define the 'rules of encounter' between agents. Another interesting issue is while building the agents they should be built such that individual agents used for negotiation uses a strategy that maximizes its own welfare [7].

Once the suppliers have been qualified, they may be asked by the manufacturing industry to participate in the reverse auction round, which is done mainly to increase the competition and minimize the price while concentrating on the quality of the products. Abstractly an auction takes place between an agent known as auctioneer and a collection of agents known as bidders. The goal of the auction is for the auctioneer to allocate the good to one of the bidders [7]. In a reverse auction E-Procurement, the supplier who bids the lowest is awarded the contract. However, price is not the only constraint in a procurement decision making process, the quality of service should also be taken into consideration while bidding. 'Quotes' is a negotiation tool for industrial E-Procurement developed by the researches in the Intelligent Software Components iSOCO. The auctions in Quotes include several parameters like when to clear the auction, what information is to be revealed to the bidders like the bidders identity, highest bid etc., whether or not bid withdrawal is allowed before/after winners are determined etc[1].

To determine a "winner" of a bid while maximizing revenue is a strategic issue. The determination of an optimal winner combination is a complex problem which cannot be solved manually with common data analysis tools. 'Quotes' provides an optimization

module that uses a Branch and Bound systematic global search algorithm to optimize the desired target [1]. The agents can use the approximation algorithms for the problems that occur with the winner determination in the combinatorial reverse auctions.

3.3 Agent Technology in assimilating and gaining new knowledge in E-Procurement

In the purchasing activity in a manufacturing industry, the buyer in the purchasing unit needs to have a good experience and knowledge in procurement of goods and knowledge about the current market trends so as to minimize the cost incurred in procurement. This involves tacit knowledge and the profitability of the enterprise wholly depends upon the experience of the purchasing staff [2]. But the knowledge gained in making procurement decisions is not or little shared. This necessitates the need for a knowledgebase in the enterprise involved in strategic E-Procurement. C.F. Cheung, W.M Wang, Victor Lo and W.B. Lee has proposed an agent oriented and knowledge-based system for strategic E-Procurement called AOKBS. This system captures and optimizes the knowledge of an enterprise to generate dynamic business rules, which is based on the enterprise needs and analysis of the current market conditions. AOKBS also monitors and evaluates the performance of the suppliers. A supplier evaluation module is built into AOKBS that evaluates the suppliers based on a scoring model. The scoring model is composed of a series of business rules and norms and weighting of the significant factors that are used to judge the performance of the supplier. The supplier score is evaluated and updated for every procurement cycle [2]. Hence this tool provides a way to transform the tacit knowledge into the explicit knowledge for a company to make efficient and effective decisions while performing a purchasing activity.

4 Conclusion

We have presented several novel components in Agent technology for strategic E-Procurement implementation. Installing a fully automated E-Procurement suite that offers the capabilities of searching for products or services, negotiating, auctioning, and rendering new knowledge to make powerful decisions, may result in higher return of investment for the enterprises. Automating all areas of E-Procurement will achieve a more human like behavior in the efficient and effective procurement

process. Nevertheless, designing agents that are able to mimic human intelligence: dealing with unstructured events and acting against several constraints in the decision making process like real humans, remain a challenge till today. Indeed, each business entity has its own unique requirements and the best agent solution for one company may be the worst for another. Alas, there may never be a perfect solution after all.

A future direction of this research entails a plan to study the deployment of the agent technology in searching the electronic catalogs, as limited extensive work has been conducted in this area to the best of our knowledge.

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