Towards a Platform for Supporting the Buyer in Trading in Heterogeneous Marketplaces

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Abstract

While the number of electronic marketplaces has increased on the Internet, tools to help buyers in participating in these marketplaces (heterogeneous marketplaces) are lacking. As part of the European Union funded eBroker project on electronic marketplaces, we attempt to address this problem by developing tools that help buyers in trading in these electronic marketplaces. This paper addresses the following issues: problems buyers face when trading in heterogeneous marketplaces, sources of problems, and how to solve them

1 Introduction

The eBroker project is about trading in virtual distributed marketplaces. A significant problem addressed by the project is how to assist buyers in participating in heterogeneous marketplaces. By heterogeneous marketplaces, we mean electronic marketplaces that use more than one trading model. The problem faced by the buyer can be posed as follows: suppose a buyer wants to buy a certain quantity of goods of a certain type, and suppose the goods are on sale at several different markets, but each market uses a different selling model, e.g., one market uses an English auction, another uses a sealed-bid auction, and yet another market a fixed-price selling model, etc. The buyer wants to come up with an optimal buying plan that minimizes his expenses and at the same time meets his buying needs. The buyer then wants to carry out the buying plan to accomplish his buying mission. If the final buying plan entails that he participates in more than one marketplace, this will mean that he has to negotiate with multiple vendors at the same time. He must be able to monitor the progress of each negotiation instance and give timely responses to events that might arise needing his attention, e.g., a call to submit a higher bid. In addition, we need to take into account that the negotiation process in each market has to be finished within a certain time frame and how risk averse the buyer is. This task is complex and as such calls for software support. In this paper we explore ways how this task can be accomplished and give a conceptual framework that can be used as a starting point for the needed software support. The rest of this paper is organized as follows: Section 2 is related work and Section 3 discusses problems in heterogeneous markets; Section 4 dwells on an approach for solving these problems, and Section 5 concludes the paper.

2 Related Work

Much research has been done in an effort to help buyers in participating in electronic marketplaces. Agent systems like *PersonaLogic*, *Firefly*, *BargainFinder*, *Jango* and *Tete-a-Tete* represent an early attempt to assist the buyer by automating some of the buying steps as given in the Consumer Buying Behavior (CBB) model [2]. These tools do not assist in negotiation, neither do they assist in selecting a set of heterogeneous markets that the buyer may buy from. More advanced tools were developed. Tete-a-Tete did more than just assist the buyer in finding the best product and merchant, but also helped in negotiation [5]. Buyer owned agents co-operatively negotiate across multiple terms (e.g., price, delivery dates, warranties, etc.) with seller owned agents. Kasbah [1] allows both buyers and sellers to create agents that go into the marketplace to transact goods on their behalf. The user gives the agent some negotiating strategies and sends it off into a centralized marketplace where it proactively seeks deals with other agents on behalf of its owner. There is no scope in Kasbah for a buyer to contemplate participating in more than one marketplace. The FishMarket system is a metaphor of the real world fish market where fish is sold using a downward bidding protocol (DBP) [6]. Market participants, e.g., *auctioneer*, *mar-*

ket boss, *credit officer*, *buyer* and *seller* are represented by agents. The FishMarket system does not give the buyer direction with respect to the best markets to take part in. The Michigan AuctionBot is an auction server that supports both human and software agents. Auctions are parameterized and based on that a configurable auction server implemented [8]. Although the Michigan auctionBot implements different auction models, it does not help the buyer in deciding the best market to participate. CASBA [4] uses intelligent agents to enable buyers and sellers to participate in an electronic marketplace. CASBA however does not assist the buyer in choosing the best markets to buy from. We believe has aspect has not receieved enough attention.

3 Problems in Heteregenous Markets

There are two fundamental sources of problems in heterogeneous markets. Firstly there are problems that emanate from the heterogeneity of business models and secondly, there are problems that result from the dynamicity of business models.

3.1 Problems due to Heterogeneity of Business Models

Heterogeneity of business models entails that we have a number of trading models that use different rules. An example is that on the Internet today, there are markets that implement (i) various types of auctions like English auction, Dutch auction, Sealed-Bid auction Vickrey auction, and other auction variations, (ii) various types of bargaining, like bilateral and multi-lateral bargaining, and (iii) call for tenders, etc. This heterogeneity gives rise to the following problems: (i) heterogeneity of negotiation patterns and (ii) non-standardized descriptions of negotiation rules.

3.1.1 Heterogeneity of Negotiation Patterns

Each business model has a unique set of rules that define how trading partners interact; an example is, in an English auction, a buyer responds to an auction by placing a competitive bid against the current highest bid. The price of the item on sale increases with time in accordance with the number of competitive bids being received. The auction closes when no bidder is willing to increase his bid, or when a predefined closing time is reached. To win an auction, a buyer's bid must be the highest, and the winner pays the amount of his bid. The rules are different for each trading model, e.g., in a bilateral bargaining type of model, the buyer and seller make offers and counter-offers until they agree on a price. Not only must the buyer be familiar with rules governing each trading model, but he may also be required to monitor and respond to each negotiation process he is taking part in. This obviously is a complex undertaking for the buyer.

3.1.2 Non-Standardized Descriptions of Negotiation Rules

The other challenge the buyer faces is that of negotiation rules that are not described in a common standard. This makes it difficult to compare different trading mechanisms. To co-ordinate and compare results from each trading mechanism, a common ontology must be used to express the different trading models. This means that there is need to formally define negotiation rules using a standard formalism.

3.2 Problems due to Dynamicity of Business Models

The dynamicity of marketplaces presents two major challenges. The first is the non-deterministic nature of outcomes of the interactions. The second challenge is a consequence of the need for the buyer to meet certain time requirements to reach and conclude a deal. This results in time constraints being an issue in heterogeneous multiple market trade negotiations. We discuss these problems in detail below.

3.2.1 Non-deterministic Outcome of Interactions

When starting a negotiation process with a vendor it is not guaranteed that an agreement will be reached. This results from the fact that various models used by different vendors are dynamic processes with an uncertain outcome. For example, we might prefer to participate in an auction as we expect a lower price than from a Fixed-price deal. However, during the course of an auction, the price might rise above the level of a Fixed-Price deal so that it is advisable to revise our intended buying decisions. Another reason for changing plans is time constraints (see Section 3.2.2 below). Thus, continuous monitoring of negotiation process is required, and a revision of decisions has to be initiated if necessary.

3.2.2 Time Constraints

Usually we have to take into account time constraints in a buying process, i.e., goods to be acquired within a certain time frame. As for most of the negotiation methods no end date can be guaranteed; delays in negotiation process can also be a reason for revised decisions. Consider an example that we participate in an auction as we expect that the auction finishes within a desired time frame. Thus, if we observe that the auction proceeds slower than expected, we might be forced to acquire goods from a different vendor.

4 Solution Approach

To overcome problems identified in previous sections, we propose the following steps: *(i) modeling of interaction patterns, (ii) static plan generation* and *(iii) dynamic plan adaptation*. These are explained further in sections below.

4.1 Modeling of Interaction Patterns

In this stage, an ontology and associated semantics for terms used across trading models are defined. After defining a common ontology and semantic, interaction patterns in each trading protocol should be modeled based on the defined ontology. A formalism for use in each trading model must be selected. This addresses the problem of *non-standardized descriptions of negotiation rules* discussed in Section 3.1.2. Work done so far includes selecting a modeling technique and using it to specify some trading models. Statecharts have been selected as the favoured modeling technique because they are formal and they can, with some extensions model concurrent interacting processes in distributed environments like the web [3]. We have also developed an algorithm to automatically generate the process of one role from that of its complimentary role. There are two advantages to this approach, (i) we can dynamically couple processes and (ii) we can automatically check if two processes are compatible or not.

4.2 Static Plan Generation

The modeling of interaction patterns is followed by *static plan generation*. The static plan should be optimal, i.e., it should represent the best buying plan for the buyer based on variables like the likelihood of getting the goods, time constraints, and how risk averse the buyer is. The notion of utility theory helps us to analyze the different possible outcomes in each negotiation thereby enabling the generation of an optimal static buying plan for the buyer. This addresses the problem of *heterogeneity of negotiation patterns* in that although negotiation patterns remain heterogeneous, the buyer does not directly participate in negotiation, but rather lets a tool generate and execute a buying plan for him. Details of how this is done have been deferred to a separate paper.

4.3 Dynamic Plan Adaptation

In this step, the planning model is enhanced to dynamically handle new information. Dynamic plan adaptation is useful where existence and or verity of information changes with time, and situations arise during plan execution that were not taken into account at plan generation time [7]. In the example given in Section 3.2.2, a buyer may be forced to revise his buying plan because an auction (in which he is participating) proceeds slower than expected. The ability to get feedback and intervene during plan execution partly solves the two problems of *non-deterministic outcome of interactions* and *time constraints* discussed in Section 3.2. This has to be complimented by a good decision model to determine the markets to take part in and the likelihood of succeeding.

5 Conclusions and Future Work

In this paper we argued that tools for assisting buyers in choosing and participating in heterogeneous marketplaces are lacking. We identified problems buyers face in such marketplaces, their sources and a way how to tackle them. Future work involves more detailed work on how to model different trading processes using a common formalism, how to incorporate a decision model for determining best markets and how to generate dynamic plans for the buyer.

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