The Impact of InfoCenters on E-Marketplaces

Itai Yarom
School of Computer Science
and Engineering
Safra Campus, Givat Ram
Jerusalem, Israel 91904
jarom@cs.huji.ac.il

Claudia V. Goldman
Department of Computer
Science
Unversity of Massachusetts
Amherst, MA 01003
clag@cs.umass.edu

Jeffrey S. Rosenschein
School of Computer Science
and Engineering
Safra Campus, Givat Ram
Jerusalem, Israel 91904
jeff@cs.huji.ac.il

ABSTRACT

Information marketplaces enable entities to buy and sell information; these buying and selling entities can be humans, or automated agents that represent them. In this paper, we introduce a new type of participant into electronic information marketplaces, namely the InfoCenter agent, which can not only buy and sell information, but can also procure and sell manipulated (i.e., processed) information. We explore the effects that InfoCenters have on the marketplace and on the other agents that participate in it. We show that the benefits of extending an information e-marketplace with InfoCenter agents are twofold. First, InfoCenters can help buyers obtain better information; second, InfoCenter agents can help sellers gain higher profits. Furthermore, we empirically test the influence of different pricing algorithms and payment methods on the buyers', sellers', and InfoCenters' behaviors.

Categories and Subject Descriptors

I.2.11 [**Artificial Intelligence**]: Distributed Artificial Intelligence—*Intelligent agents*; H.4.2 [**Information Systems Applications**]: Types of Systesm—*Decision Support*

General Terms

Economics

1. INTRODUCTION

This paper focuses on information as a commodity traded in e-markets. In particular, we have developed the notion of InfoCenters, automated agents that have wide accessibility to information products, as well as to manipulated data. An InfoCenter is a software agent that interacts with information suppliers (i.e., sellers), information consumers (i.e., buyers), and Information Service Providers (InfoSPs) that can be automated agents or humans. Therefore, an InfoCenter agent can buy and sell information products. Moreover, it can obtain manipulated information from the InfoSPs. The InfoSP agent enables services such as changing the encoding of information (e.g., JPEG to GIF), adapting the

presentation to different platforms (e.g., desktop or palmtop), updating information, summarizing it, or combining pieces of information. InfoCenters act as information intermediaries, and can reside, for example, in a library, at a portal Web site, or at a site that answers user questions.

The marketplace investigated in this paper contains InfoCenter agents, InfoSPs, information consumers (buyers), and information suppliers (sellers). We focus on the impact that InfoCenters have on an e-market when they sell new information products resulting from applying operators on basic units of information. This study is part of a larger research project that aims at studying the effects of different AI techniques, such as planning and coordination, on the InfoCenter decision process.

2. THE MODEL

Our study is based on the same marketplace model proposed by Kephart et al. [2, 1]. This marketplace contains commodities that are offered by S sellers, and which may be bought by any of the B buyers, assuming $B >> S$. Our framework extends the basic model [2] by including InfoCenter agents and Information Service Provider (i.e., InfoSP) agents. InfoCenters are added to the basic market as intermediaries of information. These agents interact with information suppliers and consumers by buying and selling information. The InfoSP agents are responsible for manipulating basic pieces of information. New commodities will eventually be built out of the existing commodities in the market. InfoCenter agents can approach InfoSPs to obtain new information after the InfoSPs have manipulated it.

Buyers can buy information products directly from regular sellers, and they can also buy them from the InfoCenters, taking advantage of the more sophisticated features of the latter. Regular sellers can sell information to the InfoCenters as well, regarding them as other interested buyers. Sellers are the basic information sources (i.e., we assume that sellers already hold information products). InfoCenters are agents that can buy information products from sellers and can sell it, potentially in a different form. In the more general model, InfoCenter agents can also buy information products from other InfoCenters. The InfoCenter agent can use any one of the following payment systems to pay for information sold by sellers:

- Full Price (FP).
- Wholesale Price (WP) — The InfoCenter agent pays a reduced price if it buys a large quantity of information, using one of the suggested discount methods:

– Discount Price (e.g. 10% discount).
– Average Price.
– Minimum Price — increasing the number of trans-actions while reducing the average profit.

- Subscription Payment (SP) — The InfoCenter agent pays a subscription payment for the right to sell a certain quantity of information, and royalties on each information unit that it sells. The seller can use one of the discount methods described above, and in addition will have to determine the ratio between the subscription payment and the royalty payments.

We tested two criteria for evaluating the effectiveness of the different configurations and algorithms. The first is **profit**. This criterion compares the profit obtained by InfoCenter agents, information suppliers, and consumers in all settings tested. Applying this criterion, we can learn whether sellers and buyers benefit from the existence of InfoCenters in e-markets where they exist. The second criterion is **stability of the marketplace**. A marketplace with frequent price changes can create unstable environments for buyers. The reason is that a commodity bought now may cost, for example, half the price or twice the price if the buyer waits. A marketplace with (relatively) stable prices is desirable, although care should be taken to avoid a monopolistic marketplace, in which prices will be set to their highest point. The desired marketplace is one with stable prices that are competitive.

3. INFOCENTER BEHAVIORS

We have currently implemented InfoCenter agents with three capabilities that give them advantages over classical sellers. First, InfoCenters can offer new information products after having approached an InfoSP, who manipulates a given piece of information. Second, InfoCenters may switch among the commodities they offer for sale. Since InfoCenters do not "hold in stock" the information they sell, these agents can flexibly decide upon the area in which to specialize. Third, we have implemented a mechanism for sharing information among InfoCenters, so that information remains distributed and its price is not necessarily handled by a monopolistic agent. In this paper, we focus on the InfoCenters' basic capability, which is manipulation of information. Experiments run on InfoCenters with additional capabilities will be reported separately.

4. EXPERIMENTS

In the simulations, we examined whether the addition of InfoCenter agents to e-markets is beneficial, i.e., they gain a positive profit. In all of the markets studied, there were two basic commodities, three sellers, and one hundred buyers. The number of InfoCenters in each scenario varies as follows:

1. No InfoCenters — We will use this as a control group.
2. A single InfoCenter Agent.
3. Homogeneous InfoCenter Agents — In this case, there are three InfoCenters that implement the same pricing and payment algorithms.
4. Heterogeneous InfoCenter Agents — In this case, we have simulated markets with two sets of InfoCenters (one InfoCenter in one set and additional four InfoCenters in the other set), where each set followed different pricing and payment algorithms.

Furthermore, we check the effects that the different discount methods have (as mentioned at section 2).

5. SUMMARY AND CONCLUSIONS

In this paper, we have examined the role of InfoCenters, value-added information middle-men, in information marketplaces. InfoCenters in the e-marketplace gain positive profits. In addition, both sellers and buyers benefited from the existence of InfoCenter in the market. The sellers' average profit does not change, even though they sell information to InfoCenters at a discount. InfoCenters are additional buyers, which enable sellers to sell more information and increase their total profit. Buyers benefit from the existence of InfoCenters, because InfoCenters can offer additional information that was not offered previously by sellers. That information may be more relevant, and in that way buyers get more for the money they pay.

There was no payment method that InfoCenters will prefer to use at all times in all configurations. But in most cases, they will benefit most by implementing the full price (FP) payment. In other words, in most cases an InfoCenter benefits more from the price war between sellers, than from the discount that the sellers offer.

When we compared the different discount methods that can be used when an InfoCenter buys a large amount of information from a seller, we found that the seller will gain the highest profit when the discount is higher. The InfoCenter will gain the highest profit when the discount is lower. Therefore, sellers gain more when selling their information with lower prices to selected customers, while those customers preferred higher prices. This is because a seller benefits from selling to an InfoCenter that buys a large amount of information, even if it sells it at a lower price. The InfoCenter, on the other hand, will prefer to buy the information at higher prices, because that will enable it to sell the new information with higher prices as well.

The existence of InfoCenters in the marketplace did not affect price behavior. This is because InfoCenters bought the information offered by sellers and sold new information. Therefore, sellers had additional buyers (i.e., the InfoCenters), and the InfoCenters were the sellers of the new information.

6. FUTURE WORK

We would like to check whetever AI techniques can help InfoCenters to increase their profit. InfoCenter can use planning in order to choose 'wisely' which InfoSPs' services to use. Furthermore, InfoCenters can approach buyers in order to understand what kind of information they are interested in and offer this information to them.

7. REFERENCES

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