Electronic Commerce

with Software Agents

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Electronic Commerce and Marketing on the Internet
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I. INTRODUCTION

Electronic commerce is enabling business-to-business and business-to-consumer retailers to create electronic communities where daily business is transacted. The general commerce framework defines several sequential processes for completing a sales transaction. The question that arises is how effective are these companies in automating the processes within the general commerce framework. What is the role of the software agent in automating the sales process?

This paper analyzes the framework for defining the relevant characteristics of a software agent. In this paper we hypothesize about the relevant importance of each characteristic and the role each plays in automating the general commerce framework. In this paper, we will examine several sites which represent both business-to-business and business-to-consumer to determine the role of the software agent. We will also analyze the characteristics of the software agents to understand what characteristics automate what processes within the general commerce framework.

II. FRAMEWORK FOR UNDERSTANDING AGENTS IN ELECTRONIC COMMERCE

To analyze agents we can start with the general commerce framework:

*Figure 1: General Commerce Framework*

```
<table>
<thead>
<tr>
<th>Sell Something</th>
<th>Buy Something</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identify potential customers</td>
<td>Identify potential sellers</td>
</tr>
<tr>
<td>Identify customer needs</td>
<td>Identify own needs</td>
</tr>
<tr>
<td>Inform potential customers</td>
<td>Evaluate alternatives</td>
</tr>
<tr>
<td>Obtain order</td>
<td>Place order</td>
</tr>
<tr>
<td>Deliver the thing</td>
<td>Receive the thing</td>
</tr>
<tr>
<td>Receive payment</td>
<td>Make payment</td>
</tr>
<tr>
<td>Provide customer service</td>
<td>Use the thing</td>
</tr>
</tbody>
</table>
```
This framework tries to capture all of the general processes that must happen in a transaction. We could have analyzed agents along each one of these dimensions, but found that synthesizing them into two terms, “brokering” and “negotiation,” helped us to better understand how agents add value to the process.

*Brokering is the matching of buyers and sellers for the purpose of getting to a deal.*

*Negotiation is the act of closing the deal.*

Therefore, the brokering action can be thought of as a synthesis of the first three steps in the general process: (1) identify who the potential buyers and sellers are, (2) identify what the customer’s needs are, and (3) informing customers of potential alternatives. Likewise, negotiation is related to the fourth step, (4) placing and obtaining an order.

*Figure 2: The Brokering & Negotiation Aspects of Commerce*

<table>
<thead>
<tr>
<th>Sell Something</th>
<th>Buy Something</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Inform potential customers</td>
<td>Evaluate alternatives</td>
</tr>
<tr>
<td>Obtain order</td>
<td>Place order</td>
</tr>
</tbody>
</table>

We have decided not to address the steps in the process which follow the closing of the deal because we think the most value-add, and the future of electronic commerce, is in the brokering and negotiation.
Now having said that, we would like to introduce the concepts of ontologies, personalization, and reputation & trust. These concepts represent the information which enables the brokering and negotiation processes to take place. You can think of these concepts descriptively as follows:

*Ontology is the rules of the deal.*

*Personalization is the information about your preferences.*

*Reputation & Trust is the information that you have about the other party in the deal.*

So, given the structure that ontologies, personalization and reputation & trust are the information which support the brokering and negotiation processes, our main proposition is:

**Proposition**

| The more robust your ontologies, personalization and reputation & trust, |
| the more efficient the transaction process. |

In some sense this proposition says — the greater and better organized the information content in the deal, the easier it is to do the deal. To investigate whether or not this proposition was true, we did mini-case studies of eight commerce-related Web sites. We analyzed each site along all five dimensions of brokering, negotiation, ontology, personalization, and reputation & trust. First, we scored each of the eight sites along each of the five dimensions on a scale from 1 to 5, where 1 is the lowest possible score and 5 is the highest possible score. The results of these scorings are as follows:
Table 1: Scorings for e-Commerce Sites

<table>
<thead>
<tr>
<th>e-Commerce Site</th>
<th>Ontology</th>
<th>Personalization</th>
<th>Reputation &amp; Trust</th>
<th>Brokering</th>
<th>Negotiating</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA Central</td>
<td>5</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>FireFly</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>PC Financial Network</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>OnSale</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Nets, Inc.</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>AirFare</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>United Computer Exchange</td>
<td>4</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>MIT Bazaar</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Next, we averaged our scorings for ontology, personalization, and reputation & trust into one number and compared that to the average of our scorings for brokering and negotiation. These averages are as follows:

Table 2: Average Scorings for e-Commerce Sites

<table>
<thead>
<tr>
<th>e-Commerce Site</th>
<th>Average of Ontology, Personalization and Reputation &amp; Trust</th>
<th>Average of Brokering and Negotiating</th>
</tr>
</thead>
<tbody>
<tr>
<td>MBA Central</td>
<td>3.33</td>
<td>2.50</td>
</tr>
<tr>
<td>FireFly</td>
<td>4.67</td>
<td>3.00</td>
</tr>
<tr>
<td>PC Financial Network</td>
<td>4.00</td>
<td>3.50</td>
</tr>
<tr>
<td>OnSale</td>
<td>1.33</td>
<td>2.00</td>
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</tr>
</tbody>
</table>

Then we graphed these figures to see if there was a correlation between aggregate quality of ontology, personalization and reputation & trust (i.e. the “robustness”), and the aggregate quality of brokering and negotiation (i.e. the “efficiency of the transaction”). We found a 57% correlation. That’s not overwhelming, but is does prove the relationship as shown below:
Figure 3: Analysis of Our E-Commerce Sites

The Greater the Information Content in the Deal, 
The Easier it is to Do the Deal

III. DIMENSIONS

In this section we outline in greater detail our working definitions of the dimensions, and the questions we came up with while trying to sort out how each of the sites should be scored along the five dimensions.

- Ontology
- Personalization
- Reputation & Trust
- Brokering
- Negotiation

Ontology

An ontology is a description of the way things are. It delivers a form of understanding that enables more efficient communication. We would expect that ontologies for the same products, manufactured by different vendors, will begin to converge and it will start to look a lot like a standards race. There will probably be an era of many separate sites with different ontologies, yet trading the same products, before they consolidate.
We scored our commerce sites high as long as the ontology that they used was appropriate for the complexity of the product being described. For example, because you can almost fully describe the purchase of a CD to someone using just Artist, Album, Price and possibly Delivery Time & Charges, it is easy to develop an ontology that is well suited to this product. But, you can imagine the complex ontology you would need to fully describe a car. Of course some of the most important information which is still necessary to do the deal is the reputation and trust of the other party. And a good ontology will capture these elements when describing the product.

The sites’ ontology scores depend on the following characteristics:

- number of levels of depth
- complexity of the good and the complexity of the context within which it fits
- degree of complexity of the categories presented

**Personalization**

The essential feature of an agent is its specificity with respect to a certain function or task. This is the sense in which it is literally an “agent” taking action in the interests of another just as a real estate agent is understood to represent the interests of a buyer or seller. But a software agent is considerably simpler than a human agent as software agents exist solely to perform the tasks for which they are custom-built. To the extent that the outcome of the agent’s primary task is controlled by specific information supplied by the user, the agent is personalized for that user.

A search engine such as Yahoo! or Alta Vista is an example of a software program operating on information supplied by a user and illustrates a simple form of personalization. In this case the user-supplied information is not stored by the agent for future filtering tasks, but rather each time a user wishes to obtain results that meet his personal interests, he must supply a term or terms that correspond to these interests. These search criteria act as user profile data on which the agent operates to deliver filtered search results customized to the user’s information needs.

The sites’ personalization scores depend on the following characteristics:

- degree to which the agent requires user-specific information
- degree to which the agent captures a complete user model or profile
• degree to which the agent makes unique recommendations or experience
• degree to which the agent maintains a user model or profile
• degree to which the agent adapts its user model or profile (does it learn by itself?)
• degree to which the agent interacts differently with other agents based on the given user model or profile
• degree to which the agent delivers user information when it is needed
• degree to which the agent takes timely action based on the user model or profile
• degree to which the agent guesses what you want based on a user model or profile
• degree to which the agent helps you find what you want based on indirect information

**Reputation & Trust**

When your agent brings you the names of five competing sellers of the product you want, and all of their prices are close, how do you choose? Why would you trust one more than the other? Things such as independent scorings could help your agent decide which seller to go to by depending upon your personalized preferences about price vs. reputation. Your level of trust about a seller can depend on the enforcement policies. What is your recourse if things don’t go well?

In addition to the issue of having agents which can interpret reputation, what about trusting your agent itself? Now that your proactive agent has the ability to transact on your behalf, do you want it to? Do you trust your agent to do the right thing? To help mitigate this problem your agent will likely learn from you. If it has made choices that you like or dislike you can let it know. And maybe someday you can simply ask your agent to buy a present for your boss and it will do an even better job than you would have on your own without using another second of your time.

FireFly is an example of an “agent” which has been building a reputation and trust. To the extent that FireFly selects new CDs that you like, you will trust it to continue to do so in the future and maybe even trust it to do so with other products like videos.

The sites’ reputation & trust scores depend on the following characteristics:
• extent to which the agent monitors factors outside the interaction
• extent to which automated mechanisms exist to enforce trustworthy behavior
• extent to which mechanisms exist to enforce contracts and commitments
• extent to which mechanisms exist to punish "bad" behavior
• extent to which mechanisms exist to reward "good" behavior
• extent to which mechanisms exist to track and report the behavior of users over time
• extent to which opinions and preferences of the user community affect transactions
• extent to which the system acts as an enforcer of fair behavior among buyers and sellers
• extent to which the system is reliable (e.g. does not crash)
• extent to which the system incorporates indirect means of enforcement
• extent to which the agent uses the reputation of other users in transactions
• extent to which the agent builds a reputation for the user

Brokering

Agents may also serve to obtain desired information, often from a variety of sources, and supply it back to the user. In the context of electronic commerce this activity brings information from the buyer and seller together and presents it to either the buyer or the seller or to both. Brokering is different from personalization in that brokering is the function of information retrieval and delivery, given personalized instructions. Again, the search engine that delivers query results is a simple example of a broker, as it gathers and delivers results based on personalized input. So-called “meta-indexes” perform this function on more than one data source.

The extent to which a site functions to bring a user closer to a buying transaction that meets the user’s personal criteria defines the extent of its usefulness. The extent of this usefulness is limited in most agents by the detail and accuracy of the user profile data inputs held by the agent and the volume and organization of the information upon which the agent operates. There are also factors extrinsic to the agent itself that increase or decrease an agent’s usefulness such as the availability of the specified good at the time and price at which it is sought. A highly sophisticated brokering agent would likely show a high number of user profile criteria, a high number of on-line sites at which it shops, and perhaps even a scheme for assigning relative priorities to the different buying criteria supplied by the user. These priorities might be assigned directly by the user but a complex agent might also learn these priorities by capturing actual purchasing decisions, checking them against the user’s previously stated buying preferences and then adjusting the weight of the priorities assigned
to the different preferences. Applications in which such a “weighted average” prioritization methodology would be useful are transactions involving several different buying decision criteria and a large number of possible options from which to choose, each of which performs differently in the different decision-making categories. Such a system, if possible, would be useful in complex buying decisions such as car or house purchases.

The sites’ brokering scores depend on the following characteristics:

- degree to which it finds the user the needed information
- degree to which it can handle complex or multiple items, requests, or attributes
- degree to which agent does not miss things that you want when they exist — completeness of the search
- degree to which agent filters out what you do not exactly want
- degree to which the agent delivers the information the user needs when it is needed
- degree to which the agent delivers the information in a useful form
- degree to which the agent can guess what you want based on a user model or profile
- degree to which the agent prioritizes and/or filters information based on a user model or profile and history of choices
- degree to which the agent can help you find what you want based on indirect information
- degree to which the agent captures a complete user model or profile
- degree to which the agent finds who to transact with
- degree the which the agent is manual or automated
- degree to which the agent searches — the domain of the search and type of search, open or closed
**Negotiation**

The third aspect of value added by agents in electronic commerce is their usefulness in the dynamic process of transacting a deal. An example of this kind of functionality exists in the “program trading” that takes place on Wall Street today, in which software programs are constantly watching for the occurrence of certain conditions or the crossing of pre-assigned thresholds by the changing prices of securities that trade over time in financial markets.

The sites’ negotiating scores depend on the following characteristics:

- the number of constraints the negotiating agent considers
- the agent’s ability to recognize time
- degree to which the negotiating agent actually executes a transaction
- degree to which the agent automates the transaction
- extent to which the agent compares different possible, available deals
- extent to which the agent interacts with other agents
- the dollar magnitude of the purchase the agent is empowered to handle
- extent to which the agent needs approval to execute the transaction
- extent to which the current goods are negotiated
- extent to which the agent adds value through negotiation
- extent to which the agent captures or compares different utility functions
- extent to which the parameters of the negotiation are fixed or variable
- extent to which it is possible to make a counter-offer
- the number of parties involved in the negotiation
- the extent to which the agent has a protocol for counter-offers
IV. CASE STUDIES

To better understand how electronic agents could add value to the commerce process we decided to look at the following agent-based industries and sites:

Table 3: E-Commerce Sites Studied

<table>
<thead>
<tr>
<th>Industry / Type</th>
<th>Company Name</th>
<th>Internet Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Travel Agent</td>
<td>AirFare</td>
<td><a href="http://www.airfare.com">www.airfare.com</a></td>
</tr>
<tr>
<td>2. Job Hunter</td>
<td>MBA Central</td>
<td><a href="http://www.mbacentral.com">www.mbacentral.com</a></td>
</tr>
<tr>
<td>4. Recommendations</td>
<td>FireFly</td>
<td><a href="http://www.firefly.com">www.firefly.com</a></td>
</tr>
<tr>
<td>5. Retail (B-Goods)</td>
<td>OnSale</td>
<td><a href="http://www.onsale.com">www.onsale.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td>guttman/research/kasbah/</td>
</tr>
</tbody>
</table>

The format for each case study is as follows:

- Title Page
- Sample Screen Prints
- General Business Description
- Analysis of Each Dimension
  - Ontology (score: )
  - Personalization (score: )
  - Reputation & Trust (score: )
  - Brokering (score: )
  - Negotiation (score: )
- Conclusion
1. MBA Central
1. MBA Central

MBACentral is software and a service that support job search and recruiting for MBA students and alumni. Users download client software to their PCs and register their job preferences online in a variety of industrial, functional, geographical and other categories. Users then receive notification by email of opportunities that match their stated preferences. The user signifies interest in jobs by responding to the email notification. Responses are screened by MBACentral and sent to employers. It appears that representatives from MBACentral call respondents to ask questions and confirm information.

<table>
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<td>4</td>
<td>1</td>
<td>4</td>
</tr>
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</table>

Ontologies (score: 5)

One would expect the ontology that MBACentral uses to represent jobs to be sophisticated since jobs have a complex set of characteristics, fit into hierarchies that are geographic, functional and political, and represent a broad multiplicity of domains. The MBACentral ontology is not only complex, but also has a well-designed user interface to facilitate navigation. The interface of the client software helps the user drill down to the jobs that she seeks and provides summary screens at different stages of the profiling process, making it easy to modify earlier answers to questions in the profile.

Personalization (score: 4)

The system is highly personalized in that it requests a detailed user profile for the purpose of finding jobs that match the user’s preferences. The service is essentially a broker, filtering information for the job seeking user and for the prospective employer. In order to accomplish effective brokering, it relies on a high degree of specificity in the characteristics of the user profile.
Reputation & Trust (score: 1)

There is currently no system within MBACentral that ensures quality and reliability between the job seeker and the employer to the point that these parties could get to an employment agreement electronically. There is a money back guarantee to the employer for using MBACentral’s services, but there is nothing to reassure the job seeker except the official blessing of the Career Development Office of his or her business school.

Brokering (score: 4)

MBACentral is essentially a broker, filtering the information of employers and job seekers to bring both parties together. Over a period of several months using MBACentral, I received notifications of several jobs that matched my interests. The service was moderately useful in this regard as I was interested in approximately half of the jobs of which I received notification.

Negotiation (score: 1)

Transactions in MBACentral have no negotiation component, such that the parties involved might close a deal with one another.

Conclusion

Even though MBACentral offers a sophisticated and relatively comprehensive ontology for jobs combined with a high degree of personalization, nevertheless the stakes are so high for the individual in employment agreements that a high degree of trust would be required to support any electronic negotiation. A system to support this trust would be difficult to implement as the ontology and dimensions of personalization in employment are highly dependent on specific contextual factors as well as hard-to-articulate, subjective criteria. MBACentral thus has no negotiation. This fact indicates that sophistication of ontologies, personalization and reputation and trust are not measurable on an absolute scale but only have relevance in relation to the complexity of the assets and parties to a given transaction.
2. *FireFly*
2. **FireFly**

FireFly Network is a system for users to obtain recommendations from people with preferences similar to their own with respect to products such as compact discs and movies and services such as restaurants. The system maintains user profiles that capture tastes by grouping people according to the movies, music or food that they like. For example, the same group of people might all like the movies, *Star Wars*, *Raiders of the Lost Ark*, and *Field of Dreams*. New movies that one or more members of this group enjoy might interest the other members of the group. The system captures these preferences on an ongoing basis through user interaction and direct rating of new products. The system then makes recommendations to users on specific products that they might like. The technology that supports this process of “spontaneous finding” is called “collaborative filtering.” Advertisers pay for banners in the FireFly site and users can also purchase goods such as compact discs directly through the system. It is worthwhile to note that FireFly has recently adopted a new business model that relies chiefly on sales of its collaborative filtering software.

<table>
<thead>
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<tbody>
<tr>
<td>FireFly</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

*Ontologies (score: 5)*

Firefly’s ontology for products is simple as these products, for example movies and music CDs, fall into broad categories, “action thriller” or “comedy” with which many people are familiar. More importantly, the system does not rely on a standard ontology in order to be effective. Rather, it relies on concrete preferences of users, not so much for categories of products as for the end products themselves. It is not important to the FireFly system whether or not I like “hard rock,” but it is important that I rate highly one or more specific CDs produced by the band, “Aerosmith.”

*Personalization (score: 5)*

The system captures information on the user’s personal preferences on an ongoing basis, maintaining and adapting a user profile that grows as the user rates more and more products.
across more and more domains. FireFly is relatively unique in that it can deliver personalized suggestions on products of which a user may totally unaware.

*Reputation & Trust (score: 4)*

FireFly ensures the quality and reliability of goods and parties in the system by means of collaborative filtering. The system relies on the assumption that if a group of like users all prefer a certain product, then it must be of sufficient quality that the other members of that group will like it too. The products are mostly mass market goods with major brands behind them, a fact which increases the trust of the user. FireFly makes strong statements on the website to its users regarding its high confidentiality standards with respect to user profile information. Finally, since FireFly has a well-established brand in its own right, the user has some assurance that the system works and that the company behind it lives up to the promises it makes.

*Brokering (score: 5)*

FireFly is a filtering technology and delivers a high degree of personalized brokering. FireFly is special in that it guides users not only to what they say they want but also to things that they do not even know exist. FireFly cuts through volumes of constantly growing information on available products and the users themselves to match specific product recommendations to individual users.

*Negotiation (score: 1)*

There is no negotiation in the FireFly system in the sense that products are offered at a certain price regardless of the preferences of users. One could imagine, however, that FireFly could capture pricing preferences just as it captures other preferences. This information could be useful in aggregate to the sellers who might respond to it with times sale prices or even flexible pricing models based on an individualized scheme such as the purchase frequencies of individual consumers.
Conclusion

Collaborative filtering technology obviates the problems of developing robust ontologies and sophisticated personalization. It also gets around establishing reputation and trust to a certain extent by using the “recommendations” of communities of users to make product selections. However, it scored low on negotiation because users are price takers with no means of truly negotiating anything. Rather, users are grouped and fed information in their groups. They can do with this information whatever they please but they cannot propose alternative prices or features to those the system provides.
3. *PC Financial Network*
3. **PC Financial Network (PCFN)**

PC Financial Network (PCFN) is one of the pioneers and currently a leading provider of online individual investment services in America. PCFN provides on-line discount brokerage services which allow customers to trade any time of day, seven days a week. Investors can buy and sell a variety of financial instruments such as stocks, options, mutual funds, US government securities, corporate and municipal bonds, and CDs. PCFN is in the same industry as the more well known Charles Schwab and E*Trade.

As of December 1996, PCFN’s primary distribution channels were the consumer on-line services, Prodigy and America Online, accounting for 48% and 43% of its trading volume, respectively. PCFN is certain to make headway on Internet as demonstrated by the fact that 7% of PCFN’s trades were being done on the Web less than 3 months after launching the service. The final 2% in trading volume comes from Reuters Money Network, a hybrid of stand-alone PC software and financial on-line service.

PC Financial Network (PCFN) is a division of Donaldson, Lufkin & Jenrette (NYSE: DLJ), an investment bank in New York. Ever since it started in 1988 on Prodigy, PCFN has been profitable. PCFN generated revenues of about $35 million in 1994, $50 million in 1995, and had expected to generate approximately $70 million in 1996. With an average of 125 employees in 1995, that translates into a revenue per employee figure of $400,000. At a growth rate of about 40% per year in accounts and executed trades, PCFN had projected to finish 1996 with about 280,000 accounts that will generate close to 5,000 trades per day.

The Internet has brought hyper-competition to the on-line brokerage industry causing commission rates to drop dramatically as the execution of trades and providing of basic news and stock quotes becomes a commodity business. The new challenge is to find services which investors find more valuable while at the same time keeping costs low. Software agents can provide help on both of these fronts.
Ontology (score: 5)

We scored PCFN very high on ontology because the underlying asset being traded, usually a stock, is a commodity and therefore not difficult to describe. If I say “IBM stock,” virtually everyone in the world of business knows exactly what I’m talking about. More complex financial instruments do exist, like options, but almost all on-line trades are for common stocks. A small amount of mutual fund are traded electronically through PCFN, but even in those cases, PCFN’s ontology is sufficient for the fairly low, although increasing, complexity of the funds which are usually described by the name of the fund company (Fidelity), the investment goal of the fund (Growth & Income).

Personalization (score: 3)

PCFN was middle-of-the-road in personalization because it does not capture the investment preferences of customers, but does produce customized information for investors. For example, PCFN provides automated “Alerts” to investors based on their specific account balances or holdings, and PCFN also provides news and quote information specific to the customer’s portfolio. PCFN does gather standard credit information on new customers, but as a discount broker, they do not gather information about investment goals and risk preferences. Discount brokers are starting to offer advice which requires them to gather such information, but for now PCFN can only learn these things retroactively by tracking the transaction history of its customers. There is great room for growth at PCFN in the area of personalization by using electronic agents. PCFN could be even more proactive about making information available

Reputation & Trust (score: 4)

A securities firm has many mechanisms for trust, agencies like the SEC and SIPC, as well as robust legal system as a means of recourse. This helps an investor believe in using the system even if it is just their first time. Reputation, which is built up over time, helps a user decide
which service to use or to continue using. Reputation is especially important in the brokerage industry because you hold much of your liquid assets with these companies. Once you have established relationships, even with the faceless discounters, you generally become a repeat customer (even though switching costs are very low). So, because of the inherent mechanisms for trust and the importance of reputation, PCFN scored high in this area.

*Brokering (score: 3)*

What?! A “brokerage” firm can’t even score a 5 in brokering? We wavered back and forth from saying that PCFN performed the brokerage function perfectly because it matched the buyers and sellers of securities almost instantly, to saying that PCFN was the worst broker because it did virtually nothing to help you figure out what product you needed. This is where we had to breakdown brokering back into the pieces of the general commerce framework from which the term was synthesized. We decided that the two major components of brokering were helping the consumer decide “what” to buy and then finding out “who” was selling it. PCFN scores a 5 on the “who” because once you already know what security you want to trade, PCFN will route it to the proper market and find a seller. But because it is a discount brokerage firm, PCFN scores a 1 on the “what” because it does not give any advice on what to buy like a full-service firm would (e.g. Merrill Lynch). So we averaged the 5 and 1 to get 3. Because PCFN is legally restricted from giving advice it tries to help out on the “what” question by providing some means for investors to help themselves to decide, gain/loss information on their existing portfolio and mock portfolios are two examples.
Negotiation (score: 4)

PCFN scored relatively high on negotiation for a few reasons. First, most people think of negotiating as haggling over a price for a good. If you believe what you learned in business school, you understand that the stock market is “efficient.” And in an efficient market, especially for a commodity, the negotiating process is easy because there is supposed to be perfect information about the product. For greater than 99% of electronic trades, no one is “negotiating” a better deal for you. But floor brokers still exist who will specially handle large orders (maybe 100,000 shares) by walking them out to the only specialist post in the world for an NYSE listed stock and “working” the order to get you best possible execution.

The second main reason for a higher score in negotiation is that the order may be customized by the user. An investor can specify the price at which they will not pay any more (“limit” order), the time frame they would like that order to stay in force (just for the “day”, or “good until canceled”), and how they would like to pay for the transaction (in their “cash” account or on “margin,” i.e. borrow half the money). Then the specialist on a listed exchange will follow these orders by keeping the trade on their “book” until the trade can be executed.

Conclusion

So, congruent with our proposition, PCFN scores higher on brokering and negotiation because it has a good ontology, made easier by a less complex product, some personalization, and good mechanisms for reputation & trust.
4. *OnSale*
4. OnSale

OnSale is a “live auction house” of B-rated consumer goods. Right now they primarily offer computer related equipment (computers, monitors, printers, etc.) as well as consumer electronics (stereo components, cameras, etc.). The user enters the site and finds the product they would like to bid on. The user is required to give their personal information and valid credit card before placing a bid. Having chosen a good the user will inspect the current “market” for the good and then place a bid. The “market” will show you the current lowest bid needed to get into the auction for that good. The minimum initial bid, fixed bid increment and closing time are established prior to the auction. There are usually multiple units of the good available for sale, sometimes as many 100, so it is not unusual to see a spread of 3 or 4 bid increments between the highest and lowest bidder. Auctions usually last a few days after which the goods are allocated based upon the final bids. In a Yankee auction, the highest bidders pay exactly what they had bid, whereas in a Dutch auction all winning bidders pay the lowest successful bid price.

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<tr>
<td>OnSale</td>
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*Ontology (score: 1)*

OnSale does a very poor job of helping you to find a good that you are interested in. Their structure is very shallow. It starts with a nice set of categories: Desktop PCs, Notebooks, Printers, etc., but then if you choose Desktop PCs for example, you are confronted with a long list of full PC descriptions like “NEC Ready 9625 w/166MHz, 32 MB RAM, 2.5 GB HDD, 8X NEC CD-ROM.” (See the Web page printouts.) It does not have the further structure that you would expect, like a choice of Manufacturer then Processor Speed, etc.
**Personalization (score: 1)**

OnSale is very weak in personalization because all of your preferences are brought to the deal in your head and none are captured electronically. It lets you enter your email address to get information on “hot deals” but they don’t ask what you want, they use it to push goods onto you.

**Reputation & Trust (score: 2)**

The only thing keeping OnSale off of the bottom in this dimension is the commitment that is required of the buyer before making a bid. Requiring your credit card number and other personal information up front adds to the sellers trust that a buyer will not make a bid and then not pay for the good. Also, having gathered information about the buyers will allow the system to restrict users who have previously broken the rules. But there is not much information or infrastructure which helps the buyer trust the seller or even the goods of the seller.

**Brokering (score: 2)**

OnSale scored low in brokering because it does not offer a broad array of goods and does not help you figure out which good to buy. Even if you go to the site looking for a particular computer, printer or scanner it is not likely to be there. The customers of this site are likely to be very flexible either on the timeframe in which they need to buy the good or flexible with the exact maker of the good you are looking for. This site was made for bargainhunters.

**Negotiating (score: 2)**

Although OnSale provides a rather unique forum for bidding on goods that people are used to paying a fixed price for, it is still not as flexible or efficient as it could be. This low score may reflect the flaws of an auction compared to a market more than anything else. An auction is not a very efficient process. First of all it can take days to get to a deal on a fairly simple good. Second, there is a lot of gaming going on in the system. If the interested buyers could form a coalition they would all try to keep the price artificially low. But then there are defectors who leap toward a more fair market price to make sure that they get the good, which may send others even higher, until some bidders suffer (especially in a Yankee auction) suffer the winners curse of overpaying. This type of gaming is minor compared to the
analysis that the sellers do. Sellers will bring out a certain size lot of goods one week, say 20 scanners, and then based on the results sell more of exactly the same scanners the next week. They have many more goods than they present at any one time. So you end up wasting time deciding when to get into the market. Will this item go for less next week because all of the eager beaver bidders will be out of the bidding war by then? Or should I get in now because I think the market is pretty thin and the price will remain low?

Conclusion

OnSale proves our proposition, but at the low end of the spectrum. Without a good ontology or methods of enforcing reputation & trust, the brokering and negotiation processes are much more cumbersome. But, it is most notable that this site, if they could improve their ontology and reputation & trust mechanisms, could most clearly be retrofitted with electronic software agents. As a buyer, instead of having to check the “market” on a regular basis, to see if you have been outbid, you could provide your software agent with preferences like a bidding strategy and maximum price, then let the agent update the bids for you. This site, although scoring the lowest overall of our sites, is one of the more unique applications of e-commerce.
5. *Nets Inc.*
5. Nets Inc.

Nets Inc. is a business-to-business Internet-based intermediary for the industrial parts market. The company created and maintains a database of industrial parts' suppliers. This information is available to buyers, who join the electronic community, on the Internet. Nets Inc. has created an electronic market that matches buyers with suppliers. The Web site also contains information pertaining to the industry standard ratings of all of its suppliers.

The technology is based on Web pages that retrieve and display information from databases in real-time. This gives the supplier the flexibility to add or remove parts in real-time. In addition, the buyers get accurate supplier information.

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*Ontology (score: 5)*

This site is valuable to both the buyer and supplier because of its ontologies. Nets Inc. is rated high for its ontologies. The site uses ontologies to describe the industrial parts. For each company, the user can drill down to retrieve information for a certain type of part. The user can drill farther to select a particular part and retrieve detailed information about that part. The data available for each part is consistent and the users’ terminology is the same across all type of parts.

*Personalization (score: 1)*

Nets Inc. gets a low rating on the personalization scale. The site does not allow buyers to tailor their search information with anything other than part information. As a result, a buyer searches the database purely on industrial part type. Any additional buyer preferences are manually filtered once the list of suppliers, who manufacture the part, are retrieved from the database.
Reputation & Trust (score: 4)

A key feature of this site is its Reputation & Trust component. The industrial parts' market has a rating system for suppliers. The rating system account for the quality of the order, on-time delivery, parts availability, and other characteristics important to the buyer. Nets Inc. makes this information available to the buyer on the Web site. This is a mechanism for qualifying and measuring the suppliers. It aids the buyer in evaluating potential suppliers.

Brokering (score: 5)

Brokering is a strong feature of Nets Inc. site. This Web site successfully matched buyers with suppliers. There are strong matches between the buyer and supplier because of the level of detail of the information in the database and the accuracy in the data. A result of a search, performed by the buyer, yields a list of suppliers. The buyer can look at each supplier’s database entry for detailed information about the part.

Negotiation (score: 1)

Nets Inc. does not execute any transactions for the buyer. There is no negotiating represented at this Web site. The site matches the buyer with suppliers. Any additional contact between the parties takes place off-line from the Web site.

Conclusion

Nets Inc. rates high scores for brokering, reputation & trust, and ontology. The site does not receive high scores for personalization. It is appropriate for this site to move to the upper right quadrant of the matrix in Figure 3. In the upper right quadrant, the site would exemplify the components for a complete deal. In its current state, the site matches the buyers and sellers well. It provides adequate information with its extensive ontology to filter the information and match the buyer with the sellers. However, this site falls short in its ability to execute the deal. Because the site scores poorly in its personalization component, there is no ability to customize the deal. The product information, through ontology, and the seller information, through reputation & trust, are available. Rounding out the site with additional buyer information will pull this site into the arena where electronic transactions can occur.
Unfortunately, at the time of this paper, Nets Inc. is in bankruptcy. Nets Inc. received its original funding from AT&T, but was unable to secure additional venture funding. The company has reduced its workforce from 200 to 20 people and is currently looking for alternative means of funding.
6. **Airfare**
6. Airfare

Airfare is an electronic ticket agent for the purchase of airline tickets. It enables the user to select the date and time of travel. Airfare presents the user with a list of airlines and flight times that fall within the user’s criteria. The user can retrieve additional flight information including aircraft type and available food service for that flight. The user can purchase the selected tickets directly from the electronic agent once the selection process is complete.

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Ontology (score: 4)

Airfare rates high on ontologies because of the level of detail required from the user to describe the product. There is a level of complexity in the product description that enables Airfare to return flights that successfully match the user’s requirements. The degree of complexity in the product description is detailed enough to add value for the user and reduce the number of required searches.

Personalization (score: 1)

Airfare rates very low on the personalization component. The only user information the system accepts is the flight date and time information. There is no additional user preference data retained such as preferred seating or special meal requirements.

Reputation & Trust (score: 3)

Airfare rates about average for Reputation & Trust. Airfare does not offer the user any information about the carrier, therefore the user cannot use this site to rate the different carriers. The user scores the available flights on price and the convenience of date and time. Airfare could offer information about the carrier’s safety record, on-time arrival and departure records, and quality of service. With this carrier information, Airfare may be able to differentiate its commodity product by introducing carrier information into the decision-making process.
Brokering (score: 5)

Airfare is rated high on brokering. Airfare enables the electronic purchase of a commodity product, an airline ticket. It processes the user’s needs and offers a list of flight options. Airfare performs adequately in matching user requirements with available flights and prices.

Negotiation (score: 1)

There is no negotiation performed by this site. Airfare offers a commodity product. It filters the available flights and matches the flights with the user’s requirements.

Conclusion

Airfare is selling a commodity product. Commodity products require brokering but they do not require negotiation. In this case, buying and selling an airline ticket, the price is set by the seller and the buyer’s agent needs to match the buyer with available product. Brokering has high added value to the buyer given that the filtering in the brokering process is accurate enough to present only viable options to the user.
7. United Computer Exchange (UCE)
7. United Computer Exchange (UCE)

The United Computer Exchange Corporation is a global clearinghouse for buyers and sellers of new and used microcomputer equipment. Their "UCE OnLine Exchange" is where sellers can list their equipment for sale broken down by category and features and where buyers can search and bid on products for sale. Unlike traditional classified ad systems, UCE is completely anonymous. All transactions go through UCE's office in Atlanta, Georgia. Forced anonymity allows UCE to make a commission on all exchanges since there is no obvious way to circumvent the system by contacting other parties directly.

However, UCE also adds value in a number of ways. First, they provide "The United Index of Used Microcomputer Price". This Index is a listing of the average sales prices nationwide of used microcomputer equipment. The Index reflects national activity in the primary and secondary markets. Other information such as introduction dates, current retail prices and various helpful statistics are listed as well.

Second, UCE provides an escrow service for exchanges made either through their OnLine exchange or elsewhere. For example, they will act as a "trust intermediary" to help facilitate consumer-to-consumer transactions.

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<tr>
<td>United Computer Exchange</td>
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Ontology (score: 4)

UCE provides a thorough ontology for the products they help transact. Products are broken into several categories:
- CPU (i.e., a computer)
- Monitor
- Printer
- Scanner
- Bundle (i.e., two or more of the above products combined)
Each of these categories are further broken down into features. For example, CPUs have the following attributes:

- Category (e.g., Mac/Clone, PC/Clone, Workstation)
- Type (e.g., Desktop, Notebook)
- Manufacturer (e.g., "Apple Computer")
- Model (e.g., "PowerBook Duo")
- Processor (e.g., PowerPC 603)
- RAM (e.g., 16 Megs)
- Hard Drive (e.g., 500 Megs)

This ontology makes it possible to easily pinpoint a product either automatically via a commerce agent or manually via a search form.

**Personalization (score: 1)**

UCE is not personalized. Although they provide an automated e-mail service to alert users of changes to their databases, these are not tailored to the user in any way.

**Reputation & Trust (score: 4)**

There is no automated reputation or trust facility in the OnLine Exchange. However, UCE acts as a "trust intermediary" by providing two services: a unit check/cleaning service and an escrow service. When a seller accepts a buyer's bid (by marking the bid as "accepted" on the web site), the buyer is anonymously notified. The seller then ships the unit to UCE and the buyer sends the bid amount to UCE.

When UCE receives the unit, it first sure that it was accurately described by the seller. For example, if the seller advertised a computer with 16 Megs of RAM, UCE makes sure that there are indeed 16 Megs of RAM in the unit. UCE then also cleans the unit and makes sure it's minimally functional as advertised. When UCE receives the money from the buyer for the unit, it puts it into an escrow account. Then, UCE ships the product to the buyer who has several days to check it over. The buyer may ship the unit back if he or she feels it is not as advertised (but not for any other reason). After the allotted escrow period is over, UCE sends the money to the seller which completes the full transaction.
Brokering (score: 3)

Brokering is manual; buyers must explicitly search the OnLine database. However, UCE provides a number of useful ways for buyers to find sellers (but not vice-versa). Searches can be made within several categories (e.g., CPU, monitors, printers, etc.) and further broken down by sub-categories (e.g., Mac, PC, desktop, notebook, etc.) and even within sub-category (e.g., manufacturer, model, processor, RAM, hard drive size, price, etc.) Here is an example search:

Show me all Mac Notebooks whose manufacturer's name contains the word "Apple", whose model name begins with "PowerBook", whose processor is the PowerPC 603, that has at least 12 Megs of RAM, and costs no more than $3,000.

Clicking on any item in the results list shows more information on the product along with a means to bid on the product. It should be noted that although UCE does not provide an automated way to match buyers and sellers, it is relatively straight-forward to build a third-party commerce agent that can navigate the site and find appropriate matches due to the semi-detailed ontology.

Negotiating (score: 2)

Negotiation is manual; sellers must set their price and bidders must bid using whatever information is at their disposal (e.g., the United Index, previous bids, etc.)

Negotiation follows a modified continuous double auction protocol. Bidders and sellers can bid (and modify their bids) at any time. The current selling "price" and all bids are easily viewed at any time. Bidding is haphazard since their are (generally) no time restrictions and do not need to be greater or less than any previous bid. The auction is over when the seller (also the auctioneer) marks one of the bids as "accepted" or chooses to take the product off of the market.

Due to the public and anonymous nature of the auction, collusion is possible (and likely). Collusion can take several forms. First, bidder rings could be formed which could drive down the price of the initial auction. The winner could then re-auction off the good in a secondary auction. Second, shills could be easily planted in the bidding group to drive up the price. For
example, if one or more bidders seem interested (and perhaps risk-averse), the seller could bid as if he or she wanted to purchase the item to drive up the prices of the other bidders. The buyer should therefore adapt his or her strategy to the possibility of shills. For example, the winning bid may ultimately be less than the highest bid since the highest bid may have come from the seller!

As with brokering, it is relatively straight-forward to build a third-party commerce agent that can navigate the site and negotiate in the on-line auctions.
8. *MIT Bazaar*
8. MIT Bazaar

MIT Bazaar was developed at the MIT Media Lab. It was coined “bazaar” not because it is freaky, but because it represents an open market for trading general goods. Although in its current incarnation those goods are limited to CDs, Books and Magic Cards (a truly bazaar item traded by MIT undergrads). A user can post a good for sale, or look to buy. There is a certain structure used to define the good, including a metric for the condition it is in. Then the system takes the preferences for buyers and sellers in terms of the most they are willing to pay and or the least they are willing to sell for, the timeframe in which they would like to buy or sell the good, their opening bid and ask prices, and one of three decay functions for how they would like their opening prices to move toward their reservation prices. Then the negotiating is handled entirely by the buyer’s and seller’s agents. After the deal is done, the two humans in the deal must arrange a time and place to get together to exchange the goods, MIT Bazaar does not store the goods as in the case of United Computer Exchange. Then both parties are able to comment and rate the other on whether they lied about the condition of the good, or did not pay, or did not even show up for the exchange.

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<td>MIT Bazaar</td>
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*Ontology (score: 4)*

Because MIT Bazaar is dealing with goods which are not complex, its ontology is sufficient for buyers and sellers to be able to describe the goods which they would like to post as well as find the goods they would like to buy. Although the ontology tries to capture the quality of the used good, this is very difficult because of its subjective nature. People have a much better understanding of “new” than they do the semantics used when describing used goods.

Beyond an ontology for the goods which are bought and sold, there must be an ontology for aspects of the brokering and negotiation. Because all of the agents in MIT Bazaar use the same standards for negotiating, they can communicate to get the deal done. This is the value of a centralized system such as Bazaar.
Personalization (score: 3)

The negotiation aspect of Bazaar captures many user preferences, but beyond that, the personalization is low.

Reputation & Trust (score: 3)

MIT Bazaar does include some mechanisms both for establishing trust and building reputations. As described above there exists a “better business bureau” scoring which allows parties in a deal to comment on the conduct of the other side. Just knowing that these scorings exist, provides a form of trust that people will follow up on their commitment, and also allows for the building of reputations. You can imagine the network externalities at work. The more times you use the system fairly, the better reputation you get and the more likely people are going to want to deal with you rather than a person who does not have a scoring or has a bad scoring, even if they offer a lower price. MIT Bazaar would be better in this area if they were able to store and guarantee the goods. For the purposes of their testing, this is not a feasible option.

Another reason Bazaar’s score is not higher in this area is that most people do not like to give full agency to anyone, let alone a software program, to commit to a price in a transaction which is enforceable. Faith in a software agent is not high.

Brokering (score: 4)

If you consider the geographic constraint placed on the Bazaar system, i.e. within the MIT campus effectively, then it seems that Bazaar is one of the most efficient ways available to broker used CDs, Books, and Magic Cards. The market for used books usually becomes efficient for only a small period of time during the beginning and end of the semesters, but what about at other times? And if you are looking to keep the middle man out of the system to save some money then MIT Bazaar is excellent alternative.

Negotiation (score: 4)

This is one of the most exciting areas for MIT Bazaar because the actual negotiation is handled entirely by electronic agents. As described above, agents on both sides change their
bid and ask prices over time depending on the rate at which their opening price decays to their reservation price.

Conclusion

This site is interesting because offers the most robust agent controlled commerce we have yet seen. MIT Bazaar represents a glimpse at the future. The have given software agents the responsibility to handle processes in general commerce where they had never been before. The agents involved display all traits of a software agent, i.e. being (1) proactive, (2) adaptive, and (3) personal.

You might be able to imagine a future in which there are “agent parks” in which all of the agents “speak the same language,” that is they share the same ontology and can therefore communicate. These agent parks may be accessible from all over the world and provide a global marketplace for similar type goods. Just like IBM stock trades at one place in the world, at the New York Stock Exchange where everyone shares the same protocols, there may some day exist only one site where you will get the best market price on a particular music CD.
V. IMPLICATIONS FOR THE FUTURE & CONCLUSION

In the sections of this paper above, we presented a proposition for electronic commerce, “the more robust the ontologies, personalization and reputation & trust provided by an agent-based system, the more efficient the brokering and negotiation processes,” that is, the easier it is to carry out electronic commerce. We also provided some substantiation from our research on electronic commerce websites in support of this proposition. Then we described the dimensions of a general analytical framework for evaluating the usefulness of agent-based systems in electronic commerce. These dimensions are: “Ontologies, Personalization, Reputation & Trust, Brokering, and Negotiation.” Finally we applied this framework to analyze eight electronic commerce websites. Next we conclude this paper by drawing out some implications for electronic commerce from our research.

There are implications that arise from the discussion above for pricing models, new business opportunities, and the design of agent-based systems for electronic commerce. First, as more and more agents maintain user profile information and relay that information, at least in aggregate, back to sellers, it seems likely that some sellers will generate their prices from direct, real-time analysis of user demand, finding new ways to auction products or to provide deals to preferred customers. Obviously this is nothing new in many product domains, however, it would be new for consumer products such as compact discs.

Second, there are implications for identifying and pursuing new business opportunities if the proposition above is true. One could imagine looking for opportunities to substitute electronic commerce for traditional ways of doing business in markets with inefficient transaction processes. These markets would need to have definable frames of reference (ontologies), definable preferences for each of the parties in any given transaction (personalization), and a well-defined mechanism for ensuring quality and reliability of the goods and parties in a transaction (reputation & trust). Our analysis does not cover all the pieces of a transaction, but it does include most of the value-creating steps that lead to the consummation of a deal.

Third, this research has some implications for designers of agent-based systems. At a minimum, the framework elaborated above can serve as a set of issues to consider. To the extent that ontologies, personalization, and reputation & trust are in fact the crucial challenges of using agents to facilitate electronic commerce, designers would want to define performance metrics in these categories and set target specifications in these metrics for the
systems they design. These metrics and the performance values that constitute success will vary from market to market, but if the elements of the framework are truly representative of the primary issues in using software agents in electronic commerce, then the agent designer or design team has a simple and useful new way to frame its design and development challenges.

The implications above are for new pricing models, new business opportunities, and design priorities for agent designers and developers. Our intention in the research for this paper was to strip away the hype surrounding agent technologies since people seem to rely on a variety of definitions when they discuss agent-based systems. The hype surrounding agent technologies seems a residual effect of past public debate on the promise of artificial intelligence. To get past this hype, we explored a central proposition that focused on the business value delivered by software agents as systems that facilitate transactions in electronic commerce. Our research served to substantiate the proposition that when they are well-designed and are applied to problems that are definable in certain crucial respects, software agents can add value in lowering transaction costs.