

# Understanding the Role of Software Agents in E-Commerce

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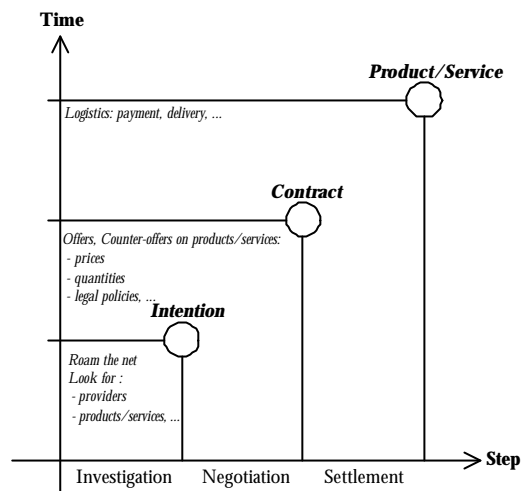
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## Overview

In one of their contributions [10], Froehlich et al. asked the following question: what makes e-commerce different from normal commerce? In fact, their question was motivated by the claim that since computers currently mediate almost all business transactions, all commerce is electronic. Froehlich et al. answered that e-commerce is not just the presence of computers or absence of papers, but it implies more than such using a non-proprietary open network; not requiring proprietary client software that is any browser should do; servicing 24 hours a day, 7 days a week; establishing the identities of parties without requiring physical contact; and possibility of bypassing brokers in case significant value-added services to users and providers are not introduced.

In our research work, we aim at understanding from the user perspective the value-added of Software Agents (SAs) to e-commerce systems (it is assumed that providers are already associated with SAs). We studied why, how, and when users could entrust a part of the e-commerce operations they undertake to SAs [1]. Usually, most of these operations are complex and though repetitive with a large segment suitable for computer aids and automation. In addition, users are already overwhelmed with information that needs to be filtered and sorted out before this information could be used efficiently and effectively. To assist users in their daily e-commerce operations, we suggest first, associating users with software agents and second, decomposing an e-commerce scenario into three phases: investigation, negotiation, and settlement. This is illustrated in Figure 1 where texts in *italic* summarize the operations that occur and their outcome. Currently, several implementations of agent-based e-commerce systems are available on the Internet (e.g., PersonalLogic: [www.personallogic.com](http://www.personallogic.com), Goto: [www.goto.com](http://www.goto.com)).



**Figure 1** Proposed chronology of operations in an e-commerce scenario

## Phases in an e-commerce scenario

In what follows, investigation, negotiation, and settlement phases are explained (see Figure 1).

The purpose of the investigation phase is to look for the providers that have the products/services that could satisfy needs of users. To this purpose, agents assist users; they roam networks of providers on behalf of users, identify the providers that could interest their users, and exchange messages with these providers about different matters (e.g., prices, return policies). Finally, the agents report their findings to their users. If users approve their agents' suggestions, agents are mandated to inform the potential providers about the users' intention to request their products/services. The investigation phase outcome is an intention to request products/services.

The purpose of the negotiation phase is to trigger an offer and counter-offer process, if needed. This process concerns the requested products/services and applies to their prices, payment conditions, return conditions, delivery, and last but not least legal policies. The outcome of the negotiation phase is a legally binding contract that documents the agreed upon obligations and commitments of both users and providers. Users should assist their users agent in negotiations. In fact, agents need to get their users' agreements before making decisions and committing their users.

The purpose of the settlement phase is to implement the clauses of the contract. Different operations are initiated, such as shipping and delivering products, notifying users, and paying for the received products/services. In the settlement phase, agents are tasked to monitor the progress of these operations according to the agreed upon schedule. In case of delays, users have to be notified and corrective actions may have to be taken. The outcome of the settlement phase is product/service delivery.

Table 1 illustrates when users/software agents combination is desired. We anticipate that the negotiation phase is the one in which users and agents should be “tied” together. Although a software agent should be autonomous, it has to inform the user about the progress of its negotiation for follow-up and quality control purposes. If a negotiation strategy is not followed appropriately, it could “harm” the user. Supporting electronic negotiation is one of the MEMO (MEdiating & MOnitoring electronic commerce) project’s recommendations to the expansion of e-commerce [2]. Negotiation could also be adaptive, which should be valuable for both users and providers [5]. Adaptability means selecting the appropriate negotiation strategy taking into account various dynamic parameters such as market trends, payment conditions, and products availability.

**Table 1 Desired combination of users and software agents**

Step	Combination	Outcome
Investigation	Agents	Intention
Negotiation	Users & Agents	Contract
Settlement	Agents	Product/Service

In an e-commerce scenario, agents are in charge of multiple operations that can be summarized as follows:

- ? Investigation phase:
  - o Build users’ profile based on their interests and needs;
  - o Map users’ needs into requests;
  - o Suggest modifications to users’ requests;
  - o Recommend products/services based on users’ requests and agents’ experiences;
  - o Be aware of the market trends for notification purposes;
  - o Recommend alternate products/services in case of the investigation phase fails;
  - o And, compare products/services.
- ? Negotiation phase:
  - o Keep track of changing negotiation conditions;
  - o Recommend negotiation strategies based on users’ requests;
  - o Suggest to users to relax/not-relax certain constraints in case of the negotiation phase fails.
  - o Switch from one provider to another during negotiations while retaining negotiation contexts;
  - o Compare negotiations’ results;
  - o And, recommend to users the decisions to make.
- ? Settlement phase:
  - o Pay for the agreed upon products/services;
  - o Enforce the clauses of the signed contracts;
  - o Ensure that the agreed upon products/services are delivered;
  - o Notify users in case of delays and assess the consequences of these delays;
  - o And, suggest corrective actions.

In the settlement phase, paying for the requested products/services is among the

operations that need to be carried out. Different types of payment model exist. A distinction exists between the services that are free to users and those that users have to pay for should be made. A “service” refers to anything users could purchase from providers whether a physical good or an electronic one. Free services to users are usually paid through the advertisement or sponsoring done by other companies. Getting the latest market update of the stock quotes is a sample of free services. Paid services are calculated according to their duration of use, number of use, or a combination of both.

## **Agents and types of e-commerce exchanges**

In [8], the authors did a survey on software-agent systems in the context of consumer buying behavior. Different systems were cited on the basis of the stages that could constitute a typical e-commerce scenario. These stages are needs identification, products brokering, merchants brokering, negotiation, purchase and delivery, and finally product service and evaluation. These stages are similar to the phases we presented in the beginning of this paper (see Figure 1). However, the authors did not discuss the role of agents in the exchanges that consumers could take part into. This is one of our objectives in this paper. Five types of exchange exist [3]: bartering, bargaining, bidding, auctioning, and clearing.

According to [3], customers (i.e., users), providers, and brokers can participate to different types of e-commerce exchange. Each type has its set of operations to be carried out. A well-known type of exchange is the bilateral; users and providers interact directly. Trilateral exchanges are possible and involve brokers that support both users and providers. Bartering, bargaining, and bidding are bilateral exchanges. Auctioning and clearing are trilateral exchanges. Below, we discuss in which type of exchange agents should be deemed appropriate for e-commerce. Bartering is not discussed.

**Bargaining:** involves one user that negotiates with a provider until an acceptable agreement for both is reached. First, the user looks for a provider, consults his products/services, and negotiates with him for an agreement. If negotiations fail, the user searches repeatedly for other providers till an agreement is reached with one of them. Agents would be suitable for looking for providers, negotiating on behalf of users, and saving the interactions their users have had in the past with providers for evaluation purposes.

**Bidding:** implies that one user and several providers participate. First, the user calls for bids. Next, the user compares the offers he received from providers. Finally, the user selects the best offer that is the lowest one. Agents would be suitable for looking for providers, initiating bids, accepting bids from providers, comparing bids, and notifying the winner provider.

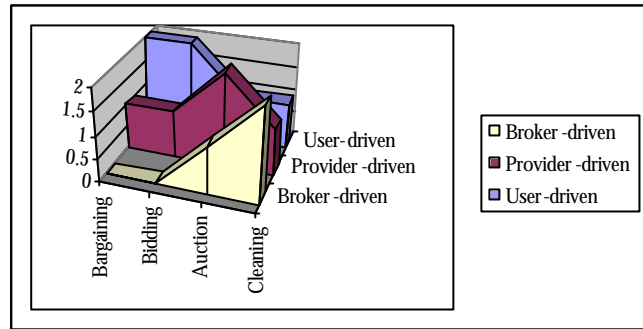
**Auctioning (English scenario):** involves one provider, several potential users, and a broker. Successively, users make an offer on the product/service to be provided. First, the provider fixes the lowest price of the product/service to be auctioned. Through the Broker, the provider advertises the product/service and calls for auctions. Afterwards, the

users submit offers to the Broker. Finally, the broker selects the user who has made the highest offer regarding the initial-provider's offer (other types of auctions exist such as Dutch and Vickrey). Agents would be suitable for finding the broker, monitoring users' offers, sending offers to the broker, and following-up the auctioning progress on behalf of users.

Clearing: requires that several users, several providers, and one broker take part. Users and providers submit their requests to the Broker in terms of needs and offers respectively. Next, the Broker matches needs to offers. If there is a success match, the Broker informs users and providers about this match. Agents would be suitable for finding the broker, sending offers to the broker, and monitoring the progress of users' requests.

Based on the operations that agents could fulfill in these four types of exchange, we proposed the following classification: bargaining and bidding are user-driven, auctioning is provider-driven, and clearing is broker-driven. By user-driven, we mean that users have the initiative to lead the entire e-commerce scenario. However, users have less "opportunity" to regulate the progress of the e-commerce scenario in provider/broker-driven exchanges. Thus, software agents would be more suitable for user-driven exchanges rather than for provider/broker-driven exchanges. In user-driven exchanges, user-agents would be actors. However, in provider/broker-driven situations user-agents would be spectators. The actor/spectator analogy is supported by the work of [7] with regard to active and passive role. The authors listed four situations in the marketplace, each specified differently: active-provider, passive-provider, active-consumer, and passive-consumer. Active-providers try to sell their products by initiating a selling process. Passive providers wait until an active consumer makes a request to purchase its products. Similarly, active-consumers make requests for products to buy and passive consumers wait for an active provider to propose products.

In order to understand how SAs fit in the user/provider/broker-driven classification, we suggested representing the involvement of agents (see Table 2, Figure 2). The following scale is used: 0 for not involved, 1 for weakly involved, and 2 for strongly involved. As stated above, user-agents are strongly involved in bargaining and bidding exchanges. However, they are weakly involved in auctioning and clearing exchanges. In these exchanges, the functionalities that user-agents used to carry out are now delegated to broker-agents.



**Figure 2** Representation of Agent involvement

**Table 2** Agent involvement in e-commerce exchanges

	User-driven	Provider-driven	Broker-driven
Bargaining	2	1	0
Bidding	2	1	0
Auctioning	1	2	1
Clearing	1	1	2

## Discussions

In this paper, we argued that combining users and software agents is another issue that should be dealt with. What would happen if agents were used to address the aforementioned issues? Will we overcome them or will we make them more complex? For instance, before trusting a provider a user should trust his agent [9]. Moreover, based on the characteristics of e-commerce exchanges such as bidding, agents should be able to use the appropriate strategy and adapt their behavior. Does adaptability improve efficiency? Efficiency, trust, fairness, and effectiveness are among the issues that need to be explored when designing an e-commerce environment [4].

- ? Fairness: does everyone have an equal opportunity to participate in negotiations? Do prices favor users over providers or *vice versa*? Can prices be manipulated?
- ? Efficiency: how much time and cost does it take to transact a single purchase?
- ? Trust: do players trust their collaborators or is some form of guarantee needed to enable stable collaborations?
- ? Effectiveness: given a specific market configuration what are the relevant strategies for interactions, negotiations, etc.?

Another issue that needs to be considered is what types of agent are relevant to populate an e-commerce environment. We assumed that it would be useful for users to be associated with user-agents. We also assumed that providers and brokers could be associated with their provider-agents and broker-agents. These three types of agents have mostly been identified. We could simply think that these agents would be adequate to set up an e-commerce environment. The method proposed in Bussmann et al. [6] states that

identifying appropriate agents for a system requires more than looking for the roles that could be played by agents. Relying on this statement, an e-commerce environment could probably require more than three types of agents. For instance, new types of agents could assist a user-agent in carrying out its responsibilities: one agent could be concerned with products' prices; one agent could be concerned with products' returning-policies, just to cite few. Bussmann et al.'s method comprises two steps: analysis and identification. The analysis step creates a decision-based model of tasks while the identification step assesses the suitability of an agent-based approach and identifies the relevant agents of the future system. In e-commerce, different types of decisions are made on products, types, prices, qualities, warranties, and returning policies, for example. Since multiple types of exchange characterize e-commerce scenarios (bargaining, bidding, auctioning, and cleaning), we focus in what follows on expanding the list of agents that could be needed in each type. We use bargaining and auctioning for illustration purposes.

1. Bargaining: requires user-agents and provider-agents as participants. Below, the decisions that each agent could make are listed.

? User-side:

- o Decision on the provider's relevancy.
- o Decision on products/services.
- o Decision on the outcome of negotiations (success, failure)

According to these decisions, two agents could support the user-agent: one will look for providers and their products/services and one will take care of negotiations.

? Provider-side:

- o Decision on accepting to deal with a user.
- o Decision on the outcome of negotiations (success, failure)

According to these decisions, two agents could support the provider-agent: one will accept dealing with users and one will take care of negotiations.

2. Auctioning: requires several user-agents, one provider-agent, and one broker-agent as participants. Below, the decisions that each agent could make are listed.

? User-side:

- o Decision on the broker's relevancy.
- o Decision on auctioning or not.

According to these decisions, two agents could support the user-agent: one will look for the broker and one will take care of monitoring the auctioning.

? Provider-side:

- o Decision on setting up the lowest price.

According to this decision, no additional agents are required to support the provider-agent.

? Broker-side:

- o Decision on the provider's relevancy to users and *vice versa*.
- o Decision on pursuing/stopping the auctioning based on the highest offer vs. the initial offer.

According to these decisions, two agents could support the broker-agent: one will match users with providers and one will manage the auctioning.

## **Conclusion**

Associating users with software agents aims at shifting the role of users from carrying out operations by themselves to supervising and coordinating agents that will perform these operations on their behalf. Understanding the role of software agents in e-commerce is an important step towards the current trend of agent-oriented e-commerce development that sees a wider deployment of agents in the following cases [9]:

- ? SAs will help customers to identify and locate the products or services that they require.
- ? SAs will help to keep track and inform customers of new offers that match their preferences.
- ? SAs will help customers to negotiate electronically with the seller SAs in order to buy and sell goods or services that is in the best interests of both parties.
- ? SAs, with the approval of customers, will handle the payment of the purchased goods or services on their behalf.



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