



**Chapter X**

# **Agent Technologies and Business Models for Electronic Commerce<sup>1</sup>**

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*Agent technologies have proved to provide adequate solutions to some of the challenges posed by the new business models that are arising in the field of electronic commerce. In this chapter, we present some of the key challenges in turning agents' research into commercial applications, provide an overview of the electronic commerce business models, and discuss how they can benefit from the new developments in agent technologies. We illustrate the discussion with examples of the work that is being developed by projects from the IST research program of the European Union.*

## **INTRODUCTION**

In line with the rapid expansion of electronic commerce in the recent years, there has been a parallel evolution in the associated business models in order to address the new market needs and opportunities. Initial models, like e-shop and e-procurement, showed relatively little innovation when compared to traditional ways of doing business: in many cases they consist of a Web site displaying electronic product catalogues, marketing material or procurement specifications. More innovative models, like third-party marketplaces or value chain integration, bring together multiple suppliers or multiple steps of the value chain, and add value by their potential to provide broader services while minimizing costs and by their potential to exploit the information flows. Current trends in business models focus on dynamic markets/networks, where consumers and businesses can seamlessly and dynamically come together, even for short-term relationships, in response to or in anticipation of new market opportunities.

These new business models require the development of a wide range of supporting technologies to allow the efficient implementation of the required processes and services. These technologies range from customer relationship management and marketing support to collaborative working tools and negotiation schemes, from security issues to automatic contractual arrangements and conflict mediation. In this context, agent technologies have contributed with appropriate solutions to some of these technological challenges (Maes et al., 1999).

Electronic commerce has proved to be a domain where the full potential of intelligent agents can be demonstrated. It requires managing enormous amounts of information, which in many cases is heterogeneous, not structured, and distributed in space, and needs to be dealt with in a personalized way with decision making that may need to be validated in a negotiation process. This combination of complex information from multiple sources that requires a personalized treatment and negotiation between different actors, calls for automatic solutions that show a certain degree of autonomy, intelligence, and ability to adapt/react to the particular environment/circumstances. Agent technologies fit these requirements since they provide an architecture for the implementation of autonomous, intelligent, and reactive behaviors. Furthermore, it is an enabling technology that is not restricted to specific reasoning or knowledge representation paradigms, and hence, it can be applied to the solution of many different problems from different perspectives and approaches (Maes, 1994; Bailey & Bakos, 1997; Ephrati & Rosenschein, 1994; Moukas, 1997).

The first agent systems that were developed for electronic commerce can be typified as *individual agents*: they have specific objectives and act on behalf of the user without interacting with other agents. This lack of interaction with other agents significantly simplifies the development of individual agents. Each agent can be programmed in an ad hoc fashion without concerns about protocols, semantics, or standards. Individual agents are already emerging in the market being incorporated into products and services. Examples include information agents, such as share price tracking or personalized newspapers, that retrieve, analyze, and integrate information available from multiple distributed sources. Examples of individual agents implemented for e-shops include user profiling and personalized marketing.

The next level in terms of complexity is *collaborative agents*: communities of agents that cooperate to achieve a goal, and that have been implemented following a detailed design and with a global view of the problem. The key point here is that, even if many agents have to interact, there is a certain control of the system and there exists previous agreement on the tasks to be performed by each agent and on the proprietary protocols and semantics for the exchange of information. Examples include agents cooperating to resolve network faults, decentralized management of limited common resources, and applications for static electronic marketplaces or value chain integration such as 'traditional' supply chain management. For the integration of collaborative agent systems into commercial applications it is still required to significantly improve in the area of agent engineering. These include rigorous methodologies for requirement analysis and system specifications, as well as tools for the verification, validation, and testing of the system functionality. In the case of large-scale collaborative agent systems, a better understanding is also needed of how individual agent's behaviors combine dynamically to generate the system behavior, since it will be different from a 'sum' of the individual behaviors in static environments. Issues such as social dynamics, self-organization, self-regulation, and adaptive behaviors become critical to avoid undesirable effects.

The most complex model is the *society of agents*: agents developed by different users or providers, implementing different objectives and strategies, and that have to inter-operate in a complex and dynamic environment. Global standards are the key issue to make possible these open agent platforms, including protocols for communication and common semantics for information exchange. Furthermore, legal and security issues, e.g. liability of contracts made by autonomous software and protection from malicious agents, need also to be addressed.

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