Relevance of Software Agents in Enterprises

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Abstract

The emergence of agent technology and its increased use in business applications arises the question, how organisations are changing due to the existence of intelligent agents. Those agents may affect the definition, the structure and the social interactions of the individual human organisation members. In this paper, some important research issues from different perspectives are identified, concerning the prerequisites to a successful integration of software agents into enterprises.

1 Introduction

Intelligent agents are intentional software systems, showing (bounded) rationality. Together with their ability of autonomy, they exhibit a limited form of social capabilities, enabling them to notice other agents, to interact with their environment, and to form groups, coalitions and even ‘artificial’ organizations [Kirn 1998].

These properties distinguish intelligent agents from other software systems, enabling them to take part in complex systems of social interactions such as enterprises. In such cases, agents may adapt themselves to formal roles, and they may perform activities in order to contribute to the aims and goals of the embedding company. This infers, that classifying intelligent agents as ‘intelligent
machines’ leads to an insufficient representation of their particular social capabilities and specific problem solving strategies. Instead, we believe that agents have to be viewed as ‘artificial members’ of enterprises.

This leads to the necessity of coordinated research in the disciplines of organizational theory and organizational sociology, Distributed Artificial Intelligence and Human Computer Cooperative Work. This paper can just give some hints of the direction of a fruitful coordination of these areas.

To this purpose, first the assumed and the achieved application of intelligent agents are shown, thus leading to an identification of the already strong points of current agent technology. (section 2). Then, the potential of agent technology is viewed from different perspectives (section 3). We will start with some individual viewpoints from a potential user of agent technology and his individual needs and wishes (section 3.1). Then we shortly introduce the perspective of organizational sociology and some emerging research questions (section 3.2). The section is finished with the perspective of organizational theory and the perspective of the enterprise (section 3.3). Section 4 concludes the paper, section 5 contains the list references.

2 Empirical Relevance of Intelligent Agents

2.1 What has been predicted in the past?

The first approach (as far as we know) to forecast the market for intelligent agents has been undertaken by OVUM Ltd in 1993/94. The OVUM Report „Intelligent Agents: The New Revolution in Software“ [Guilfoyle & Warner 1994] tried to forecast the growth of the Intelligent Agent market. Revenue based on agent-related technology has been prognosticated to over $2 billion in the US, and over $1.5 Billion in Europe until the year 2000. As much as object-oriented systems and GUI agents should have the potential of revolutionising the computer market.

The following table shows the predicted importance of agents within each application related market, in terms of percentages for agent related revenues:
### Table 1: agent-related revenues in application

<table>
<thead>
<tr>
<th>Description</th>
<th>1994</th>
<th>2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-Mail/Groupware</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IA for Messaging</td>
<td>1.0</td>
<td>10.0</td>
</tr>
<tr>
<td>PDAs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IA for User Interface, e.g. handwriting Interface</td>
<td>4.0</td>
<td>16.0</td>
</tr>
<tr>
<td>User Interfaces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IA for easy to use interfaces, e.g. handwriting and natural-language Interfaces</td>
<td>0.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Business Desktop Packages</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work improvement with IA, e.g. MS Agent</td>
<td>0.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Workflow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>allocation of intelligent functions for Workflows</td>
<td>0.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Network management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network administration</td>
<td>0.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Information retrieval</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IA will travel in heterogeneous networks and finding required information</td>
<td>0.1</td>
<td>3.0</td>
</tr>
<tr>
<td>Development tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environments and tools for building IA</td>
<td>10.0</td>
<td>20.0</td>
</tr>
</tbody>
</table>

### 2.2 What has come true?

The applications of Intelligent Agents don’t seem to follow the expected and by OVUM predicted way. This caused OVUM\(^1\) to correct the expectation for agent-related application revenue to $1 Billion by 2000. Particularly Intelligent Agents in User interfaces, PDAs, and Workflows don’t have the expected significance. A lot of projects emerged, but most of them are prototypes or theoretical approaches (e.g. Info Agent\(^2\) from CILEA, AgentX\(^3\) from Intelliflo, and ICAgent\(^4\), an add-on product for InConcert\(^5\)).

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1. [http://www.ovum.com/innovate/ia2/ia2wp](http://www.ovum.com/innovate/ia2/ia2wp)
2. [http://www.cilea.it/GARR-NIR/nir-it-95/atti/giannini/giannini/giannini-nir-95.html](http://www.cilea.it/GARR-NIR/nir-it-95/atti/giannini/giannini/giannini-nir-95.html)
The market for business desktop packages shows a different behaviour. For application improvement more and more agents are implemented, helping the user at the work, e.g. MS Agent, or the PERSONA project from Microsoft Research. Lotus, too, uses Agents in Lotus Notes to automate and facilitate repetitive tasks. These agents are called Secret Agents. Another desktop agent comes from C&L Butlers Software and is called DeskTop Agent.

Through the dynamic Development of LANs and WANs, intelligent agents are becoming more important for network management. Recent examples are the announcement of 3Com to use Intelligent Agents (Smart Agents) for improved Network management in Hubs and Stacks. Lotus uses Lotus NotesView SNMP (LSNMP) agents since Lotus Notes Version 4. These agents provide intelligent functions for a better network management within the applications.

According to fast growth of Internet and based on the dissemination of JAVA most Intelligent Agents have been designed for Information retrieval and filtering. According to user beliefs and intentions, the agent’s goal consist of filtering and retrieving important informations. Paradigmatic is an application from the Department of Computer and System Sciences, Stockholm University, named Pefna. Goal of the project is intelligent filtering of Computer-Mediated Human Communication. A fully operational prototype of a filtering news reader (Pefna) has been built. Lotus Notes integrates since version 4 an agent named Notes Agent, providing E-Mail Management.

Other well-known examples for these agents are Firefly from Firefly Network, Inc., Jasper from British Telecom, Jango from Netbot, WebWatcher and WebMate, both developed within the RETSINA project, and Bargainwood.

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8 http://www.desktop-agent.pair.com/
9 http://www.3com.com/nsc/500602.html
10 http://www.lotus.com/products/systems.nsf/9aad044c4742e438525630f004e7abf/0000216
e
11 http://www.dsv.su.se/~fk/if_Doc/IntFilter.html
12 http://www.lotus.com/core/content.nsf/93bdd2a5934b2be28525631000760d02/00002552
13 http://www.firefly.net/
15 http://www.jango.com
16 http://www.cs.cmu.edu/~softagents/retsina/
17 http://www.ece.curtin.edu.au/~saounb/bargainbot/
from Bookworms. According to the user data all agents search for special information in the Internet.

In the area of design tools a great number of applications and APIs have been designed. First of all, the programming language JAVA \(^{18}\) pushes the design of intelligent agents. IBM has developed an API for programming agents named JAVA Aglets\(^{19}\). Especially for the development of mobile agents, there exists the JAVA-based Moderator Templates (JMT) Package from IBM. Many agents in the Internet are based on JAVA-Applets\(^{20}\) and the JAVA-RMI (Remote Method Invocation)\(^{21}\) API. Other JAVA-based development environments are Voyager\(^{22}\) from Objectspace, Odyssee\(^{23}\) from General Magic, Concordia\(^{24}\) from the Mitsubishi Electric Information Technology Centre America and LiveAgent Pro\(^{25}\) from Agent Soft. Most of these systems have been developed in the last months, so most of them are in a prototypical state.

There exist fully developed and tested testbeds. They have been educed at the beginning of DAI research. Examples for those testbeds [O’Hare & Jennings 1996] are ARCHON (architecture for cooperative heterogeneous on-line systems) from ATLAS Elektronik Bremen, DVMT (Distributed Vehicle Monitoring Testbed) developed at the University of Massachusetts, MACE (Multiagent Computing Environment) developed at the University of Southern California, IMAGINE (integrated multiagent interactive environment) an ESPRIT II project, TAEMS (Task Analysis, Environment Modeling, and Simulation) developed at the MAS Laboratory in the University of Massachusetts, and CooperA, a part of the research project Chemical Emergencies Management (ChEM) of the Commission of the European Community.

\(^{18}\) http://java.sun.com/
\(^{22}\) http://www.objectspace.com/voyager/
\(^{23}\) http://www.generalmagic.com/technology/odyssey.html
\(^{24}\) http://www.meitca.com/HSL/Projects/Concordia/
\(^{25}\) http://www.agentsoft.com/liveagentpro.html
3 How do Agents Change the Enterprise: Some Research Perspectives

3.1 The customer perspective

Currently, most enterprises are involved in a dramatic change process, leading to an improved customer orientation. These changes are motivated by an increased application of information and communication systems. This results in a better connection between the organizations and their customers. For private customers, it leads to individualized, demand-oriented services, and finally to selfservice. For example, [Kortzfleisch & Winand 1997] describe the change in the process of insuring by introducing a tele-insuring concept. The customer interface virtually shifts from the insurance company to the customer, thus the customers are able to act time-independently, location-independently, actively demand many solutions, and actively starting and realizing business processes. This leads to changed (multimedia) business processes, replacing the old, manual tasks with new electronic tasks. The customers are participating in these changed processes by cooperatively taking over the role of business partners for the enterprise. From the customer perspective, new applications are necessary, leading to his increased satisfaction. Those applications consist of electronic trouble and complaint boxes, form-based damage notifications, interactive product change, online help, interactive contracting and others. By viewing these new applications, one can state that the complexity of those customer-driven processes is often reduced in comparison to the traditional, enterprise-oriented processes.

Here is an integration possibility for intelligent agents into the organization of the insurance company. Those agents are often able to solve the less complicate customer problems without great interference with the human organization members. For the customer, this has the advantage of decreased costs for the services he wants to get.

By extrapolation of these tendencies, one may think of „electronic counterworlds“ [Müller 1998] filled by a variety of different intelligent agents, serving the humans and doing the simple work for them. Surely, this scenario is ethically more critical, because the humans know that agents are doing their jobs, opposed to the first example of the agents working for an enterprise and just communicating by simple, form-based mails with the users (thus normally the users are not able to identify whether the service is delivered by agents or by a human). A very important question arising is to which degree humans would accept being served by intelligent agents?
3.2 The organizational sociology perspective

According to [Giddens 1995, p.307], an organization is an association of many people with an impersonal management, which has been founded to assert specific goals. It is an important characteristic of organizations, that they are mostly planned. Organizations are necessary to coordinate activities and resources, which are important to satisfy the needs of the people living today. To achieve their goals, organizations tend to be bureaucratic. According to the most influential theses of Max Weber, the expansion of bureaucracy is unavoidable in modern societies, caused by the administrative necessities of great social systems. In such a bureaucratic concept, there is a great possibility of introducing intelligent agents as members of the organization, because the main role of most humans in such an organization is fulfilling simple tasks, which possibly could be done as well by intelligent agents.

To enhance Weber’s work, [Giddens 1995, p.310-311] is referring to different empirical studies, showing that formal relationships (which are mostly regarded in Weber’s work) are not the only relevant ones. On the contrary, a study of [Blau 1963] shows that in an office the officials are using informal ways to get their problems solved by discussing them with their colleagues. This arises the question whether people could accept intelligent agents as being colleagues.

Reed presents a different and more structured view of the domain of organizational sociology. He also starts with reflecting the historical facts leading to organizations [Reed 1992, pp.1-35]. But then he proceeds to identify the thematic continuities in organizational sociology. These continuities consist of rationality, alienation, anomie, and power [Reed 1992, pp.36-71].

Rationality is the underlying concept of bureaucratic organizations, leading to a mechanical view of an organization as a machine-like body. A consequence of this rationality is alienation, as an off-spring of the comprehensive regulations which are not able to provide spiritual or ethical foundations for social actions. A possible contrary problem is anomia, limiting moral regulations and social control, caused by uncontrolled competition, intense class conflicts and degrading work. A result of every organization is power. This is caused by the organizational structure of domination and control, leading to translating intentions of some actors into practical outcomes.

According to these social phenomena, there are a couple of interesting research questions:

Is it possible for an agent to alienate to the work it has to do? Is it desirable to build agents with those capabilities? What degree of power should an intelligent agent possess? Is it possible to give to an agent a more powerful position than to some humans in this enterprise? What would be the consequences for the humans and for the agent?

Those are only some of the very important questions in this area.
3.3 The organizational design perspective

From the perspective of organizational theory, in particular of the theory of organizational design the most important question is: Do, and if yes, how do agents affect the solution space of organizational design?

This question can be divided into (at least) four subquestions:

1. How do agents affect the internal situation of the organization to be (re-)designed?
2. How do agents affect the environment of the organization to be (re-)designed?
3. How do agents affect the workplace, the information space, and the tools of those people (employees, internal/external consultants) who are designing, and re-designing organizations?
4. How do agents affect the quality of different (re-)design options?

Up to now, there is only (very) sparse knowledge available on these topics. The answer to any of these questions thus first requires to collect empirical data, and to relate these data to the respective bodies of organizational theory. However, as far as we know, the main interest of contemporary organizational research is on post-modern organization theories, and not on the inter-relationships between the design of organizations, and the design of more and more information systems.

4 Conclusion

This paper has introduced into how agents can be incorporated, and be related to the organizational system of enterprises. Due to limited space, but also due to the very early stage of this research, we did intend to provide research issues and questions, not solutions. We are, however, convinced, that these and related issues provide an interesting, and worthwhile field of long-term research.

5 References


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