Chapter 3
Brahms

An Agent-Oriented Language for Work Practice Simulation and Multi-Agent Systems Development

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Abstract Brahms is a multi-agent modeling language for simulating human work practice that emerges from work processes in organizations. The same Brahms language can be used to implement and execute distributed multi-agent systems, based on models of work practice that were first simulated. Brahms demonstrates how a multi-agent belief-desire-intention language, symbolic cognitive modeling, traditional business process modeling, activity- and situated cognition theories are brought together in a coherent approach for analysis and design of organizations and human-centered systems.

3.1 Motivation

Brahms was developed as a multiagent modeling and simulation language to visualize the social systems of work for business redesign projects [25]. In the early years (1992-1999), Brahms was purely a modeling and simulation language and tool designed to model people’s work practice, i.e. the cultural, circumstantial, interactional influences on how work actually gets done, as opposed to an abstract
top-down functional description of an organization’s work process. In more recent years (2000-2003) we developed the Brahms language also as an agent-oriented language (AOL) for developing multi-agent systems (MAS). Besides running the Brahms virtual machine (BVM) as a simulation engine, by turning off the simulation clock, the BVM can execute its agents in real-time enabling the execution of a MAS. To couple human activity with external systems, there is an extensive Java application interface (JAPI) allowing the developer to integrate Brahms agents with external software applications, real-time devices, networks, etc, and develop agents completely in Java.

The Brahms language was originally conceived of as a language for modeling contextual behavior of groups of people, called work practice.

**Work Practice**: The collective performance of contextually situated activities of a group of people who coordinate, cooperate and collaborate while performing these activities synchronously or asynchronously, making use of knowledge previously gained through experiences in performing similar activities.

This created two very important ideas for the language; First, to model a group of people it is very natural to model them as software agents. Second, modeling situated behavior of a group imposes a constraint on the level of detail that is useful in modeling the dependent and independent behavior of the individuals. The right level is a representational level that falls between functional process models and individual cognitive models [6]. If we are interested in modeling a day-in-the-life of say ten or more people, modeling the individual behavior at the level of cognitive task models will be very time consuming, because these models are generally at the millisecond decision-making level. To overcome this kind of detail, the Brahms language uses a more abstract level of behavioral modeling that is derived from Activity Theory [27, 14] and Situated Action [26]. An individual’s behavior is represented in terms of activities that take an amount of discrete time and can be decomposed into more detailed subactivities if necessary. Brahms demonstrates how a multiagent belief-desire-intention (BDI) language, symbolic cognitive modeling, traditional business process modeling, activity- and situated cognition theories are brought together in a coherent approach for analysis and design of organizations and human-centered systems. The Brahms environment consists of different tools to develop, simulate or execute Brahms models and display agent and object interactions. Brahms is freely available for research purposes at the Brahms project website[^2].

[^1]: We refer to Brahms programmers as modelers and Brahms programming as modeling, because we feel that Brahms is a fifth-generation multiagent model description language, rather than a third- or fourth-generation programming language.

[^2]: [http://www.agentisolutions.com](http://www.agentisolutions.com)