Chapter IX

The INGENIAS Methodology and Tools

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Abstract

INGENIAS provides a notation for modeling multi-agent systems (MAS) and a well-defined collection of activities to guide the development process of an MAS in the tasks of analysis, design, verification, and code generation, supported by an integrated set of tools—the INGENIAS Development Kit (IDK). These tools, as well as the INGENIAS notation, are based on five meta-models that define the different views and concepts from which a multi-agent system can be described. Using meta-models has the advantage of flexibility for evolving the methodology and adopting changes to the notation. In fact, one of the purposes in the conception of this methodology is to integrate progressive advances in agent technology, towards a standard for agent-based systems modeling that could facilitate the adoption of the agent approach by the software industry. The chapter presents a summary of the INGENIAS notation, development process, and support tools. The use of INGENIAS is demonstrated in an e-business case study. This case study includes concerns about the development process, modeling with agent concepts, and implementation with automated code generation facilities.

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Introduction

As can be seen in this book, there are several methodologies proposed to support a systematic way of developing an MAS. Each one of them starts by assuming its own model of agents and proposing a convenient method of realizing the MAS. This diversity, in principle, benefits agent research by providing different points of view and, therefore, promoting experimentation with agent concepts. On the other hand, this diversity may be a constraint to facilitate the adoption of agent technology by the software industry and to integrate advances in the field.

New methodologies try to deal with this multiplicity of solutions by meta-modeling techniques applied to the development process and to the specification method. The goal is to finish with a set of agreed-upon concepts and MAS-building methods as a common framework to focus agent research. However, achieving this goal will take time and experimentation. Therefore, today, we are working with notations in contact evolution, support tools to cope with these changes, and development methods that have to be applied and verified in a short time.

INGENIAS assumes the need of evolving in order to adopt or change concepts as agent technology progresses and to incorporate this ongoing research into a stable body of knowledge. This approach is based on:

- **Open source CASE tools.** These tools are available freely to the community, so that the development method can be validated and replicated, which is the nature of software engineering.

- **A notation that can be extended and refined.** Meta-modeling primitives allow us to generalize or specialize concepts, aggregate new ones, or refine existing ones. There has been a significant effort to integrate results of agent research into a coherent recipe of how to define an MAS. Consequently, this is not just a personal view of MAS-building but an integrative approach.

- **There is a detailed and experimented development process.** A development process is usually misunderstood in this area as a guideline. In INGENIAS, a developer will find concrete activities to be executed, an account of the results to be obtained, support tools to produce these results, and a lifecycle to organize all of them.

- **Implementation concerns.** The methodology dedicates an important effort to consider how to translate specifications into code automatically. INGENIAS proposes to include the development of a customized code generation procedure as one of the development tasks.