Chapter VII

Engineering Adaptive Multi-Agent Systems: The ADELFE Methodology

Carole Bernon
IRIT – University Paul Sabatier, France

Valérie Camps
IRIT – University Paul Sabatier, France

Marie-Pierre Gleizes
IRIT – University Paul Sabatier, France

Gauthier Picard
IRIT – University Paul Sabatier, France

Abstract

This chapter introduces the ADELFE methodology, an agent-oriented methodology dedicated to the design of systems that are complex, open, and not well-specified. The need for its development is justified by the theoretical background given in the first section, which also gives an overview of the concepts on which multi-agent systems developed with ADELFE are based. A methodology is composed of a process, a notation, and tools. Tools are presented in the second section and the process in the third one, using an information system case study to better visualize how to apply this process.
The last part of the chapter assesses strengths and limitations of ADELFE. We note that its main strength is also its main limitation—it is a specialized methodology, especially suited to the development of software with emergent functionalities.

### Introduction

Usually, classical design of computational systems requires some important initial knowledge in the sense that the exact purposes of the system and every interaction to which it may be confronted in the future have to be known. However, at the same time, today’s problems are becoming more and more complex (e.g., information searching on the Internet, mobile robots moving in the real world). Indeed, systems that are able to deal with such problems are also becoming open and complex; they are immersed in a dynamical environment; they are often incompletely specified and, especially, an a priori known algorithm does not exist to find a solution. Classical approaches then become inadequate and a new way to tackle such problems is necessary.

Our research work, for several years now, has essentially focused on these kinds of systems and has led us to propose *Adaptive Multi-Agent Systems* (AMAS) as an answer (Camps, Gleizes, & Glize, 1998; Capera, Georgé, Gleizes & Glize, 2003; Gleizes, Georgé & Glize, 2000; Piquemal-Baluard, Camps, Gleizes, & Glize, 1996). These systems are composed of agents that permanently try to maintain cooperative interactions with others. We have built, with success, several systems based on the use of adaptive agents in different areas. To ease and promote this kind of programming, we then developed the ADELFE methodology, the aim of which is to help and guide designers when developing AMAS.

The remainder of this section briefly presents the foundation of adaptive multi-agent systems and then explains how to implement adaptation in such systems. After that, the main characteristics of ADELFE, as well as the context of its presentation, are given.

### Theoretical Background: Adaptive Multi-Agent Systems

In a general way, when conceiving a system, a designer wants it to realize the right function; the system must be “functionally adequate.” But openness and dynamics are sources of unexpected events and an open system plunged into a dynamic environment has to be able to adapt to these changes, to self-organize.