Chapter II
Modelling Dimensions for Agent Organizations

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ABSTRACT

In this chapter, we discuss the concepts of agent organization, organizational model, and review some existing organizational models. Before the review, we discuss how to classify the diverse aspects of agent organizations currently captured by organizational models. These aspects are named “modelling dimensions”. We show that there are at least four basic dimensions: the structural dimension mainly composed of roles and groups, the interactive dimension characterized by dialogical interaction structures, the functional dimension formed by goal/task decomposition, and the normative dimension in which we find the concepts of norms, rights, rules, and so forth. Apart from the basic dimensions, we also identify four other complementary dimensions: environment, evaluation, evolution, and ontology. These are related to the aspects of situatedness, measurement, adaptation, and domain specific semantics of agent organizations. Finally, we compare the organizational models reviewed and describe how the idea of modelling dimension can help in finding correspondences between organizational models.
INTRODUCTION

In the last few years, a broad agreement in the area of Multi-Agent Systems (MASs) has been to consider the human organizations as a suitable metaphor to effectively assemble computational systems from a dynamic collection of heterogeneous autonomous agents (Ferber, Gutknecht & Michel, 2004; Zambonelli, Jennings & Wooldridge, 2003; Gasser, 2001). In such computational systems – often called “open MASs” –, the defining characteristics are both a variable number of autonomous agents at runtime (i.e., agents can enter and leave the system when it is in production), and the presence of agents with different interests and/or designs (i.e., agents representing different stakeholders, conceived by several designers, and/or built using different agent architectures). To cope with these characteristics, the organizational perspective proposes that the joint activity inside the MAS be explicitly regulated (moulded, constrained) by a consistent body of norms, plans, mechanisms and/or structures formally specified to achieve some definite global purpose. And this, in essence, is what “human organization” means when the autonomous agents are human beings – a dynamical collection of persons that accept to have their joint activity formally patterned and controlled, given some global goals (Scott, 1998). Inspired by the metaphor, in this chapter, we will use the term “agent organization” to denote an open MAS, or one of its sub-systems, that was designed and operates in a way similar to human organizations.

This broad agreement around agent organizations has led to the proposal of different organizational models for their engineering (incomplete list of proposals is: Ferber, Gutknecht & Michel, 2004; Lesser et al., 2004; Hüblner, Sichman & Boissier, 2002; Esteva, Padget & Sierra, 2002; Dignum, 2004; Horling & Lesser, 2004; Tambe et al., 1999; Parunak & Odell, 2002; Silva, Choren & Lucena, 2004). An organizational model provides the designer with a conceptual framework and a syntax in which she can write organizational specifications for agent organizations. From an organizational specification, an agent organization can be implemented on a traditional agent platform or, more realistically, by using some organizational middleware or platform (Hübner, Sichman & Boissier, 2005; Esteva et al., 2004; Gutknecht & Ferber, 2000). In general, these organizational middleware or platforms take the organizational specifications as input, interpret them, and provide the agents with an organizational environment (agent organization) according to the specification. In order to enter, to work inside or to leave the agent organization, the agents are supposed to know how to access the services of the middleware/platform and to make requests according to the available organizational specification.

While there has been a strong emphasis on agent organizations, as shown by the number and diversity of proposed organizational models, there is not in the literature any work whose explicit aim is to review the proposals and to assess their modelling capabilities. To our knowledge there is related work that reviews and compares organizational paradigms – i.e., general types of organizational structures like hierarchies, teams, markets, matrix organizations, etc. (Horling & Lesser, 2005; Dignum & Dignum, 2001). Some other work proposes taxonomies of organization and social concepts for the engineering of agent organizations (Mao & Yu, 2005). However, none addresses a representative collection of existing organizational models and tries to describe in a coherent view their commonalities and differences regarding the type of modelling constructs offered to create organizational specifications.

The aim of this chapter is to try to fill this gap. Firstly, we present in more detail the notions of agent organizations and organizational models. Secondly, we discuss in general terms how we can classify the diverse aspects of agent organizations currently captured by organizational models. These aspects are named “modelling dimensions”. Thirdly, we review existing organizational models taking into account the identified modelling dimensions. Fourthly, we summarize the review by presenting a comparative table of the organizational models analysed.