

MOISE⁺: Towards a structural, functional, and deontic model for MAS organization

Jomi Fred Hübner^{*} Jaime Simão Sichman[†] Olivier Boissier
jomi.hubner@poli.usp.br jaime.sichman@poli.usp.br Olivier.Boissier@emse.fr
LTI / EP / USP SMA / SIMMO / ENSM.SE
Av. Prof. Luciano Gualberto, 158 tv. 3 158 Cours Fauriel
05508-900 São Paulo, SP, Brazil 42023 Saint-Etienne Cedex, France

ABSTRACT

A Multi-Agent System (MAS) that represents explicitly its organization normally focuses either on the functioning or on the structure of this organization. However, addressing both aspects is a prolific approach when one wants to design or describe a MAS organization. The problem is to define these aspects in such a way that they can be both assembled in a single coherent specification. The MOISE⁺ model – described here through a soccer team example – intends to be a step in this direction since the organization is seen under three points of view: structural, functional, and deontic.

Categories and Subject Descriptors

I.2.11 [Computing Methodologies]: Artificial Intelligence—*Distributed Artificial Intelligence*

General Terms

Organization of Multi-Agent System

1. INTRODUCTION

A Multi-Agent System (MAS)’s organization is usually conceived as a global set of constraints which aims to conduct the agents’ behavior to those socially intended. In the MAS realm, the way an organizational model achieves this goal is normally focusing either on the structure (roles, links, groups, ...), or on the functioning (global plans, tasks, ...), or on the deontic (norms, laws, ...) aspect of the MAS’s organization.

The MOISE⁺ is an extension of a first attempt to include these three aspect in the MAS’s organization: the MOISE (Model of Organization for multi-agent SystEms) [1]. The main aspect of this extension is to clearly distinguish the structure, the functioning, and

^{*}Supported by FURB and CNPq, Brazil, grant 200695/01-0.

[†]Partially supported by CNPq, Brazil, grant 301041/95-4; and by CNPq/NSF PROTEM-CC MAPPEL project, grant number 680033/99-8.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, to republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

AAMAS’02, July 15-19, 2002, Bologna, Italy.

Copyright 2002 ACM 1-58113-480-0/02/0007 ...\$5.00.

the deontic organizational aspects. The objective is to create an organization centered model [2] where the first two aspects can be specified almost independently of each other, and can be properly linked by the deontic aspect.

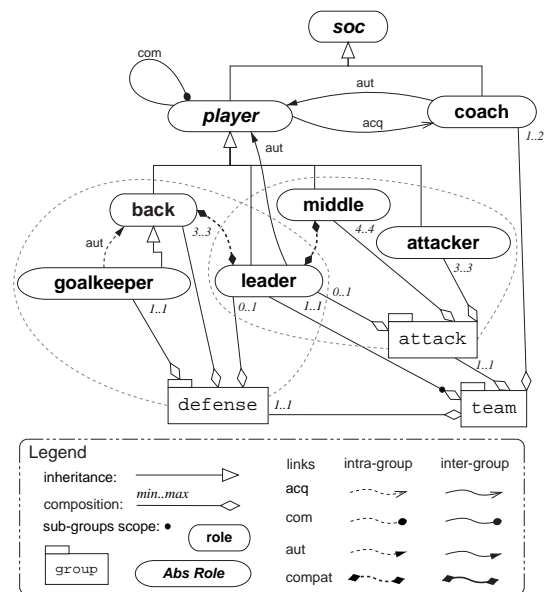


Figure 1: Structural Specification of a soccer team

2. A SOCCER EXAMPLE USING THE MOISE⁺ MODEL

The MOISE⁺ structural aspect defines the agents’ relations through the notions of *roles* and *links*. In this proposal, we enriched the original MOISE model with concepts such as role inheritance, recursive groups, role compatibility, and role cardinality. While the two former mainly have a specification purpose, the two latter constrain the role adoption by an agent according to its current roles. For example, in the defense soccer group depicted in the Fig. 1, three roles are allowed and any defense group will be well formed if there is one, and only one, agent playing the role goalkeeper, exactly three agents playing backs, and, optionally, one agent playing the leader role. The goalkeeper has authority on the backs. The leader is allowed to be a back since these roles are compatible. Due

to the role specialization, the leader also can play the goalkeeper role. In the same example, a team is well formed if it has one defense group, one attack group, one or two agents playing the coach role, one agent playing the leader role, and the two sub-groups are also well formed. In this structure, the coach has authority on all players by an authority link. The players, in any group, can communicate with each other and are allowed to represent the coach (since they have such an acquaintance link). There must be a leader either in the defense or attack group. The leader has authority on all players on all groups, since s/he has an authority link on the player role.

The **functional aspect** describes how a MAS usually achieves its global goals, i.e., how these goals are decomposed (by plans) and distributed to the agents (by missions). The original MOISE's plans are local to the agents. The $MOISE^+$ contributions here are the inclusion of the concept of global plan, called *Social Scheme (SCH)*, and the definition of preferences between missions. A SCH is essentially a goal decomposition tree where the root is the SCH goal and where the responsibilities for the sub-goals are distributed along *missions* (e.g. Fig. 2). These SCHs may be set either by the MAS designer who specifies its expertise in a SCH or by the agents that store their past (best) solutions, for instance like an enterprise does through its "procedures manual".

The **deontic aspect** describes the roles' permissions and obligations for missions. A permission $permission(\rho, m, tc)$ states that an agent playing the role ρ is allowed to commit to the mission m , and tc is a time constraint on the permission, i.e., it specifies a set of periods during which this permission is valid, e.g.: every day/all hours, for Sundays/from 14h to 16h, for the first month day/all hours. *Any* is a tc set that means "every day/all hours". Furthermore, an obligation $obligation(\rho, m, tc)$ states that an agent playing ρ ought to commit to m in the periods listed in tc . For example, the team deontic specification may include:

$permission(goalkeeper, m_7, Any)$,
 $obligation(goalkeeper, m_1, Any)$,
 $obligation(back, m_1, Any)$, $obligation(leader, m_6, Any)$,
 $obligation(middle, m_2, Any)$, $obligation(middle, m_3, Any)$,
 $obligation(attacker, m_4, Any)$,
 $obligation(attacker, m_5, Any)$

In our soccer example, the goalkeeper has the right to start the SCH of the Fig. 2 because it has the permission for this SCH's mission root. Once the SCH is created, the other agents (playing back, leader, ...) are obligated by their roles' deontic relations to participate in this SCH. These other agents ought to pursue their mission's goals just in the moment allowed by this SCH. For instance, the middle agent α that accepts the mission m_2 will get the ball (g_{16}) after the goal g_2 (the ball is in the middle field) was achieved. Since g_{16} is in a choice plan, α has to deal with the agents performing the missions m_1 and m_3 in order to decide which goal is better: g_{16} or g_{17} . In case g_{16} is chosen, α will kick the ball to the left attacker (g_{21}) after the goal g_{14} has been achieved.

3. CONCLUSIONS

We have briefly presented a model for specifying a MAS organization along the structural and functional aspect, which are usually expressed separately in MAS organization models as we have stressed in the introduction. Such a model allows an independent design of each one of these aspects. Furthermore, it makes explicit the deontic relation which exists between them. We have used the $MOISE^+$ model to properly specify the three aspects of a MAS organization in both a soccer domain, used as an example here, and in a B2B (business to business) domain, not presented here.

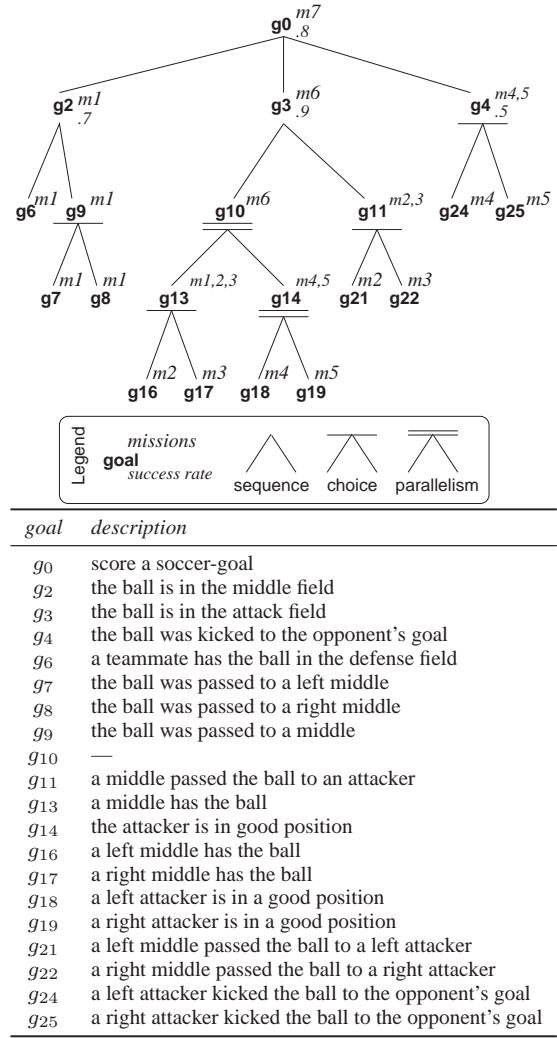


Figure 2: An example of Social Scheme to score a soccer goal

Even if an organization is useful for the achievement of a social purpose, as mentioned in the introduction, it can also make the MAS stiffer. Thus the system may lose one important property of the MAS approach, i.e., its flexibility. For example, if the environment changes, the current set of organizational behaviors which are allowed may not fit the social purpose anymore. In order to solve this problem, a reorganization process is mandatory. This trend will be part of our future work.

4. REFERENCES

- [1] M. Hannoun, O. Boissier, J. S. Sichman, and C. Sayettat. MOISE: An organizational model for multi-agent systems. In M. C. Monard and J. S. Sichman, editors, *Proceedings of the International Joint Conference, 7th Ibero-American Conference on AI, 15th Brazilian Symposium on AI (IBERAMIA/SBIA'2000), Atibaia, SP, Brazil, November 2000*, LNAI 1952, pages 152–161, Berlin, 2000. Springer.
- [2] C. Lemaître and C. B. Excelente. Multi-agent organization approach. In F. J. Garijo and C. Lemaître, editors, *Proceedings of II Iberoamerican Workshop on DAI and MAS*, Toledo, Spain, 1998.