

Towards a model which comprises the structural, functional, and deontic aspects of a MAS organization*

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ABSTRACT

A Multi-Agent System (MAS) that represents explicitly its organization normally focuses either in the functioning or in the structure of this organization. However, to address both aspects is a prolific approach when designing or describing a MAS organization. The problem is to define them in a way they can be both assembled in a single coherent specification. The \mathcal{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.

1. INTRODUCTION

The Multi-Agent System (MAS)’s organization is usually conceived as an global set of constraints which aims to conduct the agents’ behavior to those socially intended. In the MAS realm, the way the organizational do it is normally explained by focusing either on the structure (roles, links, groups, ...), on the functioning (global plans, tasks, ...), or on the deontic (norms, laws, ...) part of the MAS’s organization.

The \mathcal{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 goal of this extension is clearly distinguish the structure, the functioning, and the deontic organizational aspects. The objective is an organization centered model [2] where the first two aspects can be specified almost independently of each other and after properly linked by the deontic aspect.

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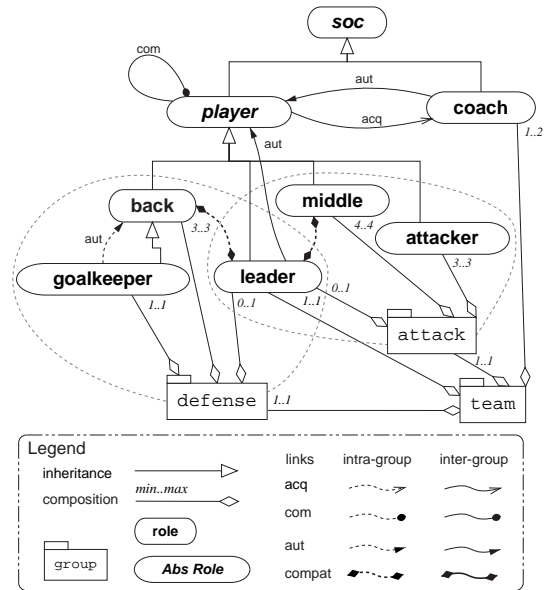
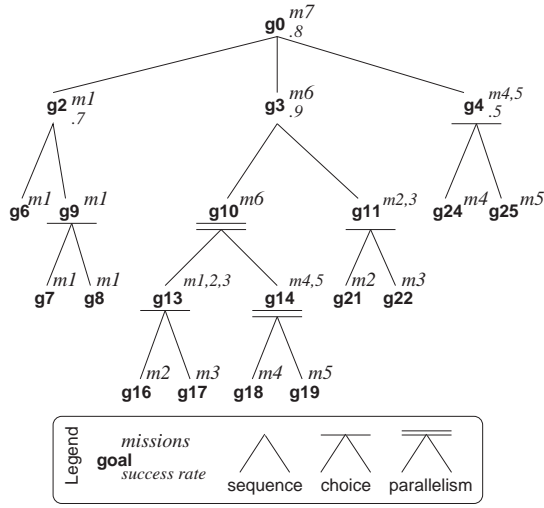


Figure 1: Structural Specification of a soccer team

2. THE PROPOSED EXTENSION

The \mathcal{MOISE}^+ structural aspect defines the agents’ relations through the notion of roles. 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 has 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 back 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



goal	description
g_0	score a soccer-goal
g_2	the ball is in the middle field
g_3	the ball is in the attack field
g_4	the ball was kicked to the opponent's goal
g_6	a teammate has the ball in the defense field
g_7	the ball was passed to a left middle
g_8	the ball was passed to a right middle
g_9	the ball was passed to a middle
g_{10}	—
g_{11}	a middle passed the ball to an attacker
g_{13}	a middle has the ball
g_{14}	the attacker is in good position
g_{16}	a left middle has the ball
g_{17}	a right middle has the ball
g_{18}	a left attacker is in a good position
g_{19}	a right attacker is in a good position
g_{21}	a left middle passed the ball to a left attacker
g_{22}	a right middle passed the ball to a right attacker
g_{24}	a left attacker kicked the ball to the opponent's goal
g_{25}	a right attacker kicked the ball to the opponent's goal

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

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 only local to the agents, thus the MOISE⁺ contributions here are the inclusion of the concept of global plan, called Social Scheme (SCH), and the 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 (as 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. In order to save space, the language for specifying the tc is not described here. *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 the best: 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 classically expressed separately in MAS models on organizations as we stressed in the introduction. Such a model allows the independent design of each one of these aspects. Furthermore, it makes explicit the deontic relation which exists between them. In the soccer domain, used as example here, and also in a business to business domain, not presented here, the MOISE⁺ has permitted to properly specify the three aspects of a MAS organization.

Although we mentioned in the introduction that the organization is useful for the achievement of the social purpose, the organization can also make the MAS stiffer. Thus the system may lose one important property of the MAS approach: the flexibility. For example, if the environment changes, the set of organizational allowed behaviors 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

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