An Adaptive Multi-Agent Organization Model Based on Dynamic Role Allocation (extended abstract)†

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1 Introduction

Robustness of a multi-agent organization functioning in critical domains is essential. Unpredictability can both be in the internal functioning of the system itself (e.g., an incorrect functioning agent), or external to the system (e.g., a sudden increase in competitive pressure). To enable an organization to be robust, capabilities are required that allow the organization to adapt in order to continue functioning adequately.

An approach could be to model a multi-agent system in which each of the agents have those specific capabilities, and show the effectiveness of the system as a whole. However, it is hard to generalize results obtained beyond the specific agents. Recently, an abstraction level higher than the concept agent has become in use: the organizational level (see e.g. [1, 2]). At this level, templates can be specified to aid analysts in modeling multi-agent organization models. These templates, for example, include specification of roles, possibly in the form of required behavior. In a given application, agents can be allocated to such roles. The templates can be reused in domains for which the characteristics comply to the ones specified for the template. Once the correctness of the template is proven (given certain domain assumptions) for a desired property, each model which complies to the specified template will satisfy that property as well, making the approach reusable. Of course, for each new case in which the template is used, an instantiation with domain-specific knowledge is still required.

This paper presents such an organizational model for the analysis of multi-agent organizations with the ability to adapt to unpredictable circumstances, maintaining the robustness of the system. The essential part of the organizational model is the specification of roles, since those can be seen as the engines of the organization. The approach taken distinguishes a number of aggregation levels, starting with the highest level dynamic property desired (i.e., robustness) and refining this property in a number of steps until the level of role behavior has been reached. Interlevel relations between dynamic properties at the different aggregation levels have been specified and verified using the model checker SMV [5].

Besides a generic template, also specific variants have been presented, addressing both quantitative and qualitative models. Applicability of the model was evaluated positively, using it to analyze two cases: social insects and incident management. For both cases simulations have been performed, based on translating the lowest level properties to an executable format.

In the domain of organizational modeling for multi-agent systems several frameworks have been extended with capabilities to model organizational change as well. In [3] for example an approach is introduced where a Change Manager is present, deciding what to change within the organization, and following a model from a well known social scientist. Such a model is however concerned with centrally

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directed organizational change whereas this paper concentrates on adaptation brought about by individuals within the organization detecting unsatisfactory occurrences in the organization. In MOISE+ [4] a central director for change is present as well; decision rules as detailed as presented in this paper are not presented.

In order to incorporate new behavior which is not pre-specified, the approach presented in this paper can be enriched with adaptation of role properties or addition of roles. Such adaptations could for example include a new specification of role behavior. This is however future work and is not addressed in this paper.

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