Multi-dimensional Transition Deliberation for Organization Adaptation in Multiagent Systems

(Extended Abstract)

Juan M. Alberola
Univ. Politècnica de València
Camí de Vera s/n. 46022
València. Spain
jalberola@dsic.upv.es

Vicente Julian
Univ. Politècnica de València
Camí de Vera s/n. 46022
València. Spain
vinglada@dsic.upv.es

Ana Garcia-Fornes
Univ. Politècnica de València
Camí de Vera s/n. 46022
València. Spain
agarcia@dsic.upv.es

ABSTRACT

In this paper, we provide an approach for organization adaptation in Multiagent Systems that considers transitions in multiple dimensions and it is aimed at obtaining the adaptation with the highest potential for improvement in utility based on the costs of adaptation.

Categories and Subject Descriptors

I.2.11 [**Distributed Artificial Intelligence**]: Multiagent systems

General Terms

Design

Keywords

Organizations,Adaptation,Transitions

1. INTRODUCTION

Organization adaptation eliminates the need to determine all possible runtime conditions a priori, which is unknown in many systems. Before this can occur, the space of organizational options must be mapped and their relative benefits and costs understood [3]. To date, however, few models have emerged that incorporate mechanisms for adaptation that focus on changes in different dimensions of the organization according to the heterogeneous impact that these changes causes in the components of the organization [2]. One main reason is that current approaches do not provide support for specifying the requirements of organizations that are to be achieved. The other reason is that without this support, it is difficult to measure without carrying out the adaptation, the impact on the costs of applying the adaptation and on the performance of the whole organization.

In this paper, we propose a novel approach for organization adaptation called Multi-dimensional Transition Deliberation Mechanism (MTDM). This mechanism provides a decision-making support that considers transitions in different dimensions such as role reallocation, agent population and the structural topology, which increases the range of adaptation solutions. By specifying the requirements of the final organization that is to be achieved, the MTDM accurately predicts the impact of the transition in terms of two aspects: the costs associated to the organization transition, and the benefits or costs that this transition causes not only to the agents involved in the change but also to the whole organization.

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2. ORGANIZATION TRANSITION MODEL

The Organization Transition Model presented in [1] defines the state of organization at two different moments and determines how to carry out a transition from organization to another. An *organization* at a specific moment t is composed by a set of roles R^t, services S^t, and agents A^t. Furthermore, organizational relationships represent links between these elements, where $offers^t$ represents the relationships between roles and services; $provides^t$ represents the relationships between agents and services; $plays^t$ represents the relationships between agents and roles; and $acquaintance^t$ represents the relationships between a pair of agents.

An *event* (ε) defines each individual change that can be applied during the organization transition in terms of addition or deletion. Given two organizations, O^c and O^f, we define $\tau = \{\varepsilon_1 \dots \varepsilon_n\}$ as the *set of events* that cause a transition to O^f when all of them are applied to O^c.

3. MULTI-TRANSITION DELIBERATION MECHANISM

The MTDM is a multi-stage mechanism that is based on a model proposed by Zott [5] in the strategic management research area for analyzing the performance of business firms. This mechanism calculates transitions in different dimensions to other organizations with high expected utility based on the cost for transition to these organizations. The benefits and costs of transition are measured in terms of Organization Transition Impacts (OTIs). Then, the MTDM decides which transition is finally implemented and provides the sequence of changes required to carry out the transition.

3.1 Calculating the Organization Transitions

The first stage calculates the organization with the highest potential for improvement in utility based on the transition cost for several transitions in different dimensions: changing the roles played by agents, the structural topology, and the agent population.

Each event ε has an associated impact $i(\varepsilon)$ that represents the costs/benefits that the application of this event causes in the organization. This impact shows the effect of this event in the components involved in the change and also how other components are affected by this event. Moreover, the impact shows the cost for carrying out the application of the event. Therefore, for any set of events τ that allow a transition from a current organization O^c to a future organization O^f, we define the OTI that is associated to this transition as the impact of applying all the events of τ: $I(\tau) = \sum_{\varepsilon \in \tau} i(\varepsilon)$.

3.1.1 Role Reallocation Transition

A role reallocation transition entails the application of a specific set of events τ_R , which transforms the $provider^c$ and $plays^c$ relationships into $provider^f$ and $plays^f$, respectively.

Let Θ_R denote the set of all the possible sets of events τ_R that define a different role reallocation transition from O^c to O^f. The challenge of the role reallocation transition is to find the specific set of events $\widehat{\tau}_R$ that minimizes the role reallocation transition impact:

$$OTI(\widehat{\tau}_R) = \underset{\tau_R \in \Theta_R}{\operatorname{argmin}}\ OTI(\tau_R)$$

The application of the set of events of the minimal impact $\widehat{\tau}_R$ to O^c would cause a transition to a future organization O_R, which can be transitioned to at the minimal OTI.

3.1.2 Acquaintance Transition

An acquaintance transition entails the application of a specific set of events τ_A, which transforms $acquaintance^c$ into $acquaintance^f$.

Let Θ_A denote the set of all the possible sets of events τ_A that define a different acquaintance transition from O^c to O^f. The challenge of the acquaintance transition is to find the specific set of events $\widehat{\tau}_A$ that minimizes the acquaintance transition impact:

$$OTI(\widehat{\tau}_A) = \underset{\tau_A \in \Theta_A}{\operatorname{argmin}}\ OTI(\tau_A)$$

The application of the set of events of the minimal impact $\widehat{\tau}_A$ to O^c would cause a transition to a future organization O_A, which can be transitioned to at the minimal OTI.

3.1.3 Agent Population Transition

An agent population transition entails the application of a set of events τ_P, which causes the modification of $agents^c$, $provides^c$, $plays^c$, and $acquaintances^c$ into $agents^f$, $provides^f$, $plays^f$, and $acquaintances^f$, respectively.

Let Θ_P denote the set of all the possible sets of events τ_P that define a different agent population transition from O^c to O^f. The challenge of the agent population transition is to find the specific set of events $\widehat{\tau}_P$ that minimizes the agent population transition impact:

$$OTI(\widehat{\tau}_P) = \underset{\tau_P \in \Theta_P}{\operatorname{argmin}}\ OTI(\tau_P)$$

The application of the set of events of the minimal impact $\widehat{\tau}_P$ to O^c would cause a transition to a future organization O_P, which can be transitioned to at the minimal OTI.

3.2 Deliberation

Once the organizations that minimizes the OTI for each dimension are calculated, the second stage of the MTDM decides which transition is finally implemented depending on the deliberation strategy. The deliberation strategy used in this implementation is focused on selecting the transition or the combination of transitions that minimizes the OTI.

3.3 Calculating the sequence of events

Finally, once the final organization O^f that is transitioned to is selected, this stage obtains the specific sequence of events τ that allow this transition from O^c to O^f and the impact associated to applying these events $OTI(\tau)$.

4. CONCLUSIONS

The contributions of this work can be viewed from different perspectives. The MTDM provides an accurate estimation of the transition impact since the organization that is to be achieved is calculated by each transition. Thus, the impact associated to each change that is required to carry out the transition, can be measured individually and more accurately than other approaches. The suitability of the adaptation must be considered taking into account not only the benefits obtained by adaptation but also the costs associated to this process. Approaches that only focus on criteria to improve the utility, the costs for achieving these transitions may be so high that the mean utility gets worse. This issue is also important in human organizations since most organizational changes may encounter problems when they are applied [4].

Another contribution of the MTDM is the possibility of including several transitions into the deliberation decision mechanism. Approaches that consider one-dimensional transitions (roles, structural topology, population, etc.) offer a more limited range of solutions than the MTDM. Thus, in heterogeneous scenarios in which several changes can affect the performance of the organization, a multi-transition criteria for deliberation would provide better decisions for adaptation.

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