



GoOrg: Automated Organisational Chart Design for Open Multi-Agent Systems

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Abstract. The organisational structure is a key factor for open multi-agent systems. It is the way agents can enter into an organisation taking its position and cooperating to achieve mutual goals. In spite of its importance, there are few studies on automatic designers that generate explicit organisational structures. This paper introduces *GoOrg*, a proposal for automated design of organisations. Our designer uses as input a goals tree and other features such as necessary skills to achieve the goal, predicted workload and throughput. The output of *GoOrg* is an organisational chart. The generated structure, for instance, can be flatter or taller, accepting matrix connections of not, according to preferences and needing of more coordination levels.

Keywords: Automated organisational design · Organisational chart · Organisation's structure · Multi-Agent Systems

1 Introduction

The organisation structure is a way in which the activities of an organisation are split, organised and coordinated. It allows members to know where they fit relative to others and it reflects authority relations and responsibility for goals, providing a natural way to assign tasks [2]. An organisation structure is a key factor for large-scale Multi-Agent Systems (MAS) and open systems.

Currently, there are a few studies over automation of organisation design process that leads to explicit organisational structures [3, 5]. Although seminal, these works still have limitations to overcome. This paper introduces *GoOrg*, an automated organisational designer that takes the organisational goals tree, looking for opportunities to gather goals into roles giving as output an organisation chart, an explicit organisational structure, according to preferences.

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2 Organisational Design

The organisation design is a process for choosing the best organisation class given necessary input such as goals, tasks and constraints to create aspects such as structure, strategy, leadership guidelines and so on [4]. In multi-agent systems, although there are few studies about automatic organisation designers, we have identified three classes of proposals.

The first class is *automated organisational structure designers* [3,5]. It considers as input organisation goals, available agents, resources and performance targets, and produces an explicit organisation, which may include roles, assignments of responsibilities, hierarchy and other relations. The main drawback of existing studies in this class is the requirement of several parameters including the modelling for each role, reducing its applicability when taking cost-benefit into account.

The second class is the *automated organisational design by task planning*. These designers create *problem-driven* organisations, for specific and generally temporal purposes. The organisational structure is not explicit and it usually is a casual result of a task distributing process. This class [1,6] creates organisations that are not suitable for open systems since the tasks were allocated to a particular MAS.

Finally, the third class is *self-organisational designers* [7]. These designers produce emergent organisations which are dynamic, may operate continuously, have overlapping tasks, have no external or central control, hierarchy and information flow in many directions. It usually overcome other classes in uncertainty scenarios. However, the structure is not carefully designed, and in open systems, entries and exits of agents make the system slower due to renegotiation processes.

3 Proposal

We have positioned our research on *automated organisational structure designer* class. The reasons for this choice are: (i) it is suitable to work in open systems; (ii) it helps to develop part of the organisation dimension; and (iii) its outcomes may be integrated into other planning techniques, reducing further efforts.

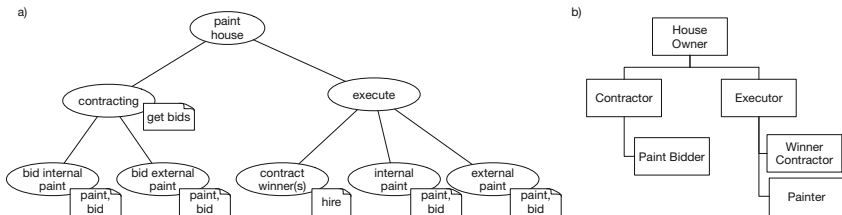


Fig. 1. Automated design for Paint a house example. (a) Inputs: goals tree and necessary skills. (b) Output: the less flat organisation chart

We propose the use of a state space search algorithm to apply in our designer, called *GoOrg*. It assigns goals to roles in a structured chart taking advantage of some characteristics of the goals such as the ones that have the same parent goal and requiring the same skills to be performed. Additionally, preferences can also determine whether to combine goals or not, e.g., if a *flatter* or *taller* organisation is preferred.

For example, in a goals tree for painting a house internally and externally it is necessary to contract agents to execute the tasks (Fig. 1). The *contracting* goal can be associated with the skill *get bids* and it may have as sub-goals: *bid internal paint* and *bid external paint*. Both sub-goals have the same necessary skills. The goal *execute* may have three sub-goals: *contract winner(s)*, *internal paint* and *external paint*. The first is associated with the skill *hire* and the others with skills *bid* and *paint*, similar to the sub-goals under *contracting* goal. In this example, the algorithm found that the sub-goals related to *contracting* could be gathered in the same role called *Paint Bidder*. The same has occurred in *execute* goal, where the *Painter* role was created.

For the next step of our research, the designing process is being split into two phases: the organisational chart designer and the binding phase. With this separation, it is expected that *GoOrg* becomes more suitable to deal with asynchronous changes on the system’s resources availability and redesign requests. To enhance the first phase, we will add on each goal the predicted workload, necessary resources, communication topics, and predicted throughput (white shapes of Fig. 2). The expected workload can be used to determine how many agents should play the same role or if the same agent should perform more than one role. With communication topics and throughput, the hierarchy levels and departmentalisation can be set. In both phases, it is proposed to consider agents and artifacts availability as an input parameter.

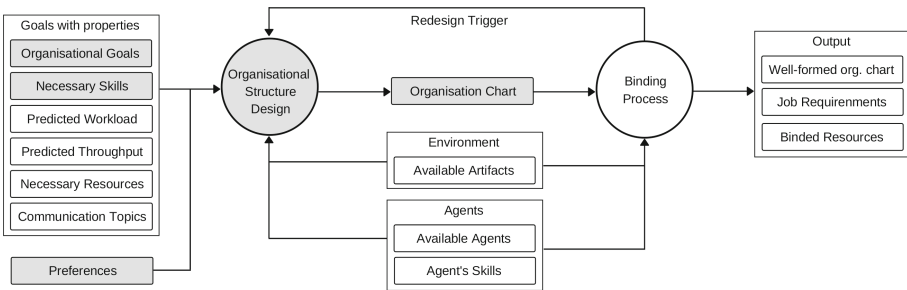


Fig. 2. Goal based Organisational designer (GoOrg).

The binding process can solve some allocation challenges that does not require a redesign. To illustrate it, consider that *external paint* goal also needs *scaffold use* skill. Consider that *agent A* and *agent B* play, respectively, the roles *internal paint* and *external paint* having all the necessary skills to play both.

Consider now that *agent B* left the system and *agent C* has joined it, but this agent has no *scaffold use* skill. The binding process can move *agent A* to *external paint* role, assigning *agent C* to *internal paint* role.

Finally, we will evaluate our solution using existing domains [1,3,5]. The goals tree and other aspects for these domains will be manually identified and we will firstly evaluate the amount of necessary input parameter needed for *GoOrg*. With these input, the ability of *GoOrg* to properly design organisations will be evaluated. These situations will be simulated to check if the organisations are able to fulfil the goals, in this sense, the evaluation will be qualitative. The preferences will be varied to evaluate different configurations and their impact on the output.

4 Conclusion

This paper has presented a proposal for an automated organisational designer based on goals and their properties as input. The current status of this research shows that it is feasible to draw an organisational chart only based on organisation's aspects, in other words, it is not necessary to build complex models as input. Besides the organisation chart, an extra outcome of *GoOrg* may be some decentralised task planning input since this study is also expecting to bind agents and roles. The previous allocation of resources is a guarantee that when running, this system will be able to have a well formed organisation. About evaluation criteria, we intended to consider the model of known domains and test if *GoOrg* is able to build suitable structures.

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