The Economical Foundations of Agenthood in Organizations

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Abstract

The IT definition of agent has been mutuated from the human notion of agent. As such, agents exhibit many properties that are typically human properties, such as goal-orientation, autonomy, proactivity and so on. A wide part of the humanistic literature also recognizes that human agents have a limited rationality, in that they do not have full knowledge about the world, and are not able to fully evaluate the available information. This recognition helps economic, psychologic and sociologic scientists in making more realistic models of organizations and organizational interaction. This work aims at exploring the bounded rationality metaphore. The goal is to see what is the effect of its introduction on the concept of agenthood. In particular, it is intended to serve as an explanation for the need for organizational aggregation of agents.

1 Scarcity

1.1 Definition

"Economics is the science which studies human behaviour as a relationship between ends and scarce means which have alternative uses" (Lionel Robbins, Essay on the Nature and Significance of Economic Science, 1932). Scarcity is the economic condition that exists when demand is greater than supply. In order to see how scarcity affects the behavior of the agents, we will now try to describe a world where scarcity does *not* exists. Later, we will introduce it in the model.

1.2 Scenario 1: a perfect world

In this scenario we assume two hypotheses:

- Perfect rationality [4]. Agents have full knowledge about the space of alternatives: have full knowledge about consequences of the actions and are able to assign a value to the consequences; furthermore, they are computationally able to explore the space of alternatives to find the desired one.

- Abundance [3]. There are not limits to the availability of resources: no transitional costs exists and no there are no constraints about the quantity that agents can hold.

In this scenario, agents have goals that they want to achieve and tasks that they can perform to achieve the goals. Tasks require resources, but, since resources are not scarce, they don't limit the capability of performing tasks. As a consequence, all the agents' goals are always achievable. And as a consequence of this, agents have no preferences, since they can reach whatever goal they want.

The hypotheses of perfect rationality and unlimited availability of resources are very strong for a theoretical model; however, they have a practical usefulness, since classical (non multi-agent) systems could be seen as systems where those hypotheses hold. Consider for instance a corporate DBMS. It stores information about employees, their responsibilities, resources and so on. It has all the information that it needs and can perform on the data all the desired tasks.

1.3 Scenario 2: introducing scarcity

Scarcity is a condition that affects resources. We take into account two classes of resources, namely, tangible and computational resources. With tangible resources we mean whatever can be exchanged between agents or acquired in some way: for instance, physical goods or knowledge. With computational resources, we mean properties of agents as individuals, such as attention or time; or, in the case of software agents, computational power.

Scarcity and limited rationality

We represent scarcity using the notion of cost. A cost is an objectively measurable payoff that has to be spent when a resource is accessed (utilized). Each agent has a personal endowment (capacity) that informs about the amount of resource that can access (the costs that can pay). Time is an example of cost.

Costs of resources, plans, goals

In this scenario, performing an action involves that the agent has to consume the corresponding resource's cost. A goal, which is achievable by performing a task or sequence of tasks, also has a cost: it is the sum of the costs of the resources needed to perform the single tasks.

Preferences

If goals are indirectly costly, agents can't achieve all the desired goals. This arise the necessity of prioritizing among goal. Prioritization factor is something intrinsic to individuals' subjectivity; we call it preference.

1.4 Dependency

Another consequence that can be drawn from resources' scarcity is the dependency between agents. Tangible resources can be exchanged, and goals can be delegated. By this way, an agent can "trade" with other agents, building the economy of MAS.

1.4.1 Vulnerability

However, depending on others raises the problem of vulnerability. The accomplishment of a goal is subject to the willingness and capability of the dependee to fulfill the goal. Since the actor has limited rationality, such willingness and capabilities can't be evaluated a priori, and the goal may remain unachieved. This, in turn, generates a need for defense.

1.5 The rational way

The first way for defending from dependency failure is based on a (limitedly) rational basis.

Evaluating and monitoring. Supposing that an agent wants to delegate a goal or task to another, it has to: a) evaluate the space of the possible alternatives (the possible dependees); b) make decisions, such as whether to trust the other or not; c) monitor the execution of the delegation, such as in [2].

The diverging cycle. However, this has a drawback. The decisions about monitoring and trust are also rational activities, and consume resources. This creates a cycle, in which: the need for resources causes dependencies on other agents; the dependencies cause a need for the agent to defend itself; and the need to self-defense causes the need for more resources. This cycle could easily diverge, so a mechanism should exist, to stop it.

1.6 The normative way

Saving calculus time. Epstein [1] notes how norm compliance greatly reduce the time spent in the evaluating of the space of alternatives. For instance, a software agent, responsible for suggesting to the user the most interesting travel, is limited, as it has no direct knowledge about the offers of the travel agencies. So, it must communicate with others agents to obtain such information. Other agents may answer and may not. To manage this situation, a rule could exist, saying for instance: "if no other replies arrive after 1 minute, then consider as if no other alternatives exist". By this way, further exploration of the space of the alternatives cut.

2 Organizations

2.1 The organizational need

Despite to individuals, that have a fixed amount of computational resources, organizations have the computational resources of their members. As a consequence, their overall capacity can always be expanded (or reduced) when agents join them or leave. So, if an individual wants to achieve a goal and that goes beyond his capability, the only approach is to organize a set of other actors.

2.2 Parameters of organizations

Organizing a set of actors means essentially two things:

- According to the *nature of the intentionals of the agents*, it means allocating the (tangible) resource, delegating tasks and assigning responsibilities.
- According to the *nature of the relationships among agents*, it means to set up the proper strategic dependencies, create a mechanisms of control and regulation, group people into working units and so on.

2.3 Alternative organizational settings

Resources define the basic costs. Plans sum the costs of the used resources. Different plans can lead to the achievement of a same goal but with different costs. Relationships among individuals define the structure of an organization. The structure of the organization defines the total cost that has to be paid by the organization to exist. The total cost faces with the organizational preferences to determine the suitability and efficiency of the organizational structure. Different organizational structures lead to different capacities of the organization.

3 Conclusion

To summarize, the concept of agent can't exist without the concept of organization of agents (system) for various reasons. One of them, is that agents are implicitly conceived as *limited* in their rationality and capabilities. For this reason, agents are not requested to manage perfectly the problem of complexity. On the other hand, the results of their behavior could be just a "local" optimum.

References

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