Designing Organizations: Towards a Model

Draft Paper

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Abstract. The purpose of this paper is to draw a preliminary model of an ontology of organizations. The emphasis is on the structural aspects of organizations and the relations that these have with the design process of the organization itself on the one hand, and with its normative layer on the other.

Keywords. Ontology, organizations, structure, design, norms

1 Introduction

This paper tries to lay the basis for an abstract model that integrates and accommodates different features of organizations which are only separately considered in the literature. In particular, we focus on a specific kind of organizations, namely social entities that are *designed* to obtain certain *objectives* coordinating some collective behavior by means of *norms*. The FIAT company or Al Quaeda are examples of the kind of organizations we intend to capture. For the time being, we don't consider 'emergent' organizations or self-organized groups (e.g. a group of friends meeting every Thursday at Mollie's pub) even though, probably, most of the aspects considered in our model are also relevant for this kind of organizations.

In our model, an organization is intended as:

- *multi-layered*: structured in irreducible layers (not reducible to basic roles and their interrelations);
- *designed*: created by means of a decisional process and with specific objectives in mind;
- *agentive*: coordinating agents in order to obtain its objectives;
- *realized*: ultimately built by autonomous agents playing specific roles;
- *situated*: immersed in the environment;

- *dynamic*: its structure and its realization may change through time;
- *regulated*: governed and structured by norms.

In this paper we focus on how the structure and the design of organizations are linked to the normative dimension. For this goal, other features need to be considered, but here we don't describe them in detail.

2   Organizations as Multilayered Entities

In literature, it is common to consider organizations as structured entities. Sociology [1], philosophy [2,3,4] and computer science[5,6,7,8] generally agree that organizations are (at least) complex sets of roles tied together. For example, the organization model of OperA [7] consists of a *social structure*, i.e. roles and groups of roles, and an *interaction structure*, which contains the interaction relations between the elements of the social structure. Similarly, in [9, p. 146] we read that "an organization is structured through a set of roles, to which are associated deontic notions (...), that apply to the agents that are the actual holder of such roles, when playing those roles". However, their structures are, in some sense, *flat*. This does not mean that these authors disregard the fact that roles can be arranged in a hierarchy (this is often the case in their models, e.g. in OperA [7] roles are hierarchically arranged by dependencies or power relations holding among them), but, at the end, organizations can be reduced to sets of interrelated roles. This is clearly true also in [10] where a function which defines the goals of the MultiAgent System as a whole starting from the goals of its agentive constituents is introduced.

Even though in our model roles are still the basic units of organizations, *sub-organizations* (i.e. organizations that are at an abstraction level which is in the middle between the one of the whole organization and the one of roles) play a fundamental role in the specification of organizations. In particular, in the model teleological considerations drive the structuring of organizations. Roles and sub-organizations are created and designed with the precise aim of accomplishing certain objectives whose achievement brings about the achievement of the overall objectives of the organization[1]. But, in real cases, the chosen structure and the chosen reallocation of objectives to sub-organizations do not offer a complete description of the whole organization. The goals of the whole organization represent the *common* goals of the sub-organizations and they cannot be reduced to a composition of the particular goals of the sub-organizations. This means that the whole organization is something more than its parts. In this sense, organizations are not only structured but also *multi-layered* entities and roles can be seen just as *unstructured* organizations.[2]

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[1] These intuitions are already present in classical works as [11], more recently in [12] and [13].

[2] The presence of these overall objectives (pre-established and not emergent) could represent a motivation for distinguishing organizations from simple groups of roles.

The literature does not consider the latter features in an integrated fashion. In [6] the authors propose an organization ontology for the TOVE enterprise model in which organizations are seen as composite entities whose parts are divisions and subdivisions; on the other hand, the teleological aspects are explained with reference to goals of the organization and subgoals which are assigned directly to roles, but roles are not linked to sub-divisions, thus leaving the teleological and the structural dimensions independent . Similarly, in Enterprise Ontology (EO) [14] an organization – called organization unit – can be decomposed into smaller organizations (persons can be seen as organization units), so that an organization structure is built by means of management links[3] between organization units, but the decomposition of goals – called in EO 'purposes' – is not taken into account.

Furthermore, we also represent the context, the environment, in which the organization is *situated*. Already in [15] it is stressed that what they call the "conceptualized environment" must be part of the organizational model. In addition, some works in sociology, as [16,17], observe that the behavior of an organization is not only determined by its internal structure, but also by the way in which it is linked to other organizations that are not under its (complete) control.

As roles and sub-organizations can be linked together by relations like *dependence*, *trust*, *delegation*, etc., in our model we allow also the same kinds of relations with external organizations. These external links represent the environment. The arguments of these relations can be organizations, objectives, states of affairs, actions, etc. As an example, an organization o_1 could delegate just a specific objective to o_2, or o_1 could trust o_2 for performing specific (kinds of) actions, etc.

3   Organizations as Designed Entities

Organizations can also be seen as *artifacts* whose function is to coordinate some collective behavior. If we take an artifact, for instance a chair, we can see that each part of the chair contributes to the main function of the chair, that is something to sit on. In the same way, we can imagine that every part of the organization has a function that contributes to the general goal of the organization. For the time being we take this only as a metaphor, leaving aside some more detailed ontological questions on artifacts, namely whether organizations are *really* artifacts and to what extent they are different from material artifacts as chairs and hammers[4].

In this section we focus only on the *design process*: a designer starts by figuring out an organization with some general objectives and successively refines that organization by introducing new sub-organizations (with new objectives) linked in a specific (and maybe normative) way. In order to model design, [15]

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[3] "To manage" here means "to assign purpose to".

[4] It is also possible to draw a parallel with the algebraic specification and program development, see for example [18], [19].

introduces a notion of *refinement* and characterizes it as a process of specification of the description of an organization. Organizations that (unstructured) are roles at a specific level of refinement can be structured and detailed at a lower level of refinement. In this sense, the design and the structure of an organization are linked, i.e. the designer expresses a specific way of 'implementing' the objectives of the whole organization by imposing a structure on it. He establishes how the objectives declared for the whole organization can be 'decomposed' into simpler objectives attributed to simpler sub-organizations and how these sub-organizations are linked by means of institutional relations. In general, this can be a much more complex relation than the standard *and/or* decomposition considered in most of the existing approaches. But a more precise link can be established between the refinement and the layers of organizations. Each refinement step can be seen as a change of layer in the organization structure, i.e. at each refinement step we are trying to implement the organization by introducing a new set of roles linked in a specific way, and we want to maintain this information in the resulting organization. This is done by decoupling the goals of the starting organization from the goals of the sub-organizations introduced in the refinement. In this sense the refinement can be seen as a link between two *flat* organizations. Clearly the designer wants to implement organizations in a correct way, i.e. he wants the refined organization to be able to achieve the goals declared for the initial one. The irreducibility of the goals of the whole organization to a composition of the goals of its sub-organizations offers all the necessary information to check the 'correctness' of the implementation, once we have a sort of composition function of goals.

Let us consider a simple example. The design process can be seen as a sequence of refinement steps: $o \rightsquigarrow o'$ stands for "o' is the refinement of o". If o is already structured (even though flat), we write $o \overset{o_1}{\rightsquigarrow} o'$, in order to indicate that this refinement is relative only to the o_1 component of the structured organization o.

Table 1 illustrates two different design processes of the organization o. At t_1, the first step of the design (a.) introduces two sub-organizations (o_1 and r_3) that are not linked, i.e. o is refined in o^1, a flat organization exactly structured in o_1 and r_3. At t_2, the second step of the design (a.) refines only one component of o^1, namely o_1, introducing two non linked sub-organizations (r_2 and r_3). The multilayered organization that is obtained via this design process is depicted in figure 1.a. Similarly, the design process in table 1.b originates the multilayered organization in figure 1.b. If we reduce organizations to roles (unstructured organizations), then the two organizations in figure 1 are identical, but by considering them as multilayered we can also encapsulate the refinement in the structure. This is especially important in the case of organizations that are created by different designers by means of specific laws.

So far we considered only the refinement of goals. Other kinds of refinements can also be introduced: refinement of norms, refinement of the environment, etc. In addition, it is possible to consider other design operators like, for example, 'generalizing', 'deleting', etc. In particular, here as in [15] the process of speci-

fication of an organization is strictly top-down. But we can also consider some bottom-up operators, as for example the 'grouping' operator in [20], i.e. two or more organizations can be grouped together to achieve some common goals. We recognize the existence and importance of both processes: in fact a designer may decompose the overall objective of an organization into sub-objectives that he assigns to sub-organizations or roles that are purportedly created to accomplish those objectives. Otherwise, agents that have compatible, complementary or co-inciding objectives can decide to share their objectives and join in a plural entity. In our model this difference is encoded only in the design representation, the obtained organization does not depend on the direction of the design. For example, table 2 illustrates the bottom-up design of the same organizations depicted in the figure 1[5]. Our multilayered model is then compatible with both kinds of design and therefore with the two approaches in the theory of organization singled out by [21]: organizations from aggregations of agents vs. organizations as designed entities that influence the behavior of agents.

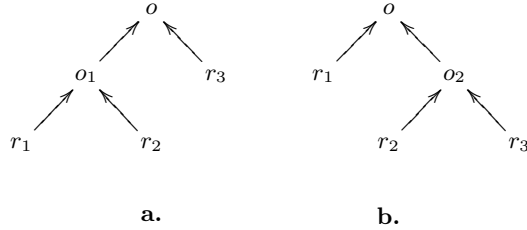| Time	Org.Intr.	Refin.	Time	Org.Intr.	Refin.
t_0	o		t_0	o	
t_1	$\{o_1, r_3\}$	$o \overset{o}{\rightsquigarrow} o^1$	t_1	$\{r_1, o_2\}$	$o \overset{o}{\rightsquigarrow} o^2$
t_2	$\{r_1, r_2\}$	$o^1 \overset{o_1}{\rightsquigarrow} o^3$	t_2	$\{r_2, r_3\}$	$o^2 \overset{o_2}{\rightsquigarrow} o^4$
	a.			**b.**	

Table 1. Different refinement processes.

Fig. 1. Different organizations resulting from the design processes in table 1.

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[5] The grouping operator is represented by $\rightarrowtail$.

Time	Org.Intr.	Group.	Time	Org.Intr.	Group.
t_0	$\{r_1, r_2\}$		t_0	$\{r_2, r_3\}$	
t_1	o_1	$r_1, r_2 \rightarrowtail o_1$	t_1	o_2	$r_2, r_3 \rightarrowtail o_2$
t_2	$\{o, r_3\}$	$o_1, r_3 \rightarrowtail o$	t_2	$\{o, r_1\}$	$o_2, r_1 \rightarrowtail o$
	a.			**b.**	

Table 2. Different grouping processes.

4   Organizations and Norms

In some accounts, as shown in [4], organizations are intended as completely made up of norms. For the moment we don't commit to such a strong position, but in any case undoubtedly norms are central in organizations and there are several ways in which the normative layer affects the organization and the behavior of its members. Here we just sketch some preliminary analyses of the following relevant topics.

Norms and design. Often the entire design of an organization is described by norms, as for example in many legal organizations. This kind of norms can be called, following Searle's terminology [22,23], "constitutive". Constitutive norms (or rules, as he calls them) are norms that, as pointed out in [24] and in [25], create new objects [25]:

> they have a defining function: they create new concepts, roles, social individuals; they can also establish which are the requirements that an entity should meet in order to be classified under a certain role or concept.

They can even create new organizations as, for example, the Republic of Italy and its Constitution[6].

Norms and the structure of organizations. By means of norms the objectives of the organizations are linked to their roles. The relations among these objectives and the roles can be permissions or obligations: as an example, a president is allowed to enter in some area but it is mandatory for the president not to interfere with the job of the technicians in that area. They can be understood as what Searle [22,23] calls "regulative rules" and Hart calls "primary rules" [30]. This kind of rules regulate antecedently existing forms of behavior. For instance, a rule like "drive on the right hand side of the road" regulates the driving without defining it: the driving exists before the rule that imposes duties to individuals by the way of the role that these individuals play.

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[6]   Formal frameworks for constitutive rules have been proposed, for instance in [26], [27], [28] and [29].

Norms and contracts. Agents' behavior is not only forced by regulative or primary norms. In what we can call 'realizations' of organizations, agents are often linked to the organizations via agreements or contracts. A realization is then a particular instance of a designed organization in which all the roles are assigned to specific agents. For instance, all the persons that actually have a (direct or indirect) employment contract with FIAT are its actual realization. In this sense, a contract can be conceived of as the bridge between the descriptive level of designed organizations and the concrete level of agents, i.e. a sort of norm that links abstract roles with specific individual agents. When an agent, say Paolo Rossi, is hired by a company, say FIAT, he acquires new rights and obligations that are partially specified in the contract he signs.

Norms and inter-organizational relations. As we stated in section 2, organizations are situated in an environment of other organizations that can be internal or external with respect to it. When two organizations are linked, this often affects the normative dimension. This kind of relations are considered in [25] and in [8]. In [25] an example of a specific iterorganizational normative relation is given, namely the relation that holds between the Italian State and the University of Torino [25]:

> We could say that the University of Torino is in a way "nested" into the Italian State. The normativity of the relation relies on the fact that the descriptive system of the "contained" organization is, in some sense, more specialized with respect to the descriptive system of the "containing" one: all the norms that are valid in the Italian State must also be valid in the University of Torino.

There are other kinds of norms and normative relations in the institutional setting, for example we can consider again contracts and agreements that make alliances possible, as in the case of military alliances among countries, like in the NATO organization.

Metanorms and organizational change. An important notion for understanding the complex relationships among organizations and norms is that of metanorm or what Hart calls "secondary rule". Secondary rules are, according to Hart [31], rules about rules. This kind of norms state – for example – how to resolve controversies in conflicting norms. At a certain time, after some steps of refinement, the designer may decide which is the structure that the organization will have. But organizations in a changing environment must be flexible. Nonetheless, not all the changes should be admissible. In this case it is possible to introduce some meta-norms that regulate the evolution of an organization by describing its acceptable changes. In addition to that, the designer itself can be subject to some norms that constraint the design itself.

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