Preliminaries to a DOLCE Ontology of Organizations

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Abstract: This paper presents a preliminary proposal of an ontology of organizations based on DOLCE (*Descriptive Ontology for Linguistic and Cognitive Engineering*). An ontological analysis of organizations is the first, fundamental and ineliminable pillar on which to build a precise and rigourous enterprise modelling. An ontological analysis makes explicit the social structure that underlies every organizational settings. In particular, the paper tries to explain what are organizations, roles and norms, how they are interrelated, what it means for a norm to be valid in an organization and what it means for an agent to be affiliated to an organization.

Keywords: Organization, Ontology, Norms, Validity, Roles

1 INTRODUCTION

The aim of this paper is to lay down the bases for an ontological analysis of organizations.

Even if the amount of literature on organizations is nowadays huge, as far as we know, there are not so many works specifically focused on the ontology of organizations. Those available can be divided according to the different perspective they take.

Most of the philosophical studies on organizations concentrate on ethical issues, like moral personhood and responsibility (French (1984)) and very few of them have a formal flavor. An important exception is the account given by Raimo Tuomela. His analysis of organizations in Tuomela (2002) is part of a wider project about institutional reality, strongly based on the analysis of the notions

of collective intentionality, joint actions and social practices. The notion of normative system is also analyzed but, differently from our paper, this is done by looking at the dynamics, trying to understand – for instance – which actions are the agents in the organization allowed or not allowed to do.

On the other hand, in computer science some works on the ontology of organizations can be found, like Fox et al. (1998), Gruninger and Fox (1996), Dignum (2004), Dietz (2003), Uschold et al. (1998), even though most of them are actually works of enterprise modeling. If we consider enterprises as a special kind of organizations, these works can be seen as more specifically oriented than ours, which is instead more "top-level".

Another relevant difference of all these approaches with respect to ours is that their scope is much wider, in the sense that they try to be global in considering not only structural aspects, but also teleological aspects, interaction patterns, and many more primitive entities. On the other hand, even if most of them represent in their frameworks some of the relations that we have concentrated on in the paper (like institutionalization, affiliation etc.), they treat them as "black boxes", while we try to "look inside the boxes". In our opinion this is something that has to be done in order to better understand what these basic relations are and to be able to build upon them.

Probably the main reason of these differences is to be imputed to the fact that often these works move from the needs that emerge in applications and try to give a theory that deals satisfactorily with these problems, while we try to reach first a "clean" theoretical account and then we try to apply it to concrete scenarios.

Obviously, there are many possible ontologies of organizations, based on different theories of organizations; therefore, our analysis is biased in two senses: it is influenced by the philosophical assumptions we take (relying on the literature and on our personal intuitions) and by the formal framework we used, which is itself based on other more general assumptions. Nevertheless, this should not be regarded as a drawback of the proposal, but rather as an ineliminable feature of all proposals of this kind.

Many kinds of analysis can be and have been conducted on organizations, so it is important to understand what an ontological analysis is and how it can be distinguished from other kinds of analysis.

A first distinction that can be traced is relative to the focus of the analysis that can be either on dynamic or on static aspects of organizations. Among analyses of the dynamics of organizations we can further distinguish what can be called "genealogical analyses" from "analyses of the actions".

Generally speaking, genealogical analyses have the purpose of answering to questions like: how are organizations born? What happens when an organization is born? What is necessary in order for an organization to be born? What kind of relation does it entartain with its founders? These questions, although very important, are not adressed by the ontological analysis we want to pursue in the paper.

On the other hand, important questions for an analysis of actions are: How are collective actions performed? Which relations do they entertain with actions of the individuals who participate to the collective one? Can organizations be considered agents of some kind? And, if this is the case, how can they act in the world? Are they responsible for their actions? What can or cannot they do? All these questions are in a way peripheral to the ontological analysis, but some of the answers can be indirectly inferred by the study of the central ontological questions.

These central questions mainly concern the so called static aspects of organizations. Such questions are: which kind of relation does it hold between an organization and its members? What is necessary for a certain agent in order for him/her to be a member of an organization? Which is the relation holding between the roles in an organization and its normative layer? In other words, what is important for this analysis is to isolate the fundamental entities of the social/organizational domain and to characterize the relations holding among them, taking them – in some sense – for given, thus without considering their origin[1]. Along these lines, in this paper we will especially underline the importance of norms in determining the nature of social entities and relations in the internal dimension (among members inside the organization and between organizations and their members) rather than in the external one (among different organizations), even though we will address some preliminary inquiries to the latter subject as well. More precisely, with respect to the internal dimension, we give a formal characterization based on an accurate informal analysis, while relatively to the external dimension, at this stage we just sketch some general hypotheses that constitute the bases for the prosecution of the work.

An ontological analysis of organizations is the first, fundamental and ineliminable pillar on which to build a precise and rigourous enterprise modelling. An ontological analysis makes explicit the social structure that underlies every organizational settings.

The study carried out in this paper will rely on DOLCE (*Descriptive Ontology for Linguistic and Cognitive Engineering*), an already existing foundational ontology that has been developed at the Laboratory for Applied Ontology (LOA) of the Institute for Cognitive Sciences and Technology of the Italian Research National Council (see Masolo et al. (2003)).

DOLCE has proven very useful in adressing various problems and the paper is part of a collection of works aimed at extending DOLCE as to make it suitable for many distinct specific domains.

The paper is structured as follows: in section 2 the background concepts of DOLCE that will be used throughout the paper are introduced, while sections 3 and 4 present the

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[1] A further possible kind of analysis is the teleological one, namely the study of the relations that organizations have with their goals; this aspect is certainly relevant from an ontological standpoint, but it will not be addressed in depth in the present work, due to the fact that it deserves a long and detailed inquiry, not possible in the limited lenght of a paper.

main entities (organizations, roles and rules) of the organizational domain and the relations (validity, institutionalization and affiliation) holding among them respectively. Section 5 gives a formal characterization of all the notions introduced in the previous sections. Finally, sections 6 and 7 contain some discussions about promising future directions of this research.

2 BACKGROUND CONCEPTS

As already mentioned, this work is part of a larger project aimed at extending the DOLCE ontology as to comprise also the social dimension. This effort has already been started with the papers Masolo et al. (2004) and Bottazzi et al. (2006) and we will try to reuse and integrate their results in the present paper.

The notions of DOLCE we will use in the paper are those of endurant, perdurant, time location, agentive physical object and social object. Endurants and perdurants are two of the most basic categories of DOLCE; *endurants* are entities that are in time, like me, my cat, an umbrella, a flower (so, roughly speaking, they correspond to the commonsensical notion of object), while *perdurants* happen in time (they can be assimilated to the commonsensical events) and examples of them are conferences, tennis matches, my sister's wedding etc.

An *agentive physical object* is an endurant that has, in some sense, intentionality and is directly located in space and time (e.g., a human person). With respect to *social objects*, we can intuitively say that they are objects (endurants) produced by communities, in the sense that they depend, for their existence, on intentional agents that conventionally create them and accept them. In DOLCE they are divided in agentive or non agentive on the basis of their possession of intentionality. Nevertheless, while dealing with the issue of agentivity we realized that this topic is particularly complex when related to entities like organizations and social entities in general as it involves notions like collective intentionality and "indirect action". A case which is particularly tricky is that of organizations: they act via the action of some physical agent who acts on their behalf; is this to be considered a sort of agentivity (maybe indirect), or should we apply the Occam's razor and say that organizations' actions are to be reduced to agents' actions? We won't commit on this yet and we'll leave the question open, focusing our attention on other features of social entities[2].

Starting from the notion of social object, Masolo et al. (2004) has given the definition of some more specific notions, like that of social concept, of description[3] and of social role.

Social concept and *description* are two disjoint subcat-

egories of the category "non agentive social object" and they are connected by a *definition* relation. This should give the intuition that social concepts are contextual in nature and descriptions are the context in which they are defined. In addition we can say that descriptions are always encoded in at least one physical support; they begin to exist when they are firstly encoded and continue to exist until the last physical support in which they are encoded is destroyed and, finally, one and the same description can be expressed in many different ways and languages without losing its identity (provided its semantic content doesn't change).

Another relevant feature characterizing social concepts is the relation (called in Masolo et al. (2004) *classification*) that these entertain with categories of the so called "ground ontology", namely categories that are taken to be non contextual (in other words, non social). As an example, take the concept "crown of the king of Spain"; in this very moment there's probably a piece of precious metal that is classified by this concept, but this relation is given by the fact that there's a description (the one of the kingdom of Spain) defining the concept of "crown of the king of Spain". We can notice that this concept doesn't necessarily classify always the same object, in fact probably 200 years ago another piece of metal, possibly made up of a different precious material, was classified by the very same concept. Moreover, it is possible that in a certain moment a concept ceases to classify at all, for example if Spain becomes a Republic, or like at the present moment the "crown of the (actual) king of Italy", which doesn't classify anything.

In some sense, apparently the objects of the ground ontology – that we pretend to be acontextual – and the social objects – whose contextual nature is explicitly taken into consideration – belong to two different and heterogeneous domains but, in line with Masolo et al. (2004), both for technical reasons[4] and for pragmatic reasons[5], we put ground objects, social individuals and social concepts as well at the same ontological level. So, intuitively, we can say that social concepts are like properties, and thus treated as first class citizens in our ontological framework.

Social roles are instead a subclass of social concepts, with two additional features, that in Masolo et al. (2004) have been called *anti-rigidity* and *foundation*. Anti-rigidity expresses the fact that roles have dynamic properties and it establishes that "for any time an entity is classified under it [a concept], there exists a time at which the entity is present but *not* classified under the concept". Foundation, on the other hand, is the property that shows the relational nature of roles; in fact, it states that "A concept x is founded if its definition involves (at least) another concept y (definitional dependence) such that for each entity classified by x, there is an entity classified by y which is

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[2]As we will see, we will distinguish between social entities that can or cannot classify other entities and social entities that can or cannot define other entities.

[3]A detailed axiomatization of descriptions is given in Gangemi and Mika (2003) and Gangemi et al. (2004).

[4]Once we give a formal account, this allows us to express both social concepts and ground objects in first order language (see Masolo et al. (2004)).

[5]People often put both these classes of objects in the same domain of discourse when engaged in a conversation.

external to it (generic existential dependence on external properties)".

Finally, in Masolo et al. (2004) another notion was informally introduced: that of *social individual*. It was introduced in order to characterize those social entities that do not classify other entities. Examples of social individuals are the MILAN football club and Alice in Wonderland.

All these notions are embedded in rich axiomatizations and presented in detail in Masolo et al. (2003), Masolo et al. (2004) and Bottazzi et al. (2006) and for them we refer to those papers. In the current analysis we are just interested in using them as bases upon which to build a preliminary foundational analysis of the main entities and relations of an ontology of organizations.

3 OUR BUILDING BLOCKS

So far we have presented those notions that have already been dealt with in papers written by people of our laboratory (LOA). In the following we'll try to single out which are the main entities of an ontology of organizations, which are the connections between these entities and the others previously presented, which are the peculiar properties they acquire for the fact of being embedded in an organizational setting and the relations they entertain with each other.

The entities that populate the organizational settings are: organizations themselves, the agents who are member of the organization and who can act in it and sometimes for it, the roles that these agents play, other "organizational concepts", namely concepts that are expressly created for being used inside the organizational setting and, finally, norms and descriptions; they can define and constitute organizations themselves, they can define the concepts used inside organizations and can regulate the behavior of agents and organizations.

For what concerns agents, a couple of works (Ferrario and Oltramari (2004) and Bottazzi et al. (2006)) have been dedicated to the analysis of their features based on their mental attitudes, plans and goals, but these are just preliminary inquiries and they can be ignored for the sake of simplicity in this work, since at this stage we are only interested in the capability agents have of acting on behalf of organizations, in virtue of some roles they play inside those organizations.

Something that is for sure of extreme interest for an ontological account of organizations is a study of the notion of collective intentionality and collective attitudes in general: are these the product or the sum of the individual attitudes of the agents composing the collective, or are these some kind of primitive notions, that are not directly a consequence of these individual attitudes?

A last thing that is important to notice and that holds for all these categories is that organizations, social roles and concepts and norms are all social objects and, hence, non physical entities. There have been many debates around the physical character of social objects and the lit-

erature presents a lot of controversial issues (see Reinach (1913),Lorini (2000) and Smith (2002)), but a couple of examples can illustrate why we decided to take the non physical stance.

First of all, if a person is judged guilty of a serious crime, (s)he can be arrested and imprisoned; conversely, it is not possible to put to jail a company, like FIAT. For roles the language is less clear, in the sense that at a first glance it seems possible to arrest the President of FIAT, but in this case the police is not really arresting the President, rather the person that in that specific moment is playing the role of President. This is confirmed by the fact that if the President unfortunately dies in prison, it is not the case that FIAT elects a new President to replace the deceased in jail. Maybe a more evident example is that of hitting: while it is possible to hit a person, a building or a book, it sounds rather odd to say that I've taken a stick and I have furiously hit an organization, a role, a concept or a rule.

3.0.1 Organizations

Organizations are obviously the main subject of our analysis. At least if we use the term with its classical meaning, they are complex social entities that are created and sustained by human agents[6]. A bit more specifically, an organization is a complex entity linked to a group of people that are thus able to constitute and regulate complex activities that otherwise could not be accomplished by non coordinated individuals.

With respect to the ontological nature of organizations, we can say that the literature has developed mainly around three fundamental questions:

- Are organizations social groups or different kinds of entities?

- Are organizations agents? If this is the case, which kind of agents are they?

- Do they keep their identity through time and changes? How?

With respect to the first question, an interesting position in literature is that of Gilbert (1989), which describes social groups as sets of people connected by some kind of tie and conscious of this tie. On the other hand, at least intuitively, the word "organization" recalls some organized structures where knowledge is heterogeneously distributed, so that some members can be unaware of the tie that links them to people they can even ignore the existence of. Thus, our choice will be to consider organizations as distinct from social groups.

As for the second question, this constitutes the main subject of the literature on organizations in legal and moral philosophy, where it raises fundamental issues as personhood and responsibility of organizations. In many accounts organizations are considered as having a personality and

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[6]Nowadays many researches in the Artificial Intelligence domain are focused on the creation of "artificial agents' societies".

identity of their own and thus as being agentive entities (Rousseau (1762), Hauriou (1925)). Nonetheless, since they act in a very peculiar way, namely through the actions of some agents who, in virtue of the roles they play, are delegated to act on their behalf[7], it is not very obvious that they can really be classified as agentive entities. Not only this: their actions (the actions these agents perform on their behalf) are of a particular form, that we can call "institutional". The President doesn't hit a piece of wood with a stick on behalf of the organization he's president of (unless this is a symbolic gesture with some further meaning), but he can very easily sign a contract on behalf of it. In other terms, every act which is indirectly performed by an organization must be institutional. For the time being, we won't take a definite position on the agentive vs. non agentive essence of organizations, but we will postpone the solution of this dilemma to future developments of this work, where the notion of "representative of an organization" will be specifically addressed.

The third question has instead been answered by claiming a sort of "immortality" of organizations with respect to their members, in the sense that they preserve their identities through the turnover of people occupying roles (Smith (2002), Ladd (1970)) and positions in it and they can even survive to the elimination of some of their constituent roles.

Our hypothesis is that organizations are social individuals; differently from social concepts and roles, they don't classify particulars (like agents or physical objects). They can create new norms, can play roles and can act by means of some member agents who play particular roles inside it.

Differently said, using Bottazzi et al. (2006)'s terminology, they depute their actions to some roles, which in turn classify individual agents, who are the ones that ultimately act.

3.0.2 Roles and Concepts

Social roles and social concepts have already been described and analyzed at length in Bottazzi et al. (2006) and especially in Masolo et al. (2004), but here we'll mainly concentrate on those roles that classify intentional agents and social concepts that classify non agentive physical objects (like inanimate things).

Starting from roles, we can sum up their main features in the following way. First of all, a role can be played by different entities, at different times or even simultaneously; conversely, the same entity can play different roles, even simultaneously, so there's no necessary relation between a role and its player(s), an entity can change role and also play the same role more than once. Roles are intrinsically relational, in the sense that, at a definitional level, they depend on the definition of other roles; a definition of a role cannot be given "in isolation" (let's think

about the roles employer/employee, buyer/seller...). Finally, they are linked to some specific kinds of entities that provide explicit definitions for them; in the case of organizations, we can think about these entities as norms and descriptions.

Roles are also attached to an unusual notion of agentivity: they cannot act themselves, but they classify entities (like intentional agents) who can act[8].

In Masolo et al. (2004) some relations between roles are also analyzed. For instance, a role can specialize another role, as in the case of "Italian Prime Minister", which is a specialization of the role "Prime Minister": some agent is Prime Minister because in particular (s)he is Italian Prime Minister. More interesting for our purposes is the relation that has been called *requirement*: it can be required that an agent, in order to assume a role, must have previously assumed another role. Again with Italian Prime Minister: in order to play the role of Italian Prime Minister, an agent needs to have previously played (and in this case (s)he must also still play) the role of Italian citizen[9].

This relation is very interesting because often in organizations there is a precise hierarchy of roles and there is a kind of "forced path" to follow in order to reach a certain position and play a determinate role.

Finally, the importance of the notion of social role or, more generally, of social concept in organizations is not only relevant for the case of agents, but also for non agentive objects. As a matter of fact, organizations have the capability of ascribing a certain *status* to certain objects: for instance, a piece of paper can acquire the status of bill or receipt because there's an organization whose members, if some norms are respected, recognize it as such.

Here we come to the third important building block for an ontology of organizations: descriptions and norms.

3.0.3 Descriptions and Norms

In our account, all norms are descriptions. So, in a sense, they constitute the context inside of which both organizations and their concepts and roles are defined.

This is in our opinion a very important part of the ontology of organizations that has not yet been addressed satisfactorily. So, we start here an informal analysis with the aim of giving a conceptual clarification of the issue as a starting point for a later formal analysis.

Following the literature (taking inspiration mainly from Searle (1995), Tuomela and Bonnevier-Tuomela (1995) and Tuomela (2002)), we have singled out three different kinds of norms; the distinction is based on the different functions they have.

1. *Constitutive Norms*: they have a defining function:

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[7] We refer to the section on Agentive Figures of Bottazzi et al. (2006) for a deeper explanation of the relations of *deputing* and *acting for* holding between organizations and roles and organizations and agents playing those roles respectively.

[8] Sometimes it is common to say that someone acted in a certain way because (s)he was acting as the President of a certain organization. A possible way to deal with such kinds of expressions is to introduce a new kind of entity in the ontology that we could call *qua-entity*. Some discussions on this issue are presented in Masolo et al. (2004) and, more extensively, in Masolo et al. (2005).

[9] For more on requirement see section 5.

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.

2. *Deontic Norms*: they regulate the behavior of social entities: what they are allowed to do (directly or indirectly), what they are obliged to do etc. They create constraints on these behaviors inside organizations. In particular, they regulate the behavior that agents must observe when they play definite roles. There are also deontic aspects connected with non agentive social concepts: for instance, the possession of a certain object that has acquired a social status can testify the fact that the owner of that object has the permission or the prohibition to do something (think about legal documents).

3. *Technical Norms*: they describe the correct procedure to do something (see von Wright (1963)). Their social status comes from the fact that they are also created and accepted by communities of agents and, similarly as deontic norms, they also have the purpose of constraining the behavior of certain members of the organization, but they are distinguished by the fact that they are not "assertory" (you must do this and that), but are like suggestions. They are often used in organizations and they are very useful[10].

4 BASIC RELATIONS

After having presented the building blocks of our framework, we start analyzing the relations that bind together these blocks. In this section we consider three basic relations:

- validity[11] (holding between norms and descriptions on one side and organizations on the other);

- institutionalization (holding between roles and organizations);

- affiliation (holding between agents and organizations, via the roles they play inside organizations).

A few remarks can be added: as we will show in section 5, the relation of affiliation is based on the relation of institutionalization which, in its turn, is based on the relation of validity. The latter relation could also be thought of as the basis of a relation of commitment to a norm: an

agent who is affiliated to an organization is committed to the norms that are valid within the organization. Nonetheless, this notion of commitment is only one among others in the literature: agents can also be committed to actions which are part of the expected behavior of the roles they play in the organization and the scope of its application is not restricted to the organizational domain, but in general it is extendable to situations in which interaction is involved. Surely commitment deserves a deeper analysis which is currently premature.

4.1 Validity

What does it mean for a norm to be valid? There are well known problems related to the notion of validity in the literature of the modern theory of law, and many different answers have been given to them at least by Hart (1961), Kelsen (1967) and von Wright (1963). We do not enter in these details here, following our goal to give a general framework for organizations, but some intuitions on this basic notions are needed.

As we stated before, a (complex) description defines an organization. In this description there is all that is required to specify what the organization is, from its general purposes (making money or the revolution, for instance) to its concepts and roles (president, CEO, comrade etc.), and to the deontic and technical norms that the players of roles defined in it must follow.

We believe that this is not enough. We need something more than an abstract specification of what this social object (organization) is: we need another relation between the description and the organization. We will call this validity relation. We believe that this notion of validity is linked with the dimension of social commitment, i.e. it is something that turns the description into a prescription for agents. When we consider the description that defines the concept *triangle*, we are in no way "legally forced" by this description, and in the same way a theory that simply defines an organization has no legal power for the agents related to it. Therefore, a description is valid when a particular social event occurs. This social event (take for instance a poll, some official publication, a promise and so on) creates a social commitment among the agents related to the organization. This relation is exactly what makes the difference between simple descriptions and (systems of) norms: norms are those descriptions that are valid within and for an organization.

With this relation of validity we can define also the relations of institutionalization and affiliation.

4.2 Institutionalization

Intuitively, "being institutionalized", for a role or, more generally, for a concept means to be embedded in the structure of the organization. Like the validity relation for norms, it is used to give a "legal status" to concepts and roles that are used and structured in the organization. In other words, the idea is that a description which

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[10]A last distinction that could be made about norms is based on their origin. Either norms are institutionally created by an authority and thus explicitly encoded on some physical support, or they can emerge from social practices. In this latter case they can be respected and still remain implicit, or they can later evolve in institutional, when their usefulness is recognized and someone in the organization decides to encode them.

[11]This meaning of "validity" is to be kept distinct from that of the logical notion.

is valid for an organization, not only describes and regulates the organization itself, but also creates new concepts that have a certain meaning only inside the organization. More specifically, it describes the activities to be performed and assigns to each activity an "actor"; this results in a description of the actions an agent is allowed, obliged, forbidden etc. to do while playing a certain role inside the organization. In a sense, one could say that a concept or a role is institutionalized in an organization when its expected patterns of behavior are described in a description which is valid in the organization.

For instance, if we take the Italian Constitution, which in a sense can be seen as a description of an organization (the Italian State), among the rules (articles) composing it, several can be found which describe the role of the Italian President, as suggested above, what (s)he is obliged to do: "Laws are promulgated by the president within a month after having been adopted", what (s)he is allowed and forbidden to do: "The president may dissolve one or both chambers after having consulted their speakers. He may not exercise this power during the last six months of his term, provided this period does not coincide partly or entirely with the last six months of the term of chambers".

4.3 Affiliation

The relation of affiliation indicates the conditions under which agents are member of organizations. For instance, an individual who plays the role of researcher is affiliated to a University and his/her role is institutionalized in the University.

This means that the agent who decides to become member[12] of and is accepted by an organization agrees to undertake all the rights and duties connected to the role that (s)he will play within the organization.

So, in a way, an agent becomes member of an organization through the assumption of a particular role which establishes her/his function in the organization and – consequently – the activities (s)he will do in the organization.

Furthermore, the property of being affiliated (which descends from the affiliation relation) ranges not only on human beings (as in the previous example), but also on organizations. That is to say that, as everyday experience shows, there are many cases of "organizations of organizations", i.e. organizations whose members are other organizations. Take for example the Italian State, which is affiliated to the United Nations.

On the other hand, even if it possible to have organizations whose members are other organizations, this chain is not infinite: at the end there are always agentive physical objects; in other terms, if we imagine a nesting of affiliation relations, in the most internal place we will necessarily find agentive physical objects.
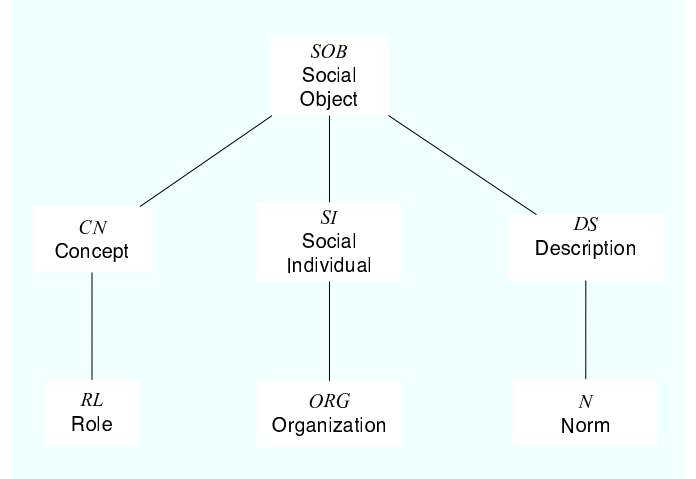

Figure 1: Social Objects Taxonomy

Lastly, it is worth noticing that, as in the case of validity, it is very likely that, at the origin of every affiliation relation there is a social event. This is the setting in which the agreement that determines the reciprocal rights and duties of the "prospective affiliated" and the "affiliating organization" takes place and creates a sort of reciprocal general commitment.

5 FORMAL CHARACTERIZATION

In this section we will provide a first draft of a formal characterization in first order logic of the main notions and relations presented in the paper. In order to do that, we need to informally introduce some predicates of DOLCE and to use some of the axioms and formulas previously presented in Masolo et al. (2004)[13].

The predicates of DOLCE we will refer to are:

- $ED(x)$ standing for "*x is an endurant*", i.e., an entity that is *wholly* present at any time it is present, e.g., a car, Berlusconi, K2, a law, some gold...;

- $PD(x)$ standing for "*x is a perdurant*", i.e., an entity that is only partially present, in the sense that some of its temporal parts may be not present, e.g., reaching the summit of K2, a conference, eating, being open...;

- $APO(x)$ standing for "*x is an agentive physical object*", i.e., an endurant that has, in some sense, intentionality and is directly located in space and time e.g., a human person...;

- $SOB(x)$ standing for "*x is a social object*", i.e., an endurant that: (*i*) is not directly located in space and, in general, has no direct spatial qualities; (*ii*) depends

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on a community of intentional agents, e.g., a law, an economic system...;

- $TL(x)$ standing for "*x is a temporal location*", i.e., a temporal interval or instant;

- $\mathsf{PC}(x, y, t)$ standing for "*the endurant x participates in the perdurant y at time t*", i.e., a person who participates in a discussion.

The next step is that of taking the notions of concept (CN) and description (DS) together with some of the relations holding among them from Masolo et al. (2004).

As we pointed out before, differently from Masolo et al. (2004), where they are classified as non agentive physical objects, here we consider concepts and descriptions simply as social objects:

(A1) $DS(x) \rightarrow SOB(x)$

(A2) $CN(x) \rightarrow SOB(x)$

(KA3) $DS(x) \rightarrow \neg CN(x)$

Then, we reuse some of the main axioms, modified as for including in the formalization the notion of social individual (SI) that in Masolo et al. (2004) was only informally introduced:

(A3) $SI(x) \rightarrow SOB(x)$

(A4) $DS(x) \rightarrow \neg(CN(x) \vee SI(x))$

(A5) $SI(x) \rightarrow \neg CN(x)$

Examples of social individuals are the MILAN football club and the Italian Presidency, but also particulars as Alice in Wonderland or the Land of Toys.

Then we import the argument restriction on the US relation, which can range only over concepts and descriptions. The intuitive meaning of the axiom is that a concept is used in a description:

(KA4) $\mathsf{US}(x, y) \rightarrow (CN(x) \wedge DS(y))$

We want to apply this axiom also to social individuals, thus we modify it in this way:

(A6) $\mathsf{US}(x, y) \rightarrow ((CN(x) \vee SI(x)) \wedge DS(y))$

So, the US relation holds also between social individuals and descriptions.

Then we import also the definition (DF) relation that is a specialization of the use (US) relation and states that concepts and social individuals are defined by descriptions:

(KA5) $\mathsf{DF}(x, y) \rightarrow \mathsf{US}(x, y)$

Intuitively, a concept is defined by a description when it is introduced for the first time, while it is used by a description when it has been defined in another description and it is just imported. Moreover, every concept must be defined by at least a description:

(KA6) $CN(x) \rightarrow \exists y(\mathsf{DF}(x, y))$

Even in this case, we want to apply the axiom also to social individuals:

(A7) $(CN(x) \vee SI(x)) \rightarrow \exists y(\mathsf{DF}(x, y))$

Thus, the following theorem is no more valid:

(KT1) $\mathsf{DF}(x, y) \rightarrow (CN(x) \wedge DS(y))$

And the theorem below follows from (A6) and (KA5):

(T1) $\mathsf{DF}(x, y) \rightarrow ((CN(x) \vee SI(x)) \wedge DS(y))$

Finally, in the following we will use the notion of classification (CF), that we will also import:

(KA11) $\mathsf{CF}(x, y, t) \rightarrow (ED(x) \wedge CN(y) \wedge TL(t))$

Now, some new notions are introduced. First of all, the notion of social event (SEV):

(A8) $SEV(x) \rightarrow \exists y, z, t(APO(y) \wedge SOB(z) \wedge \mathsf{PC}(y, x, t) \wedge \mathsf{PC}(z, x, t))$

(A8) tries to capture the intuition that a social event is an event in which participate both (at least) an agent and a social object. For instance, a social event, like a poll, involves agents and social objects like parties and ballots. We have decided to use a single variable for time for simplicity, thus assuming that agents and social objects participate both for the whole duration of the event[14]. The notion of social event and the validity relation are taken as primitive and only characterized. This is because in both cases something more is needed in order to give a real definition.

It follows from the characterization of the partecipation relation in DOLCE and from (A8) that a social event is a particular kind of perdurant:

(T2) $SEV(x) \rightarrow PD(x)$

Then we introduce a new primitive, validity (VAL):

(A9) $\mathsf{VAL}(x, y) \rightarrow SI(y) \wedge \mathsf{DF}(y, x) \wedge \exists z, t(SEV(z) \wedge \mathsf{PC}(x, z, t) \wedge \mathsf{PC}(y, z, t))$

(A9) explains that, in order for a description to be valid for a social individual, a necessary condition is the occurrence of a social event in which both the social individual and the description participate[15].

So we can define the relation, called institutionalization (INST), between a concept and a social individual that holds when such a concept is used by a description that is valid for the social individual:

(D1) $\mathsf{INST}(x, y) \triangleq CN(x) \wedge \exists z(\mathsf{VAL}(z, y) \wedge \mathsf{US}(x, z))$

This should give the intuition that when the rules of an organization (or a social individual in general) are given in

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[14]We are aware of the fact that this is not obvious, but it shouldn't be too difficult to distinguish the time of participation of the agent and the time of participation of the social object and to characterize the relations holding between these two time periods.

[15]The intuition underlying this definition of validity is that during a social event, a link is established between an institution and the description and norms that define it, thus all these elements must participate to the social event.

a description, a series of new concepts and – as we will see – roles that contribute in constituting the organization are also introduced.

In Masolo et al. (2004) a pair of important relations are introduced: the specialization relation and the requirement relation[16]. Here we are especially interested in the *requirement relation*. $\mathsf{RQ}(x,y)$ stands for "*x requires y*": if the concept x requires the concept y, all the entities classified by x must also be primarily classified by y, where this primacy is more logical than temporal.

Consider this example: Ciampi is President of Italy; in our account "President of Italy" is a concept[17]. The definition of the concept of President of Italy is based on that of Italian citizen: being an Italian citizen is an explicit *requirement* for becoming President of Italy. One cannot become President of Italy if (s)he is not also Italian citizen. In a sense, the concept of President of Italy 'definitionally' depends on the concept of Italian citizen. This is expressed in Masolo et al. (2004) by the following axiom:

(KA21) $(\mathsf{RQ}(x,y) \wedge \mathsf{DF}(x,d)) \to \mathsf{US}(y,d)$

From (KA21), (D1) and (A9) it follows that if a concept requires another concept and the former is defined by a valid description, then the latter is also institutionalized in the social individual in which the description is valid:

(T3) $(\mathsf{RQ}(x,y) \wedge \exists w(\mathsf{DF}(x,w) \wedge \mathsf{VAL}(w,z)) \to \mathsf{INST}(y,z)$

If the concept Italian President requires the concept Italian citizen and Italian President is defined in the Italian Constitution (which is valid in the Italian State), then Italian citizen must be institutionalized in the Italian State.

In Masolo et al. (2004) a precise definition of role (RL) is given, to which we refer. Here it is sufficient to point that roles are concepts:

(A10) $RL(x) \to CN(x)$

We introduce a new relation, called affiliation (AFF), between an agent or a social individual and another social individual in a certain time interval. If an agent or a social individual is affiliated to another social individual at a certain time then at that time (s)he plays a role that is institutionalized for the social individual:

(A11) $\mathsf{AFF}(x,y,t) \to (APO(x) \vee SI(x)) \wedge \exists z, t(RL(z) \wedge \mathsf{CF}(x,z,t) \wedge \mathsf{INST}(z,y))$

here affiliation is just characterized because the elements we have so far are not sufficient to give a complete definition[18].

With this machinery we can say that a necessary condition for a social individual to be an organization (ORG) is the existence of at least one agent or a social individual

which is affiliated to it during the whole period in which it (the organization) is present:

(A12) $ORG(x) \to \exists t(\mathsf{PRE}(x,t)) \wedge \forall t(\mathsf{PRE}(x,t) \to \exists y \mathsf{AFF}(y,x,t))$

From (A12), (D1),(A9) and (A11), it follows:

(T4) $ORG(x) \to SI(x)$

all organizations are social individuals.

Finally, another necessary condition in order to have an organization is the fact that there exists at least a role which is institutionalized in a description that is valid for the organization. From (D1), (A11), (T4) and (A7) we have:

(T5) $ORG(x) \to \exists y, z(\mathsf{INST}(y,x) \wedge \mathsf{DF}(x,z) \wedge \mathsf{VAL}(z,x))$

Once again, the idea we want to render is that an organization is defined both by a set of rules (like a statute) and a set of roles that give structure to it.

An interesting feature of our model is that it can be extended to characterize particular kinds of organizations, like those with only one affiliate. We call these organizations *single organizations* ($SORG$):

(D2) $SORG(x) \triangleq ORG(x) \wedge \forall y, y', t((\mathsf{AFF}(y,x,t) \wedge \mathsf{AFF}(y',x,t)) \to y = y')$

We believe that this notion of single organization is important as often organizations are not distinguished from (social) groups. Though, groups and organizations are different; one of these differences is that is it possible to conceive an organization with just one affiliate but defining a group with only one member sounds at least linguistically weird.

Now we'll try to clarify some aspects and implications of our model by providing some examples. Take the example illustrated in Figure 2: the individual Carlo Azeglio Ciampi is classified by the role President of Italy. This role and the organization Italian State are defined by the Italian Constitution, that is a description. Moreover, the role President of Italy is institutionalized by the Italian State and, because of this, Ciampi (as individual) is affiliated to the Italian State. Finally, the Italian Constitution itself is valid for the Italian State.

In figures, as in Masolo et al. (2004), the following conventions are assumed:

- universals (predicates) are represented in italics, with first capital letter;

- individuals (instances) are represented in type with small letters;

- relations between individuals are represented by dashed labeled arrows:
  $\mathsf{a} - \overset{R}{-} \succ \mathsf{b}$ stands for: $R(\mathsf{a},\mathsf{b})$;

- the "instance-of" relation between a particular and a universal is labelled by $i-of$.

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[16] For more details see Masolo et al. (2004).

[17] "President of Italy" is, more specifically, a role. For more on roles see forward in this section.

[18] For instance we cannot rule out the case of a client of a firm which is in the scope of the characterization as it is. This sounds counterintuitive as an instance of affiliate.
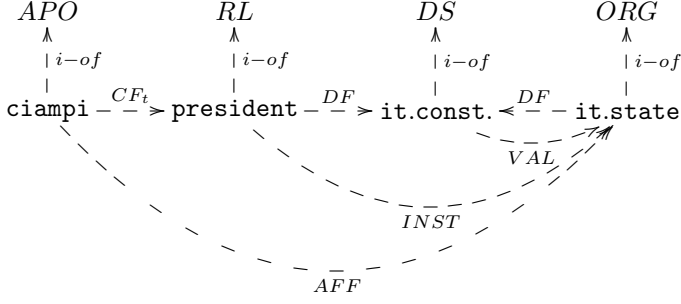
APO   RL   DS   ORG

$i-of$ $i-of$ $i-of$ $i-of$

$$\text{ciampi} \xrightarrow{CF_t} \text{president} \xrightarrow{DF} \text{it.const.} \xleftarrow{DF} \text{it.state}$$

VAL

$INST$

AFF

Figure 2: The Ciampi example

ORG   RL   DS   ORG

$i-of$ $i-of$ $i-of$ $i-of$

$$\text{esp.santo} \xrightarrow{CF_t} \text{br.fed.u.} \xrightarrow{DF} \text{bra.const} \xleftarrow{DF} \text{brazil}$$

VAL

$INST$

AFF

Figure 3: The Espirito Santo and Brazil example

With this very simple model we can also describe a relation that holds among organizations. Organizations can be affiliated to other organizations, via the institutionalized roles that they play. In this way we can define an organization of organizations, that is an organization that has at least an organization as its member:

(D3) $OORG(x) \triangleq ORG(x) \wedge \forall t \exists y (\mathsf{PRE}(x,t) \rightarrow (ORG(y) \wedge \mathsf{AFF}(y,x,t)))$

Now we come to a more complicate issue. Even if organizations can be affiliated to other organizations which in their turn have other organizations as affiliate, the chain of affiliation relations should not be infinite, it should end with an organization that has agentive physical objects as members.

A first step in order to reach this condition is the introduction of a relation, that we call 'Indirect Affiliation' (iAFF), that, differently from AFF, is transitive:

(A13) $\mathsf{iAFF}(x,y,t) \leftrightarrow (\mathsf{AFF}(x,y,t) \vee \exists z(\mathsf{AFF}(x,z,t) \wedge \mathsf{iAFF}(z,y,t)))$

Moreover we add as a requirement that an organization must always have an agentive physical object as indirect affiliate:

(A14) $ORG(x) \rightarrow \forall t \exists y (APO(y) \wedge \mathsf{iAFF}(y,x,t))$

We are aware that this is not enough in order to block the chain. Take for example models in which organizations have both organizations and agentive physical objects as members. These "suborganizations" can have – in their turn – both agentive physical objects and organizations as affiliate and the process can go on at infinite. These models although infinite, are compatible with our axioms[19].

As an example of multiple affiliation take the case of the State of Brazil (see Figure 3). Brazil is a federation and in our sense it is an organization of organizations. The Brazilian Constitution (the description that is valid in the State of Brazil) defines the role of Brazilian Federal Unit. In this way the State of Espirito Santo is affiliated to the
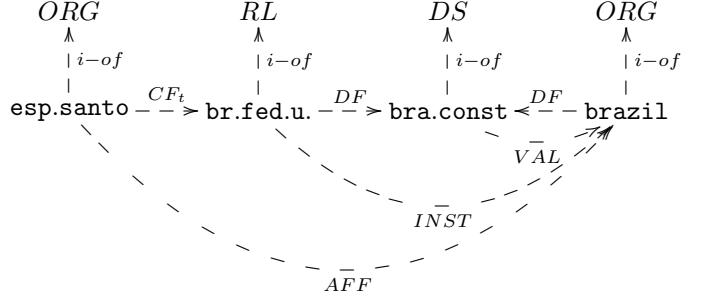
ORG   RL   DS   ORG

$i-of$ $i-of$ $i-of$ $i-of$

$$\text{brazil} \xrightarrow{CF_t} \text{un.memb.st.} \xrightarrow{DF} \text{un.chart} \xleftarrow{DF} \text{un}$$
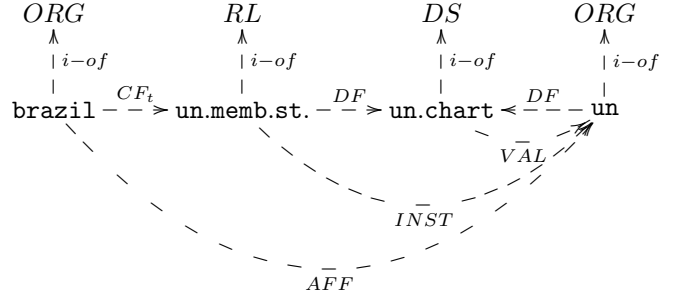
VAL

$INST$

AFF

Figure 4: The Brazil and U.N. example

State of Brazil. We can say something similar for the State of Brazil and the United Nations (see Figure 4). The State of Brazil is affiliated to the UN via the role of State Member defined in the Charter of the United Nations. This shows also that the affilation relation is not necessarily transitive: the fact that Espirito Santo is affiliated to Brazil and Brazil is affiliated to the UN does not imply that Espirito Santo is (at least directly) affiliated to the UN. In this way we can have a sort of complex chain of affiliation relations among agents and organizations, as shown in Figure 5, where Renata (a physical agent) belongs to the jurisdiction of Espirito Santo and to the State of Brazil, Espirito Santo is a member of the State of Brazil and the State of Brazil is a member of the UN.

We surely believe that this is not enough. In order to deal whit the complexity of inter-organizational relations much more work is needed, but at the same time we believe that this could be a basis in order to accomplish this very difficult task. In section 7 we try to lay down some hypoteses on this topic.

6 INTERNAL STRUCTURE: REFINEMENTS

There are many other issues tightly connected to the scenario depicted in the previous sections that deserve to be inquired in depth as they look very fundamental under many respects in the explanation of organizational phenomena.

At this stage of this work in progress it is not completely

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[19] Apparently, there are similarities with the problem of atomicity in mereology since agentive physical objects can be seen as the minimal constituents of organizations. Thus, some technical apparatus could be imported from mereology (see Simons (1987) and, more specifically, Masolo and Vieu (1999)).
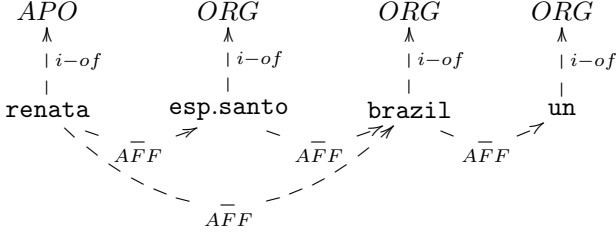
Figure 5: An example of multiple affiliation

clear yet how they will fit in the formal characterization, but this section is an attempt of giving notional elucidations and a first exploration of the possible links between these topics and what is already part of the general framework.

6.1 Representative members

The first notion that we analyze in this section is the one of representative member, that is to say a member who can act *on behalf* of the organization (s)he is member of. We will call the relation holding between this kind of members and the organization *representation relation*[20].

The representation relation holds between agents in general, thus not only – as just explained – between a human and an organization, but also between two humans or two organizations but, in this latter case, similarly as with affiliation, the relation must ultimately be based on another representation relation in which the representative member has to be a human; the reasons why it is so are explained below.

In our remarks on the nature of organizations we pointed out their immateriality and their capability to act in some way as fundamental properties, but then a problem arises: how can a non physical object act? Partially following Hobbes (1651) and Rousseau (1762) we suppose that there is one (or some) relevant agent(s) of the organization (for example the founder) that gives the authority to one (or some) other agent(s) to act on behalf of the organization:

> Of persons artificial, some have their words and actions owned by those whom they represent. (Hobbes (1651))

In this way any action that has an "institutional meaning" and is performed by the "delegate" agent could be seen as performed by the organization itself. Therefore, in our view, the relevant agent(s) (i.e. the founder of the organization) must have established in the normative system of the organization this capability of some agents of acting on behalf of it.

Moreover, the representation relation is linked to the delegation relation:

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[20] Obviously, the representation relation we are presenting here has nothing to do with the notion of representation dealt with in philosophy of mind.

[..] in delegation an agent A needs or likes an action of another agent B and includes it in its own plan. In other words, A is trying to achieve some of its goals through B's behaviours or actions; thus A has the goal that B performs a given action/behaviour. (Castelfranchi (2003))

This important relation holds in many different social contexts and, among these, also in the institutional one, but it is not specific of it. The relation that characterizes the institutional and organizational contexts and is peculiar of them is the relation of representation.

Generally speaking, the representation relation is a delegation relation that holds between agents that are classified by two roles: the *representative* and the *represented* role. Differently from the delegation relation, if the representation relation holds, the delegant cannot perform him/herself the action that (s)he wants or needs the delegate to do. Sometimes it is the case that there is a contingent impediment, other times the delegant is intrinsically unable to perform what (s)he is delegating. The case of organizations is clearly one of these. Organizations, as immaterial entities, cannot act without a physical agent who acts for them.

Therefore, any organization has at least a representative role and a represented role defined in its normative system. We can also hypothesize that the normative system defines a chain of representation relations, but the necessary constraints to this relation are that at the two extremes of the chain we have the organization (at the represented side) and an agentive physical object (at the representative side). In the "intermediate" representation relations both places can be occupied both by (sub)organizations and by physical agents.

For instance, if we take again the Italian State, we can have the Italian government that acts on its behalf and, in turn, Berlusconi who, as Prime Minister, acts for the Italian government and, indirectly, for the Italian State.

Following this line of reasoning, it seems fair to say that every organization not only has at least an affiliate, but also at least a representative, i.e. someone who can act on its behalf. Thus, going back to the formal framework, once that we succeed in defining in some way the representation relation, this could integrate the rough characterization of organizations that is given at this stage in the formalism. If we call REP the representation relation, the axiom (A12) in section 5 could be replaced by something as:

$$ORG(x) \quad \triangleq \quad \exists t(\mathsf{PRE}(x,t)) \ \wedge \ \forall t(\mathsf{PRE}(x,t) \ \rightarrow \ \exists y, z(\mathsf{AFF}(y,x,t) \wedge \mathsf{REP}(z,x,t)))$$

Most of the times representative members of organizations are also affiliates of the organization itself, but this is not always the case, as when, for instance, organizations have external legal representatives.

Anyhow, these two relations – representation and affiliation – seem to be connected in some way. In order to understand this complex link, we need to make a comparison between the *acting for* relation (between agents

and organizations) and the *membership* relation (between agents and collections) developed in Bottazzi et al. (2006) with our affiliation and representation relations. This is also important in order to build a coherent picture of the developments of the DOLCE ontology in the direction of the social reality. Moreover, we need to investigate if the elements we have considered in the paper are enough in order to define these fundamental relations.

Another element that we want to take into consideration in order to be able to characterize the relation of representation is its link with the notion of *qua-individual*. As shown in Masolo et al. (2005), if a classification relation holds between a role and an endurant, a third entity "arises": a qua-individual. As an example, take the situation in which Ciampi, an agentive physical object, is the President of the Italian State, i.e. is classified by this role. For the whole time span in which this relation holds an entity, a qua-individual (namely, Ciampi *qua-President-of-Italy*), exists. In Masolo et al. (2005) we hold that qua-individuals actually participate in events. As already mentioned, the Italian Constitution – i.e. the normative system of the Italian State – states that "the president may dissolve one or both chambers after having consulted their speakers". Therefore, when Ciampi dissolves the chambers *qua-President-of-Italy*, it is natural to hold that it is the qua-individual Ciampi *qua-President-of-Italy* who performs the action. But the qua-individual performs the action also as a rapresentative of the Italian State, so there is a sense in which it is the Italian State that dissolves the chambers. If so, how many individuals participate in this action? Who is, ultimately, the agent which performs the action? Which are the relations between these entities? Representation and qua-individuals seem to be somehow linked, so we have to inquire the nature of this link.

6.2 Teams

Another interesting topic which certainly deserves more attention is that of teams. Teams are "plural entities" which exist inside organizations, but they seem to be something different from sub-organizations, because they display a lower degree of autonomy, they seem less structured and usually they don't have a description of their own, but they are defined in the description of the organization. Anyway, it is not yet clear if these features are enough in order to distinguish them from sub-organizations.

On the other hand, taking inspiration from Bottazzi et al. (2006), they can be possibly characterized as collectives of roles played by agents. The advantage of taking this perspective comes from the possibility of reusing some of the analyses carried out there in order to characterize collectives and collections in general. For instance, in Bottazzi et al. (2006) collections (and collectives) are considered to be social objects that (generically) depend on their members; consider, for instance, a team x inside an organization. It remains the same team x even if some of the members leave and new members join. Conversely, should the role "staff member of x" cease to exist, the team x,

as a single entity, would disappear as well. This is due to the fact that collectives specifically depend on the role(s) played by their members.

For sure, these are only hints to some possible directions that our characterization could take, but there are many promising possible developments.

7 INTERORGANIZATIONAL RELATIONS

Except in the case of the analysis of the affilation relation, in this paper we have tried to investigate some features of organizations by considering them in isolation. This was done just for simplicity reasons and we are well aware of the fact that a complete account would require an analysis of multiple organizations interacting in a wider environment.

This field is very well studied in sociology (see, for a review, Whetten (1981), Galaskiewicz (1985) and more recently Strang and Sine (2000)). Nonetheless, the perspective adopted there is in a sense empirical and it is difficult to extract a general view on interorganizational relations. In ontological analysis, even if restricted to a specific domain, a general theoretical framework is fundamental.

To this aim, we want to lay down a preliminary general distinction. At a sufficient level of abstraction, we believe that it is possible to group interorganizational relations into two main types. The first one is based on the notion of normativity and the second on the notion of teleology.

An example of normative interorganizational relation could be what we call *containment relation*, which has been analyzed, even though using a different name, in Bottazzi (2003) and Boella and van der Torre (2004). What does it mean for an organization to be *contained* in another organization? As an example, take the relation that holds between the Italian State and another organization that, in some sense, belongs to this State, suppose the University of Torino. 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.

In teleological relations the emphasis is instead on goals. A "pure" teleological interorganizational relation could be the one that holds among competing organizations in a market environment. The telelogical nature of the relation is based on the fact that there is a common goal (a common end) that each organization has as its own: profit.

Starting from these two ideal types, we could consider many mixed cases, as for instance the relation between an organization and its suborganizations. The relation of being a suborganization of another organization can be considered as composed by normative and teleological aspects. As an example, consider the relation between a University, suppose the University of Torino and one of its Departments, for instance the Philosophy Department. We could

say that the latter is "contained" in the former, but there is also something more, for instance some general goals they share (doing research, forming students). Moreover, there is also a sort of "specialization relation" among the goals of these two organizations (doing research and doing research in philosophy, forming students and forming students in philosophy).

8 CONCLUDING REMARKS

This paper is meant to be a prosecution of some previous works on the social dimension of the ontology DOLCE and is mainly an attempt to present the basic entities and relations of the domain of organizations, which is included in the social realm.

Starting from background concepts imported from DOLCE and an analysis of the multidisciplinary literature on organizational issues, the paper gives two important contributions. Firstly, after having singled out the main entities and relations from the literature, it tries to formally represent them within the DOLCE framework. Second, it begins an exploration of possible developments built on top of these very basic notions and relations.

In our account there are three main entities in the organizational setting: organizations, norms and roles. Norms describe what an organization is by defining the main concepts of the organization and the beavior of the agents. The link between agents and norms is given by roles: an agent has to perform certain actions because (s)he plays a certain role.

We isolate one fundamental primitive relation: validity. By validity we define institutionalization: the relation that holds among roles and concepts on one side and organizations on the other. By institutionalization and validity we are able to characterize affiliation, a relation that holds between an agent – or an organization – that has a role institutionalized by another organization and the latter organization.

Then, after providing some examples to illustrate our model, we try to lay down some hypotheses in order to better understand the internal and external structure of organizations. For the former, we draw some hypotheses on the representation relation and on teams, for the latter we single out two main kinds of interorganizational relations: normative and teleological.

The work contained in this paper is still in progress, but it is meant to be a starting point for a possible kind of analysis on a domain which is for many respects underdeveloped at the current stage of the research. The conviction which supports the work that we are beginning with this paper is that by giving a high level analysis as the one displayed in the paper, we provide a very general framework able to describe a wide range of phenomena in the organizational domain and ready to be specified time after time when it has to be applied to more detailed real world cases.

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