

A Path to an 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 rigorous 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.

I. INTRODUCTION

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

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 “genetic analyses” from “analyses of the actions”.

Generally speaking, genetic 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 entertain with its founders? These questions, although very important, are not addressed 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 answers to 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).

An ontological analysis of organizations is the first, fundamental and ineliminable pillar on which to build a precise and rigorous 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*) [1], 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.

DOLCE has proven very useful in addressing 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.

II. BACKGROUND CONCEPTS

As already mentioned in the introduction, 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 [2] and [3] and we will try to reuse and integrate them in the present paper.

The notions of DOLCE we will use in the paper are those of *endurant*, *perdurant*, time location, *agentive* social object and *non agentive* 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.

With respect to *social objects* (both *agentive* and *non agentive*), we can intuitively say that they are objects (endurants) produced by communities, in the sense that they depend, for

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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 the present work, due to the fact that it deserves a long and detailed inquiry, not possible in the limited length of a paper.

their existence, on intentional agents that conventionally create them and accept them. They can be divided in agentive or non agentive on the basis of their possession of intentionality. Examples of agentive social objects are legal person and customer, while examples of non agentive social objects are a law or a currency.

Starting from the notion of non agentive social object, [2] has given the definition of some more specific notions, like that of social concept, of description² and of social role.

Social concept and *description* are two disjoint subcategories 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 to what already stated about non agentive social objects, 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 [2] *classification*) that these entertain with categories of the so called “ground ontology”, namely categories that are taken to be not contextual (in other words, not 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 metal, 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 [2], both for technical reasons³ and for pragmatic reasons⁴, 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 [2] 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” [2].

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 external to it (generic existential dependence on external properties)” [2].

Other two notions we want to use as backbones for our proposal have been presented in [3], where a very rich axiomatization that we will not present here is given; these are the notions of *collectives* and *collections*.

Very generally, we can say that *collectives* are collections of intentional agents. *Collections*, on their turn, are social objects that generically depend on their members (in the sense that they depend on all of them, but not specifically on anyone of them), but depend specifically on the roles played by their members (or, better, on the concepts that classify their members). This means that they also indirectly depend on descriptions.

In [3] many different kinds of collectives have been characterized, based on degrees of agreement, devisal, transparency, control and structure, but for the present purposes we can consider an undifferentiated notion of collective, which is exemplified equally well by a group of people running all together toward a shelter during a sudden tempest, by a group of fans performing the “ola” at the stadium, and by the employees of an enterprise.

All these notions are embedded in rich axiomatizations and presented in detail in [1], [2] and [3] 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.

III. 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 ([6] and [3]) 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 they have of acting on behalf of organizations, in virtue of some roles they play inside those organizations.

² A detailed axiomatization of descriptions is given in [4] and [5].

³ Once we give a formal account, this allows us to express both social concepts and ground objects in first order language (see [2]).

⁴ People often put both these classes of objects in the same domain of discourse when engaged in a conversation.

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 attitude 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 literature presents a lot of controversial issues (see [7], [8] and [9]), 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.

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.

.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 agents⁵. 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, in general in literature organizations are considered as distinct from social groups, based on the fact that normally social groups are thought of 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 [10].

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. There's a fairly wide agreement on the

fact that organizations have a personality and identity of their own and thus they are agentive entities ([11], [12]), but 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 behalf⁶. 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.

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 ([8], [13]) 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 are agents, so 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 [3]'s terminology, they depute their actions to some roles, which in turn classify individual agents, who are the ones that ultimately act.

.2 Roles and Concepts

Social roles and social concepts have already been described and analyzed at length in [3] and especially in [2], 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), so 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 act⁷.

In [2] some relations between roles are also analyzed. For instance, a role can specialize another role, as in the case of

⁶ We refer to the section on Agentive Figures of [3] 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.

⁷ 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 [2] and, more extensively, in [14].

⁵ Nowadays many researches in the Artificial Intelligence domain are focused on the creation of "artificial agents' societies".

“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.

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 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 members 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 [15], [16] and [17]), 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: 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 determinate 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 [18]. 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 useful⁸.

IV. 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 two basic relations for organizations, the validity relation and the representation relation. Before providing some intuitions about them, we must say that both relations need to be specifically considered in the institutional framework we are working on, and not in a wider sense. Therefore, the validity relation has to be seen as an institutional relation that holds between norms and organizations and not as a logical notion. The same is true for the representation relation, a relation holding among agents, that has nothing to do with the notion of representation dealt with in philosophy of mind. Another remark is important: as we shall see, the validity relation and the representation relation are respectively linked to the commitment and the delegation relations. In a sense, we can say that these latter notions are “more fundamental” than the former. They are not specific relations concerning only organizational settings, but rather very basic relations that characterize the whole social environment and are not limited to institutional aspects; surely they deserve a deeper and separate analysis.

A. 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 [19], [20] and [18]. 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 some role 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

⁸ 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.

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

B. Representation

Another important relation that we take into account is the representation relation. This relation holds between agents. As we stated before, this relation is linked to the delegation relation. In Castelfranchi’s view [21]:

[..] 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.

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.

In our remarks on the nature of organizations we pointed out their immateriality and their agentivity as fundamental properties, but then a problem arises: how can a non physical object act? Partially following [22] and [11] 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. 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 the agents of acting on behalf of it.

This could be done, in our framework, by means of the representation relation. 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. 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. The rep-

resented role must classify the organization itself and the representative role must classify at least another role defined by the normative system of the organization, for example the role “President”. The representative role must, for the aforementioned reasons, classify a role, like “President”, that, in turn, classifies only agentive physical objects. These can be seen as necessary conditions in order for the representation relation to hold.

V. 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 [2]⁹.

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...;
- $SOB(x)$ 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 on a community of intentional agents, e.g., a law, an economic system...;
- $ASO(x)$ standing for “ x is an *agentive social object*”, i.e., a social object that has, in some sense, intentionality, e.g., the Italian Republic...;
- $NASO(x)$ standing for “ x is a *non-agentive social object*”, i.e., a social object that has no intentionality, e.g., a currency...;
- $TL(x)$ standing for “ x is a *temporal location*”, i.e., a temporal interval or instant;
- $PC(x, y, t)$ 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 [2].

First we introduce restrictions on arguments for concepts and descriptions:

- (KA1) $DS(x) \rightarrow NASO(x)$
- (KA2) $CN(x) \rightarrow NASO(x)$
- (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 [2] was only informally introduced:

- (A1) $SI(x) \rightarrow ASO(x)$

A social individual is an agentive social object; examples of social individuals are the MILAN football club and the Italian

⁹ From a notational standpoint, axioms, definitions and theorems imported from [2] can be distinguished from the ones that are originally introduced in the paper by the fact that they are preceded by a K letter.

Presidency.

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

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

$$(A2) \text{ US}(x, y) \rightarrow ((CN(x) \vee SI(x)) \wedge DS(y))$$

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

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

This states that the definition (DF) relation is a specialization of the use (US) relation and that concepts and social individuals are defined by descriptions.

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

This axiom states that every concepts must be defined by at least a description. Even in this case, we want to apply the axiom also to social individuals:

$$(A3) (CN(x) \vee SI(x)) \rightarrow \exists y(\text{DF}(x, y))$$

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

Thus, the theorem above is no more valid and the theorem below follows from (A2) and (KA5):

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

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

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

Now, some new notions are introduced. First of all, for the sake of simplicity, we introduce the predicate Agent (AG), that is the union of the categories of APO and ASO:

$$(A4) \text{ AG}(x) \rightarrow (APO(x) \vee ASO(x))$$

We introduce the notion of social event (SEV), which is a particular kind of perdurant:

$$(A5) \text{ SEV}(x) \rightarrow PD(x)$$

A further characterization of social event is the following:

$$(A6) \text{ SEV}(x) \rightarrow \exists y, z(\text{AG}(y) \wedge \text{SOB}(z) \wedge \text{PC}(y, x, t) \wedge \text{PC}(z, x, t))$$

(A6) 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 event¹⁰.

¹⁰ 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.

$$(A7) \text{ VAL}(x, y) \rightarrow SI(y) \wedge \text{DF}(y, x) \wedge \exists z(\text{SEV}(z) \wedge \text{PC}(x, z, t) \wedge \text{PC}(y, z, t))$$

Here we introduce a new primitive, validity (VAL) and (A7) 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 participate¹¹.

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

(D1) defines the relation, called institutionalization (INST), between a concept and a social individual when such a concept is used by a description that is valid for the social individual.

$$(A8) \text{ RL}(x) \rightarrow CN(x)$$

In [2] a precise definition of roles (RL) is given, to which we refer. Here it is sufficient to point that roles are concepts.

$$(D2) \text{ AFF}(x, y, t) \triangleq \text{AG}(x) \wedge \exists z(\text{RL}(z) \wedge \text{CF}(x, z, t) \wedge \text{INST}(z, y))$$

(D2) defines the relation, called affiliation (AFF), between an agent and a social individual in a certain time interval. An agent is affiliated to a social individual iff (s)he plays a role that is institutionalized for the social individual.

$$(A9) \text{ ORG}(x) \rightarrow \exists y \text{ AFF}(y, x, t)$$

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 who is affiliated to it.

From (A9), (D1) and (A7), it follows:

$$(A10) \text{ ORG}(x) \rightarrow SI(x)$$

all organizations are social individuals.

This is only a preliminary characterization, in order to have a formal definition of organizations as described above, we need to characterize the representation (REP) relation just described. Thanks to the REP relation, (A10) and (A9) could be replaced by the following definition:

$$\text{ORG}(x) \triangleq \exists y, z(\text{AFF}(y, x, t) \wedge \text{REP}(z, x))$$

In order to illustrate our main entities and relations, let us consider an example (illustrated in figure 1) in the context of our formal framework. 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 figure 1, as in [2], the following conventions are assumed:

- universals (predicates) are represented in italics, with first capital letter;
- individuals (instances) are represented in type with small letters;

¹¹ 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.

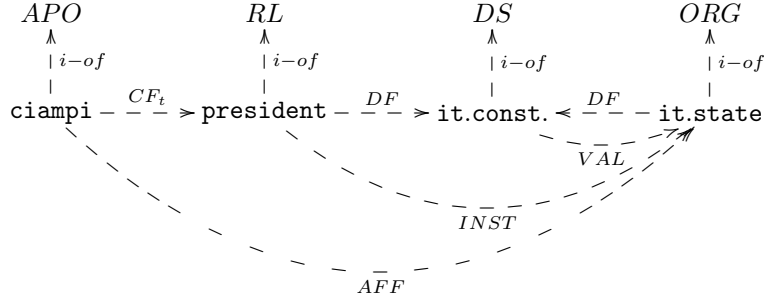


Fig. 1. Main relations and entities illustrated by the Ciampi example.

- relations between individuals are represented by dashed labeled arrows:
 $a - \xrightarrow{R} b$ stands for: $R(a, b)$;
- the “instance-of” relation between a particular and a universal is labelled by $i - of$.

VI. RELATED WORKS

As far as we know, there are not so many works 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 ([23]) and very few of them have a formal flavor. An important exception is the account given by Raimo Tuomela. His analysis of organizations in [17] is part of a wider project about institutional reality, strongly based on the analysis of the notion 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 [24], [25], [26], [27], [28], even though most of them are really 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”. As a consequence of this specificity, they mainly focus on workflow, activities, time-constrained processes and all those elements relative to the dynamics of organizations, thus resulting in ontologies of action.

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.

VII. FUTURE WORK

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. As a further step, we want to improve this preliminary work in four directions, starting from the two just sketched relations.

1. As a first move, we’ll try to clearly link the notion of representation with the notion of *qua-individual*. As shown in [14], 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 Republic, 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 [14] we hold that *qua-individuals* actually participate in events. Following the example, 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 representative 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.
2. A second possible improvement is to link the affiliation with the representation relation. 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 [3] with our affiliation and representation relations. Moreover, we need to investigate if the elements we have considered in the paper are enough in order to de-

fine this relation.

3. Thirdly, organizations are composed by human agents, but also by pluralities of non agentive entities. So, as mentioned in section II, the notions of collection and collective are central.

In [3] collections are considered to be social objects that (generically) depend on their members; consider, for instance, a collection of books in a library, suppose the collection of books of the Library of Congress, which remains the same entity even if some books are lost and others acquired over time. If we consider the Library of Congress as an organization, we could call the collection of its books as one of its “resources” (aside with others, like its furniture, buildings and so on). We could also say that for a collection, in order to be a resource for an organization, it must have at least one role defined in the normative system of the organization itself. Let’s then recall the main difference between collections and collectives: members of the latter are agents. So, similarly, we could consider the staff of the Library of Congress as a collection where the roles that characterize it are defined in the normative system of the Library.

The idea is that we can consider the notions of resources and staff of an organization as a specialization of the notions of collection and collective and thus try to reuse some of the analyses already done for these two latter notions.

4. Finally, 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. A special case would be that of organizations that are embedded in other, bigger, organizations. As an example, consider the relation between a University, suppose the University of Trento and one of its Departments, for instance the Philosophy Department. We could say that the latter is “contained” in the former, but what does it mean? What is required for this relation to hold? What happens to the normative systems of both these social individuals? Must there be some special roles defined into their normative systems?

These are some of the questions that are left unanswered in this paper, but that can help to enhance the understanding of what is the ontological nature of organizations.

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