

Antonio Leone Carmela Gargiulo
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Environmental and territorial modelling for planning and design



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TOWARD CLARIFICATION OF MEANINGS VIA ONTOLOGICAL ANALYSIS METHOD

IN ENVIRONMENTAL PLANNING PROCESSES
AND ACTIONS

**DOMENICO CAMARDA^a, MARIA ROSARIA
STUFANO MELONE^a, STEFANO BORGO^b
DINO BORRI^a**

^a Polytechnic University of Bari
e-mail: domenico.camarda@poliba.it

^b Laboratory for Applied Ontology, ISTC-CNR

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ABSTRACT

This work shows a research approach aiming at enhancing standard methodologies oriented to interpret places, by using information coming from new forms of place interpretation and description. This proposal is developed by investigating on geographical places as complex spatial environments well suited for the exploitation of different paradigms. The approach is based on ontological analysis. It can be useful to integrate a cognitive stand within the traditional analytical and organizational views of complex spatial environments, in particular aiming to facilitate decision-making processes.

In this context, the argument of the paper has a twofold implication. Certainly, the introduction of ontological layers is rather useful for organizing the modelling of complex systems. Yet, while these layers are informative, our understanding of space cannot be reduced to the ontological elements per se, as they may lack a contextual perspective. Deeper studies and research are then needed to develop formal frameworks that effectively integrate standard and ontological methodologies for general modelling purposes in environmental planning.

KEYWORDS

Spatial Cognition; Ontological Analysis; Cognitive Modeling; Planning

1 INTRODUCTION

Multiple commonsense definitions are possible for places. They are landscapes observed from far distance, as well as cities that are lived from inside or imagined from outside. They can be seen as ecological systems, social-technical systems and much more. This notion variety is harshly challenging for modelers typically based on limited methods and modelling techniques. Yet, models are required to identify and manage a large diversity of information and standpoints. In order to deal with such challenge, the approach of this work is on *lived places*. An underlying notion of physical place is put here, made up of a concept of space and a concept of place. They have different declinations and possible definitions, none of them simple. For example, a cognitive viewpoint considers space as typically developing and changing with agent's changes and evolutions, not just a geometrical entity (Freksa et al., 2014). Possibly more complicated than that, place is an interpreted, reasoned space, raising feelings, resulting from an aesthetic fruition etc. Place usually embeds a set of mental images, also representing an architecture of cognitive processes. Place's essence is connected with the quality of being in a specific location -e.g., "here" and perhaps not "there" (Rapoport, 1977). For example, the status of *being enclosed* (enclosure) tends to be a key aspect of the construction of a place. Places are mainly understood through cognitive contexts. That is why we can read *places in which we live*. We can interpret our being in a space as an objective proposition according to geometrical rules/indications. Nonetheless, our being in a place is defined only via a richer description. Every single person in a place has a subjective point of view and it is that point of view that characterizes that place as such. Points of view and contexts are results coming out from a historical – cognitive – cultural selection. Our knowledge of places can derive from experiences, from stories that structure ideas and feelings about them. When we talk about 'subjective knowledge' of places, what are we really dealing with? 'Subjective knowledge' is a kind of representation of places, and a representation vary from subject to subject and even across one's life (Orr, 1992). "Knowledge of a place — where you are and where you come from — is intertwined with knowledge of who you are. Landscape, in other words, shapes mindscape." (Orr, 1992). Many attempts have been carried out to get a definition of space representation. Ontological research (Borgo & Masolo, 2010) is increasingly seen as providing methodologies and tools to move forward in this direction. One advantage is that these systems are typically specified in languages that abstract away from data structures and implementation strategies. The languages of ontologies are closer to first-order logic than languages used to model databases. In computer and information science, an ontology is a technical term denoting a conceptual artifact that is designed for a purpose, which is to enable the modeling of knowledge about some domain, real or imagined (Gruber, 1993).

2 DEALING WITH PLANNING

The complexity of social and natural environments usually implies a dramatic level of uncertainty in modelling techniques. The traditional deterministic and quantitative approaches to urban planning and design in risky contexts seem to increasingly fall short of expectations in environmental domains; and this is now widely recognized (McConnell et al., 2010). Typical planning approaches try to manage complexity as the result of a recurring interaction between collective knowledge and the desired results. This position requires that *sharing* is the foundation of a necessary political dimension of contemporary design (Formato & Russo, 2014). An urban project as a plan or as a strategy has to evolve over time, it can't stay frozen (Ingallina, 2007). The planner, like the urban designer, has always to look at changes of the territory and

has to read the different relationship between built space and complex urban organization. Architecture, social sciences or anthropology have an active role in the thinking and the development of urban projects. In the anticipation game, a city is a relational system that must be thought as a whole, not a mere composition of districts (Gregotti, 2004). For these reasons a rich and reliable modeling of the place is an essential starting point for the planner.

3 INTERPRETATIONS OF GEOGRAPHICAL PLACES

Complex spatial environments are lived, moved and perceived by humans using different paradigms. Their interaction with space is sophisticated. It continuously changes over time and relies on a variety of information types that can be classified in as many types as topology, geometry perspective, dynamics, affordance, society, culture and so on. Perhaps due to the richness of this interaction, humans are not aware of how their understanding of and interacting with space is realized. Ontological analysis, the study of what is at the core of our view on reality, can help to recognize, clarify and organize the essential elements and features of places that is crucial to humans in terms of objects, properties and processes. Searching for a general framework where to discover and organize this kind of information, we can list a few layers that seem quite relevant. Without aiming at an exhaustive list, we propose to subdivide these layers as follows: spatial, artifactual, cognitive, social, cultural and processual. These layers, in turn, can be subdivided in finer layers as we can see from these cases.

The spatial layer

The spatial layer may be considered as perhaps the most studied layer since it is in large part independent of the subjective perspective easily leading to a formal analysis (Bateman et al., 2007). Here we can recognize the *mereological* layer within which one understands space in terms of parts, e.g., recognizing the distinction between an area and its neighborhood. A second layer is the *topological* one within which one understands space in terms of contact and unity, e.g., recognizing the contiguity between neighborhoods and the unity of a city. Another layer is the *geometrical* where one understands space in terms of shapes, e.g., recognizing that the shape of a city is constrained by that of the valley where it is located. Finally, the *geographical* layer in which one understands space in terms of locations and their descriptions, e.g., distinguishing being along a valley or having a radial disposition in space.

The artifactual layer

Within the artifactual layer one recognizes the physical realm and how human activities can change it. Here we have the *material* layer where one understands space in terms of materiality, e.g., seeing the presence of wood, concrete, water. Then the *structural* layer that allows to understand space in terms of qualified components, e.g., distinguishing natural vs manmade and a residential area vs a production area. The *artifactual* layer adds an intentional aspect to the environment (Borgo et al., 2011), e.g., looking at a garden as an intentionally modified environment. The next layer is the *functional* one where one understands space in terms of functionality, e.g., recognizing a building as a shelter. Finally, the *production* layer looks at entities as manipulation sites, e.g., seeing a farm as production site.

The cognitive layer

The specific abilities of humans play the main role on the cognitive layer. The basic *cognitive* layer allows to understand space in terms of experience, e.g., perceiving how to move across objects in space. Instead, the *representation* layer leads to understand space in abstract terms, e.g., perceiving the relationships among areas in an airport. The *observation* layer is where one understands space in terms of how things in it may change, e.g., perceiving the change in the transportation system. Next, we have the *phenomenological* layer

where one understands space as a moving entity, e.g. perceiving a city as evolving. The *perspectival* layer allows to understand space from a perspectival viewpoint, e.g., differentiating a square depending from where one is looking at it. At the *conceptual* layer space is seen as a collection of realized concepts, e.g., perceiving space as the manifestation of natural and artificial objects. Finally, the *action* layer where one understands space as an entity in which to act, e.g. perceiving the changes that one can enforce on things.

4 A CASE-BASED APPROACH

The experimental context of the present work of ontological analysis of places is the making of Taranto (Italy) strategic plan, oriented to 2065. Data were collected via a series of nine community-based, interactive processes of knowledge exchange, aimed at building future scenarios for the new plan. The interactive processes of knowledge exchange were carried out in Taranto, southern Italy during spring and summer in 2014. They were carried out to support policies and decisions on urban socioeconomic as well as environmental domains and organized as a sequence of face-to-face brainstorming forums aimed at cooperatively singling out strategic lines to build alternative development scenarios. From a methodological point of view, it was a 2-step *scenario-building* activity (Khakee et al., 2002). First, agents were invited to report problems they faced in their town districts. Then, each agent was invited to generate a reflection about the future of the district, particularly concerning expectations of future changes. Such sessions were organized in all town districts, indoor or outdoor, with participants divided in groups each of them sitting around a dedicated desk. A municipal representative coordinated each desk without taking part in the generative session, she/he had only the task of transcribing in linear charts concerns, problems, expectations and desires presented by the participants at the desk.



Fig. 1 The Taranto case study

Real time synthesis and refinement of results during the interactive process was supported by the use of conceptual maps drawn using dedicated software tools (Decision explorer, Inspiration) (Heft, 2013) (Fig. 2). This resulted in a real/virtual hybridization of the process, following well-established research trends, as reported in a number of case studies (Khakee et al., 2002). During the nine interactive meetings, a number of results were achieved, being very different from one another. In particular, the first meeting was organized in the Città Vecchia (inner city district) with its great historical, environmental and cultural resources as well as significant environmental, physical and social degradation problems. In the Città Vecchia session the citizen participation was very high. About 80 stakeholders joined from different societal domains: residents, merchants, students, tourists, visitors. These agents, gathered around 6 desks, interacted intensively, so that about 150 instances were collected in the end. The resulted database of session was very rich, interesting and articulated. Because of this reason, it represents a significant and valuable source for the present research effort.

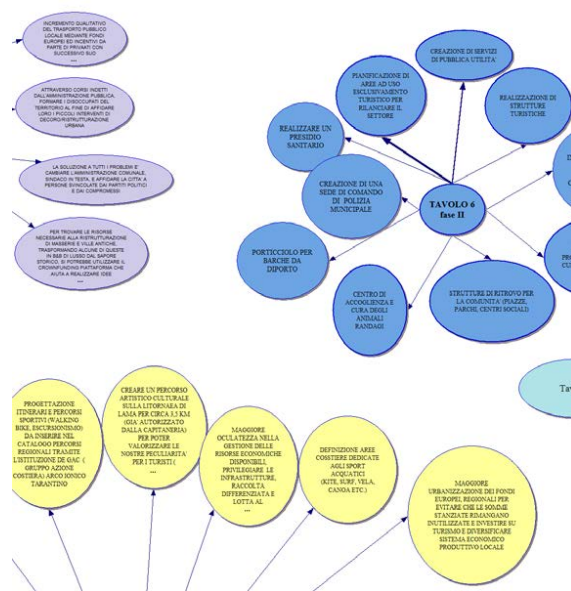


Fig. 2 Example of cognitive map (excerpt)

In a fairly natural way, the process leads to two general types of instances, that is, contextual problems and future visions. These two set of instances are about each quarter of the city as well as about the city in general. From an analysis of the data emerges that the environment is the most recurring issue in the groups. It is present in community problems and/or expectations, but also in the perceptions of the physical reality of the city. The industrial problem, on the contrary, is often absent from the discussed issues. Looking across the groups, a first common character is the natural environment, present and persisting in many city representations - so apparently resisting the consequences of an industrial culture. A second one is related to a structural relationship that the city has with the sea, intended as an element of both union and communication. A third is the potential of the city as tourist attraction which is linked to different characters in relation to the different peculiarities of the area. The industrial problem often seems

idiosyncratically absent from protocols, but it is difficult that findings can be used for strategies disregarding industrial relations. The forum session held in the industrial district showed an almost total absence of participants, perhaps given the disillusionment with past policymaking. Other issues are related to the inadequacy of urban and metropolitan linkages to the city center, as well as related to the recovery of many illegal settlements. Other instances are about the inadequacy of the urban services and about the inadequacy of metropolitan connections. Further instances are about the recovery of unauthorized coastal settlements. The Città Vecchia (inner city) forum session was quite a complex event and process. It was held with a hybrid computer-based and traditional, rather conflictual interaction among the participants. Outcomes showed a clear prevalence of visions on mere problems: important issues were the unstopped relationship with the sea (for touristic aims and/or city infrastructuring) and the enhancement of Taranto as archaeological and historical center (Magna Graecia colonization).

5 ANALYZING THE SOCIAL LAYER

Generally speaking, the analysis of layers is useful to identify if every layer is well structured or if it is necessary to model additional information. Later in this research line we will proceed to characterize the specific sub-layer. Taranto dataset was built without specific research objectives since it was collected during the participation activities belonging to the strategy planning process. However, we think that it can be useful to start from this data for a first delineation of 'objects', 'attributes' and 'relations' populating the different layers.

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Fig. 3 An evaluation of the possible ontological levels of analysis

A pre-analysis was carried out aiming at trying to work out the most significant layer on which to carry out our ontological analysis. All statements were broadly valued by the authors on a simple 1-5 scale for their semantic closeness to each layer. After concisely looking at statistical descriptors (Fig. 3) we decided to start from the social ontological layer. Above all, the material collected in the Taranto case study is very rich from this perspective. We also believe that the material could be useful to analyze the cultural and process layers but this has not been evaluated yet. These views are not studied in this paper. Finally, the material collected in Taranto does not seem suitable for an analysis of the remaining layers, e.g., cognitive and spatial.

In order to specify the context of this analysis, we need to limit the broad connotation of 'social' to a main focus on social practices, i.e., the way people live a city and its parts. Still, we include also the quality of the interactions between people and how they change in time. Note also that at the social layer it can be difficult to elicit the distinction between formal and informal knowledge because the social knowledge is principally informal, tacit and implicit. For this reason, our work in this paper should be considered preliminary under several aspects. References to places and landmarks are singled out their relevance in social practices and by listing the relevant entities and the relationships that were expressed between them. Then we look at how inhabitants use those places and the social habits they implicitly or explicitly expressed. Finally, we classify the collected entities in ontological terms following the DOLCE foundational ontology (Borgo & Masolo, 2010). By carrying out our analyzing effort, the social layer it clearly emerges that the objects of the city are not just building, locations and landmarks. They are complex cognitive objects enriched with a set of different meanings/signifiers that can acquire different meanings depending on the time and even on the person. This analysis shows that at some point it will be necessary to investigate complex entities' definitions. Also, several objects that a technician would image essential key points for the sociality were not mentioned in the discussions, for instance: the San Cataldo cathedral, the S. Domenico church, the Ringhiera, the doric columns, the Aragonese castle, Fontana square, the stone bridge, the Ponte girevole and even the town hall. Instead we find *places* and *landmarks* like the beachfront, the bathing establishments, the area of Porta Napoli, the new Acropolis, the island and the piers. These entities are separated from other *objects* which are taken at their face value like buildings of low interest, the cruise ships and, from some aspects, the sea itself. Indeed, the same term can occur with different meanings, e.g., as a landmark and as a generic building. These lists do not cover the whole range. Many entities have special social *roles* like the city itself as the capital of Magna Grecia, the convergence point (a place where roads and railways converge), the service center or the old city seen as an eco-museum. At this point, we have the *service* layer that includes public services like restaurants, cafes and shops, bathing establishments (this time the term denote the service, not the physical entity nor the landmark), the service center, the university and the pedestrian network across the city (mainly identified in special areas like the waterfront). Finally, the identified the desired features which can be presented as functional objects, reassessment of existing objects, services, norms or generic topics. Here we find work, areas close to traffic, primary and secondary infrastructure, regulation of public spaces. When considering relational aspects, we need to point out the difficulties to classify the above elements since the data are only partially qualified for our analysis. This leads to some uncertainty regarding the relationships holding across these elements. We find strong relational bounds between the space and the city in terms of districts, between space and objects in terms of locations, space and landmark or role, space and services (the location of needs), landmark and social practices as well as between social practices.

4 CONCLUSIONS

Perspectival considerations usually strongly characterize the way we live in places. It is a kind of description (mostly implicit) of the place that includes what are for us the relevant elements in it and their relationships. Thus, a perspective provided by a place is an information entity that contains: a (typically partial) description of the place, what there is in it and how the place is evolving (e.g. things moving, leaving or arriving, agents acting and transforming them etc.) and possibly the potential interactions between us and what is in the place. A place is grounded, as opposed to a generic location, is a context that refers to one or more actual/existing entities.

A number of links usually enrich a place, suitable to be elicited by ontological analysis and classified for understanding places in general and the actual place that we are experiencing. For this reason, the analysis has to include the physical elements (e.g. location and objects), the material components and layout (e.g. enclosed spaces, object distribution); agentive figures (e.g. habitants, organizations, social roles) the relationships across them and the objects (e.g. generic dependences and actual goal or habits). In the end, a concise ontologic taxonomy has been drawn out, whose excerpt is reported in Fig. 4.

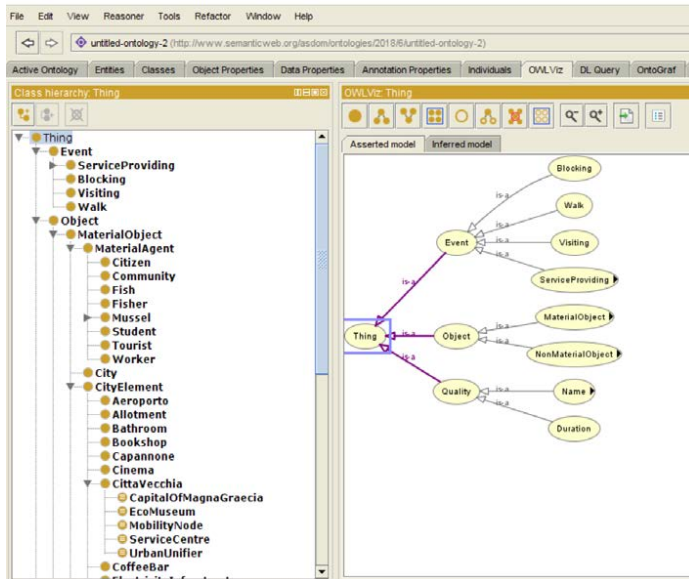


Fig. 4 Protege layout (draft)

We decided to start from the highest layer in the given ontological list, i.e., the social layer, because of the available database at hand. Here we have reported the very first achievement of a complex ontological analysis aimed to unravel the complex knowledge that forms the city. The following activities of our research is being increasingly devoted to this aim.

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AUTHOR'S PROFILE

Domenico Camarda is Associate Professor in Urban techniques and planning at the Technical University of Bari, since 2015.

Maria Rosaria Stufano Melone is winner of a biennial research grant for "Building of knowledge models ontology based applied at organization and representation of space", for design and environmental planning at Polytechnic of Bari – Dicatech.