Using an Ontology-based Model for Knowledge Representation in Rural Landscape *

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Abstract. In the field of the territorial planning the problems related to the management of information increase everyday. This process needs of more and more effective and efficient Knowledge Management techniques. Such techniques lead to a suitable organization (and therefore to a more detailed analysis) of the phenomena, which in turn suggests how to choose the actions to perform. At the same time, the interoperability between heterogeneous subjects at different levels of the planning process and belonging to multiple disciplinary fields becomes an unavoidable element. Information represents a strategic resource for the subjects in charge of territory planning: it is in fact raw material, job tool and final product. In a complex research scenario such as the territorial science, some fundamental elements, useful to analyze and resolve several problems, can be represented using a framework based on an ontological approach. Amongst the different territorial planning fields, we chose as case study the issue of landscaping, in particular the one related to rural landscapes. This choice is motivated by the cultural and scientific innovations, which led in recent years to a completely new interpretation of landscape, as a good to be preserved (being it an expression of the ecological and social transformations on the territory resulting from the community activity). The paper aim is to resolve conceptual misunderstanding and semantic ambiguity and, on the other hand, we need a precise and accurate description of our knowledge, i.e. of the terminologies representing our concepts, which influence goals and entail actions to be implemented. Due to those considerations we propose a suitable ontology-based model implemented in a system to manage ontologies.

Keywords: Rural Landscape, Knowledge Representation Formalisms and Methods, Ontologies, Semantic Networks, OWL, WordNet

1 Introduction

The problem of defining new methodologies for Knowledge Representation (KR) has a great influence on information technology and, from a general point of view,
on cognitive sciences. In particular, the wide spreading of communication technology forces the modern information systems to manage large amount of data. New techniques have been developed to solve those problems. Some of them are based on ontologies to reduce conceptual or terminological mess and to have a common view of the same information. The ontological aspects of information are intrinsically independent from information representation, so the information itself may be isolated, recovered, organized and integrated with respect to its content. A formal definition of ontology is proposed in [1] according to which “an ontology is a formal and explicit specification of a shared conceptualization”; conceptualization refers to an abstract model of a specific reality in which the component concepts are identified; explicit means that the type of the used concepts and the constraints on them are well defined; formal refers to the ontology propriety of being “machine-readable”; shared refers to the fact that an ontology captures the consensual knowledge, accepted by a group of persons. We also consider other definitions of ontology: in [2] “an ontology defines the basic terms and relations comprising the vocabulary of a topic area, as well as the rules for combining terms and relations to define extensions to the vocabulary”. This definition indicates the way to proceed in order to construct an ontology: i) identification of the basic terms and their relations; ii) agreeing on the rules to arrange them; iii) definition of terms and relations between concepts. From this perspective, an ontology includes not only the terms that are explicitly defined in it, but also those one that can be derived using defined rules and properties. Thus an ontology can be seen as a set of “terms” and “relations” among them, denoting the concepts that are used in a specific domain. In this paper we investigate on the use of ontology in the territorial planning fields using a suitable ontology-based model implemented in a system to manage ontologies. The landscape is a central aspect in our approach for the interesting discussions about this theme in the research community and for its intrinsic complexity in the territorial planning field. For these reasons it is an ideal candidate for a formalization using ontologies. Amongst the different in this field of interest we chose the one related to rural landscapes. The cultural and scientific innovations led in recent years to a completely new interpretation of landscape, as a good to be preserved (being it an expression of the ecological and social transformations on the territory resulting from the community activity). From this point of view, the landscape has the distinguishing peculiarity of not being characterized by just one category of elements (physical, natural, historical, . . . ), rather representing the totality of them. Amongst the wide-ranging Italian landscape conformations, the rural one not only represents the most important component in terms of surface, but also a system of great importance both from an environmental and from a cultural and architectonic point of view. It indeed represents a basic joint element between the human activity and the environmental system, where human abilities and skills represent the continuous research of a global eco-systemic balance. Once understood that the process of understanding the landscape is priority and propaedeutic for the definition of actions for its preservation, management, and planning, we need to individuate those homogeneous
territorial contexts, which contain highly related and characterizing factors. To this aim we must try to resolve conceptual misunderstanding and semantic ambiguity and, on the other hand, we need a precise and accurate description of our knowledge, i.e. of the terminologies representing our concepts, which influence goals and entail actions to be implemented. A global and shared planning, by means of complementary factors and synergies (i.e. shared knowledge), allows the territorial entity to increase its own auto-organizing skill, in order to evolve.

The paper is organized as follows: in section 2 we describe our choice about the concept of landscape; in section 3 we define and describe our model using OWL [3] a standard language to describe ontologies; in section 4 is described the system architecture and the approach used to extract information from a general knowledge base to arrange ontologies; a use case of the proposed model and strategy is in section 5; conclusion and future works are in section 6.

2 The concept of landscape as surroundings

The recent cultural innovation about the landscape topic shows that the process of landscape identification must be supported with the central and active role of asset (landscape itself) which must be defined and protected regarding to its general context. After the European Landscape Convention [4], undersigned after a long and hard discussion between state members, the landscape planning action based on passive preservation has come to an end. Pursuing a suitable landscape planning action, the public authorities should define a set of “general principles, strategies and guidelines that permit the taking of specific measures aimed at the protection, management and planning of landscape”; from this assumption the landscape management is the basic element “to ensure the regular upkeep of a landscape, so as to guide and harmonize changes which are brought about by social, economic and environmental processes” [4]. Since the “landscape means an area, as perceived by people, whose character is the result of the action and interaction of natural an/or human factors” [4], we argue that:

- it is very important to understand how every inhabitant perceives the landscape;
- the landscape key features come from natural and/or cultural factors, because the landscape evolves during the time from natural forces and/or from human actions;
- the landscape is a whole of natural and cultural elements, which must be simultaneously considered and completely related.

Once observed that the landscape is a key element both for the individual and social well-being and, for this reason, aiming at quality goals implies a detailed definition of the characteristics that local people expects for its life environment, once it has been identified and described in its general characters (aesthetical, perceptive and eco-systemic ones). A better landscape quality corresponds to a more effective social organization, assures the individual and collective well-being, increases the places’ capacity of attracting investments by developing their
territorial competitiveness. Hence managing the landscape means considering the landscape as an entity related both to the economical and social needs of the population and to natural processes. The landscape becomes the output of an ongoing process in which many entities are involved. The approach to landscape planning is renewed by the characterization and the definition of landscape values. These considerations are taken into account in several national and international laws and directives defining various perspectives to the analysis of the landscape. For example in Italy, the “Accordo tra il Ministero per i Beni e le Attività Culturali e le Regioni e le Province autonome di Trento e Bolzano sull’esercizio dei poteri in materia di paesaggio” (published on the Italian Official Gazette of 19.04.2001) invites the Regions to start management policies that take into consideration, apart from landscape recognized as owning exceptional values, also the entire territory. This directive permits the application, for each part of the territory and in according to the landscape’s features and values, of suitable preservation tools and innovation forms for requalification which can create a diffused landscape quality [5]. To this aim, the planning tools must be provided with a “cognitive, prescriptive and pro-active content”, and the procedures of preservation, enhancement and requalification must be set on the basis of the “level of integrity and significance of landscape values”. Therefore we consider fundamental and relevant the phases of landscape learning, assessment of its conservation state and definition of the quality of its values [6].

As required by the cited Agreement, the following “Codice dei beni culturali e del paesaggio” completes a regulatory landscape coding which, at least in its principle enunciations, seems one of the most innovative in Europe. This new Code introduces in Italy an innovative definition of the landscape concept compared with the previous laws; for the first time, it highlights the centrality of the anthropized, built and managed landscape. These considerations clearly show the extreme complexity of the concept of landscape, which is to be seen as the whole of several aspects (natural, anthropo-cultural and perceptive). The landscape recognizing is obtained not only by means of elements identification (climatic, environmental, physical, historical), but also identifying the spatial and temporal relations between them. “The landscape recognition is obtained by the interaction between physical-biologic elements and human activities, considered as part of the environmental historical definition process and it can be defined as the complex combination of objects and phenomena related between them by mutual functional relations, as well as locations, in order to be a whole” [7]. The ability of clearly recognizing the constituent features of a landscape represents one of the most important factors from the observers. A landscape poor of “recognizable” elements or characterized by a messy overlapping of several components (natural and/or anthropological) or from an excessive fragmentation of the same ones, could “disturb” an immediate perception; it is usually considered a landscape poor “of values”.

On the other hand, a landscape in which the complexity is clearly structured and noted comes positively appreciated. The value of a landscape essentially is in the possibility that its structure and identity are clearly read.
2.1 Methodologies for landscape reading and rendering

With the increasing attention about the landscape, the questions related to evaluation and modalities of reading the specificities of territorial patrimony are assuming more and more importance, because it is not simple to assign precise rules to outline the landscape. The knowledge discovery is the first, basic and necessary phase for every preservation policy, innovation and requalification of the landscape; only through a suitable cognition of landscape values it is possible to manage themselves changes. The different ways of reading the landscape have always been subordinate, till now, to the planning requirements; they emphasized of just an aspect of the landscape respect to another one. The Italian experiences in the '70 and the '80 are a meaningful example: when, as a result of the institution of parks and natural reserves, for pursuing purpose of protection and government of nature, environmental were more preserved than the cultural and historical ones. In an analogous way in several European Countries the formalization and specification of landscape components have different roots and characteristics: for example in north Europe, the attention is put on natural and ecological problems; in others countries other aspects, as the aesthetical and architectonical ones, are meaningfully considered; in other ones economic, productive, and recreational elements are taken more in account.

In [8] the author argue that from the international experiences of landscape reading we can define six fundamental typologies:

- **Reading through atlases and lists**: it is used in the large scale in order to characterize and circumscribe different landscape units; in this way the territory is subdivided in homogeneous and adjacent areas. This experience is used in several European Countries at a national level (Slovenia, Norway, France and England) or for regional initiative or local administrations (as the preliminary or complementary regional studies for Regional Territorial Plans in Italy) or, finally, from research agencies (Italy, France).

- **Reading through natural features and environment**: this typology is related to the disciplines of earth and biological sciences. These, considering abiotic and biotic factors, examine the natural and environmental aspects of life places, paying particular attention to the systemic relations between living organisms and environment. The landscape ecology scope is to know natural assets features relate to anthropological dynamics, in order to have an ecosystem balance. Therefore the landscape is the result of an organic and complex ecosystem, comprehensive of people and their activities. We can found this approach in Germany in '70 years, but it has been diffused in other European Countries (i.e. Austria). The environmental approaches also consider how the user perception regards to nature: the botanical interest in some species of trees or cultivations for their high value of biodiversity, it is often related to an historical and cultural interest hidden by the species themselves. It is the case of terracing, historic orchards or vineyards and old tracks. From this point of view we argue that the quality of places is not only tied to the quality of the environment, but also to its historical and cultural features (in Germany, in '80 years, it is the Kulturlandschaft).
– **Reading through visual perception:** it is used to comprehend the morphologic characteristics and design of considered places and, on the other hand, to know the physical persistence and the historical and cultural meanings. It is a methodology used in many European Countries (Great Britain, France, Holland, Spain, Poland), it sources from the American experience, which considers the landscape as a discipline.

– **Reading through historical and cultural persistences:** its aim is to give a punctual knowledge of the historical patrimony (it is a methodology diffused at an international level during '60 as result of a series of Charters and Dispositions); it has found its formalization with the developing of cultural assets lists and recently with the analysis of historical systems. This last methodology (mainly used in Great Britain) is used to find relations (physical, functional, visual) between system parts.

– **Reading through symbolic meanings:** it is used to describe places that are valuable for communities (places of memory) even if they are lacking of specific goods. They are places described in pictorial or literary works, places where particular historical events took place, or places where important people in political and cultural history stopped.

– **Reading through aesthetic and material characters:** they not only define the object in itself (design), but also the composing materials, and the used techniques. It is a reading typology used in Italy (especially in the provincial plans level) Great Britain, and in the alpine area (Germany and Austria), for the description of rural assets.

Every reading methodology is built on specific cultural tendencies and it is subordinated to the specificities of the different territorial realities. The various contributions about the main reading methodologies and landscape assessments used in the European Countries underline the remarkable methodological elaboration and testing worked out during these last years, but also (as already for the definition of the term landscape) the urgent need of a terminology and basic criteria for information exchanging, allow comparing the different experiences, thus yielding to mutual enrichment, crucial for a general growth on these topics, both from a cultural and an operational point of view [5]. Today, even if codified methods for studying and describing the landscapes are increasing, the need for a new methodology for reading the landscape, which take in account the conceptual evolution of it, the multi-disciplinarity of this matter, and the interoperability among the different points of view of researchers. For those reasons the use of conceptual and formal models, as the ontology-based ones, is a useful tool for knowledge managing and sharing in a complex scenario as the landscape planning.

### 2.2 Rural landscape reading

Rural landscapes are the expression of the correlation between human activities and environment, where the human facility is showed by a continuous search of balance. They express the functional evolution, occurred in the course of time,
linked to the working technique, dwelling ways, natural dynamics and social conditions. Those are landscapes produced by a long adaptation until reaching ecological essentiality and stability given by man-nature compromise. The Italian rural landscapes are characterized by several architectural productions being different in forms and typologies, but linked by a common author: the farmer-architect. By using the stones taken from the fields or the being more easily found and economic material, he unconsciously designed a landscape with such a high historical value that it has become the symbol of the local culture. The functionalism leading the different architectural typologies doesn’t stress only the formal component, but points out the strict connection between the function linked to rural activities and saving exigencies and rational management, reproducing a model that can be defined *unconsciously sustainable* [9].

Knowing and understanding the landscape matrices is the first step toward their appraisal and conservation. The forms of rural landscape issue not only from the territorial physical structure, but also from the rules entailing the use of social power to transform the territorial structures following each other in the course of time. Apart from the productive activities, we should consider various elements of a man-made landscape (historical centres, architectural models, building structures). Historical built heritage should be investigated starting from its identification on a territorial scale, since it cannot be divided from its context landscape scheme. It is unconceivable to investigate settlements and buildings as close systems to be preserved and/or safeguarded without considering their ambit condition. Indeed, geo-morphological aspects, social and cultural dynamics, economic and political situations, criticalities and vulnerabilities are all part of such analysis. Also physical and anthropological factors contribute to the definition of landscape, or at least to the perception of it. Therefore, the reading of rural landscape concerns not only the visual experience or the morphological, geographical and naturalistic aspects, but gives back also historical and cultural meanings, attributed by communities which live in and use those places. After all, the rural landscape reading is mainly referred to three closely connected aspects:

- the historical point of view and the landscape development during the time;
- the landscape shape;
- the functional-anthropological aspect (use of the ground, takeovers, infrastructures).

From a general point of view, the methodologies used to read the characteristics of a place start from a low detailed scale level. However in this way we can find only the presence and the role of the elements in the general places morphology; on the other hand, other elements (i.e. terracing, hedges, tracks) structure the landscape not only with their design (formal character) but also with their materials, or particular constructive techniques and traditional cultivations. A field represents with its shape and color the function of “field”; but with its function it is also to be specified the cultivation method and every useful cognitive aspect, and the way it is related and inserted in the context [10, 11]. The landscape shapes give back the objects story. Every object, once recognized, assumes
the role of sign and it must be interpreted. The signs are the representation of 
the reality (signifier) - Eco [12] asserted that “the sign stays for something else 
which is its object” - and their interpretation gives back the signified (the sense 
and the value) attributed to the object-element. The reading of the traditional 
landscape signs must not have the scope of a reconstruction (restoration) of a 
given landscape, but of understanding the meaning of the signs themselves to 
insert them in the planning actions like live objects fitted in the context and 
in the currently needs. In a nutshell, for representation and interpretation of 
landscape elements we argue that two different dimensions should be integrated: 
an objective and a subjective one, giving to the perception (consequently to the 
subjectivity) a crucial relevance and, in particular, a great influence to its char-
acteristic and clear relationships with the environment and the territory. To this 
aim, we need of a flexible framework used on several territorial realities, there-
fore a method for integrating all the undertones in the complexes and peculiar 
territorial systems.

3 Ontology Representation

The aim of our paper is to define and implement a model for knowledge rep-
resentation using a conceptualization as much as possible close to the way in 
which the concepts are organized and expressed in human language and use it 
on a specific conceptual domain as the rural landscape. We use WordNet [13] as 
general linguistic knowledge base. All information in WordNet is organized using 
linguistic properties. The basic unit in WordNet is the synset, a logic set of words 
related by the synonymy property. Each synset is a concept in WordNet. All the 
synsets are related to the others by pointers that represent linguistic properties. 
Two kinds of relations are represented by pointers: lexical and semantic. Lex-
ical relations hold between word forms; semantic relations hold between word 
meanings. Examples of those relations are hypernymy/hyponymy, antinomy, en-
tailment, and meronymy/holonymy.

Now we are in the position of defining our model; it is composed by a triple 
\(< S, P, C >\) where:

- **S** is a set of objects;
- **P** is the set of properties used to link the objects in **S**;
- **C** is a set of constraints on **P**.

In this context we consider *words* as objects; the properties are *linguistic 
relations* and the constraints are *validity roles* applied on linguistic properties 
with respect to the considered term category. In our approach the knowledge is 
represented by an ontology implemented w.r.t. a semantic network. A semantic 
network can be seen as a graph where the nodes are concepts and the arcs are 
relations among concepts. A concept is a set of words which represent an ab-
stract idea. One of the most important progress in the KR applications derives 
from proposing [14], studying [15] and developing [16] languages for knowledge 
representation. Even if those languages have several differences they share some
common aspects based on the specification of objects (concepts) and the relationships among them.

In the last years several languages have been proposed to represent ontologies. It is the authors’ opinion that OWL is the best language to reach our purpose in terms of expressive power. Therefore we describe the semantic network implementing the ontology in OWL using the defined model. In particular we use the DL version of OWL because it has enough effectiveness to describe the ontology. The DL version allows the declaration of disjoint classes which are used, for example, to assert that a word belong to a syntactic category. Moreover it allows the declaration of union classes used to specify domains and property ranges to relate concepts and words belonging to different lexical categories.

### 3.1 The proposed model

We formally describe the ontology schema and the corresponding semantic network representation using OWL. Every node, both concept and word, is an OWL individual. The connecting edges in the semantic network are represented as ObjectProperties. This properties have some constraints that depend on the syntactic category or on the kind of property (semantic or lexical). For example the hyponymy property can relate only nouns to nouns or verbs to verbs; on the other hand a semantic property links concepts to concepts and a syntactic one relates word forms to word forms. Concept and word attributes are considered with DatatypeProperties, which relate individuals with a pre-defined data type. Each word is related to the represented concept by the ObjectProperty hasConcept while a concept is related to words that represent it using the ObjectProperty...
These are the only properties able to relate words with concepts and vice versa; all the other properties relate words to words and concepts to concepts. Concepts, words and properties are arranged in a class hierarchy, resulting from the syntactic category for concepts and words and from the semantic or lexical type for the properties.

**Concepts and Words** In figure 1 the hierarchies used to represent the objects of interest in our model are shown. Figures 1(a) and 1(b) show that the two main classes are **Concept**, in which all the objects have defined as individuals and **Word** which represent all the terms in the semantic network. These classes are not supposed to have common elements therefore we have defined them as disjoint. The class **Word** define the logical model of the word forms used to express a concept. On the other hand, the class **Concept** represents the word meaning related to a word form. We can see that the subclasses have been derived from the related categories. There are some union classes useful to define properties domain and codomain. We define some attributes for **Concept** and **Word** respectively. In particular **Concept** has: **Name** that represents the concept name; **Description** that gives a short description of concept; **X, Y, Z** that localize a concept in a 3D space. On the other hand **Word** has **Name** as attribute that is the word name. Moreover for all elements we define an **ID** within the WordNet offset number or a user defined ID.

**Table 1. Model features**

<table>
<thead>
<tr>
<th>Property</th>
<th>Domain</th>
<th>Range</th>
<th>Property</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>hasWord</td>
<td>Concept</td>
<td>Word</td>
<td>hasWord</td>
<td>inverse of hasConcept</td>
</tr>
<tr>
<td>hasConcept</td>
<td>Word</td>
<td>Concept</td>
<td>hasConcept</td>
<td>inverse of hasWord</td>
</tr>
<tr>
<td>hypernym</td>
<td>NounsAnd</td>
<td>NounsAnd</td>
<td>hypernym</td>
<td>inverse of hypernym; transitivity</td>
</tr>
<tr>
<td>holonym</td>
<td>NounConcept</td>
<td>NounConcept</td>
<td>hypernym</td>
<td>inverse of hypernym; transitivity</td>
</tr>
<tr>
<td>entailment</td>
<td>VerbWord</td>
<td>VerbWord</td>
<td>cause</td>
<td>transitivity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>verbGroup</td>
<td>symmetry and transitivity</td>
</tr>
</tbody>
</table>

**Properties** The semantic and lexical properties are arranged in a hierarchy (see figure 1(c) and 1(d)). In table 1(a) some of the considered properties and their domain and range of definition are shown.
Constraints  The use of domain and codomain reduces the property range application; however the model so far described does not have a perfect behavior in some cases. For example the model does not know that even if the hyponymy property is defined on the sets of nouns and verbs, if it is applied on the set of nouns it has as range the set of nouns, otherwise if it is applied to the set of verbs it has as range the set of verbs. In table 1(c) there are some of defined constraints and we specify on which classes they have been applied with respect to the considered properties; the table shows the matching range too. Sometimes the existence of a property between two or more individuals entails the existence of other properties. For example, being the concept dog a hyponym of animal, we can assert that animal is a hypernymy of dog. We represent in OWL this characteristics by means of property features. The table 1(b) shows several of those properties and their features.

4 System architecture

The proposed model has been implemented in a software system able to create, manage and manipulate ontologies. This software is linked with WordNet which, using the previously described model, is completely mapped into OWL. Many information systems use a knowledge base to represent data in order to satisfy information requests. In our approach we use an appropriate algorithm to extract from WordNet a domain semantic network; this net provides a general representation of our domain of interest. The system has several modules which implement its basic functionalities. The system interface shows to the user the ontology catalog stored in the ontology repository (i.e. a relational DB) by means of an appropriate software module called OntoSearcher: OntoSearcher performs a syntactic search or a browsing in a directory structure arranged by arguments to the aim of finding an ontology relevant to the user interest. When OntoSearcher finds a suitable ontology, the OntoViewer builds a graph (a semantic network) to represent the ontology. In the following we describe the algorithm used to build dynamically the semantic network. If the user domain of interest is not in the Ontology Repository, she can build an ontological domain using WordNet. This step is performed by the OntoExtractor; it enables some functionalities to build an ontology represented by a semantic network. We propose a dynamic construction of the semantic network using an ad hoc algorithm which take into account the WordNet structure. The network is built starting from a domain keyword that represents the context of interest for the user. Moreover, every domain keyword may have various meanings (senses) due to polysemy propriety, so a user can choose its proper sense of interest using the tool interface. We then consider all the component synsets and construct a hierarchy, only based on the hyponymy property; the last level of our hierarchy corresponds to the last level of WordNet one. After this first step we enrich our hierarchy considering all the other kinds of relationships in WordNet. Based on these relations we can add other terms in the hierarchy obtaining an highly connected semantic network. Clearly, even if a knowledge base could be large and detailed, it will
never give us a high level of specialization for every existing knowledge domains. Our approach tries to give a solution to this problem. In fact a user can interact with our system in order to create a first ontological knowledge representation or create a new one using the OntoEditor module. The OntoEditor functionalities allow a user to modify the ontology structure as a whole adding new terms and concepts in the network, linking terms and concepts using arrows (lexical and semantic properties), deleting nodes and arcs. We used Java technologies to implement the system and in particular the interaction with the semantic network is obtained by means of Java 3D libraries.

![Tool interface](image)

**Fig. 2.** Tool interface

5 **Use case example**

In this section we show a use case of our tool. The recent national and international legislative, regulatory and implementing initiatives described in the previous sections put in evidence the need for defining a detailed methodology for representing knowledge about landscape. The knowledge definition tasks start from several elements often poorly related. This factor increases the system complexity introducing an high heterogeneity. In the ontology pre-consensus step we define our glossary using well-know knowledge sources as [17, 4, 18, 19], providing a more detailed description of the variables, since it was affected by several particular situations about our field of interest. A specific ontology about
rural landscape has been created ex novo using this glossary. The related elements and phenomena have been individuated by applying disaggregating and re-aggregating processes to the rural landscape components. The rural landscape image has been described by means of its natural (ecological) factors, built-up (settling) factors and visual and perceptive factors. All these macrocategories have been arranged in classes, which in turn have been divided in features and variables. Successively a domain ontology about landscape is extracted from WordNet following the steps described at the end of the section 4 starting from the keyword region(sense3): a large indefinite location on the surface of the Earth. The process to extract an ontology from WordNet starts from an interaction with the user inserting a specific term (i.e. region) by means of the user interface and choosing the proper sense reading the description of the related concepts. The system gets the right sense and build the ontology following the steps described in the previous section. We choose to link the new proposed concept of landscape (an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors [4]) directly to the region synset, using it as bridge for ontology merging. Therefore we expand this ontology giving more information about the rural landscape (see figure 2). Using our tool we have the OWL representation shown in figure 3. We notice that we give a knowledge expansion of WordNet knowledge base inserting new synsets about the territorial planning research field.

Fig. 3. Owl representation of rural landscape ontology
6 Conclusion and future works

The design, implementation and reuse of existing ontologies is a non trivial task. When we want to use different ontologies, they must be combined in same way; this task is performed either with an ontology integration or leaving them separated. In both cases the ontologies must be aligned i.e. they must be in a condition of mutual compatibility. In this paper we have proposed an approach to solve this problem; we define a simple and general model, taking into account a linguistic approach considered as the natural communication way between human agents. On the other hand the use of formal models for knowledge representation could represent a necessary starting point in several research fields and in particular in the territorial planning one. From a general point of view we have an evolution during time of the concepts; this is a cause of knowledge obsolescence, so there is the need for a continuous updating. We note this problem in WordNet, in fact in this knowledge base the concept of landscape is related only to a visual appearance dimension. Moreover in all fields of knowledge the research innovation allows the definition of new concepts. For example the concept of rural landscape does not exist in WordNet; this lack needs of a knowledge expansion. This is a preliminary study, other issues are to be investigated. We are implementing a further specialization of our ontology tacking more and more into account the perceptive aspects of local communities. On the other hand we are thinking about the definition of an algorithm for automatic ontology integration; a solution to the ontology mismatch problem and the design and implementation of a distributed system for information sharing based on our knowledge representation model.

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