Chapter 14
An Ontology for Urban Mobility

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14.1 Context

The development of the urban mobility ontology was first intended as a test of the Towntology prototype (Berdier and Roussey 2007). This test permitted us to integrate fuzzy concepts and to connect two ontologies (a road system ontology and an urban mobility ontology) through a concept bridge. This prototype has shown the interest of the professionals in this tool. At the same time, the "Cité des Sciences" in Paris expressed its interest in this tool, and would like to use it in an exhibition about the city.

14.2 Purpose and Aims of Ontology

This type of tool should facilitate the coordination and cooperation between various actors in the urban field. It should also prevent semantic drift between these actors and their databases. In addition, it could also provide a link between the various specialized vocabularies in this domain (road system ontology, urban mobility ontology).

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G. Falquet et al., *Ontologies in Urban Development Projects*, Advanced Information and Knowledge Processing 1, DOI 10.1007/978-0-85729-724-2_14,

14.3 Scope

The development of a road system ontology (Towntology) allowed us to validate the interest and the feasibility of an ontology of technical objects in which the concept definitions are easy to apprehend. The questions we addressed in this test were:

- Can we obtain the same result in other urban domains that are fuzzier, and do not represent the same structuring elements?
- Can we integrate the mobility and transport concepts, in Towntology?

14.4 Methods of Development

To obtain a sample of concepts from the domain of mobility and transport, various alternatives were possible. So, we first chose to harvest concepts using a questionnaire, and not from a bibliography. This method provides a representative sample of public expectations towards an ontolgy of this domain. The sample is not exhaustive. It was necessary to list the concepts of interest to users, to help facilitate later future tests of the ontology, but also to increase the interest in this tool.

A questionnaire was developed to identify concepts associated with the domain of mobility and transport. To ensure representativeness, the sampled public was diverse: students, junior researchers, confirmed researchers, teacher-researcher, professionals, laymen, etc. About 50 questionnaires were distributed, and from the responses we have been able to build a collection of 100 concepts, for example: Accessibility, Pollution, User, etc.

The second step of the ontology construction was to collect a set of definitions for these concepts. This was achieved in two ways: first by bibliographical searches of literature on mobility and transport, to define concepts such as accessibility, as mobility, but also of specialized dictionaries. At the same time, online searches of glossaries or lexicons were conducted on the Internet. Thus a set of definitions about urban mobility was collected. Since some concepts had several definitions and some definitions lacked precision, it was necessary to disambiguate these. This took place in association with a workgroup composed of junior researchers, experienced researchers in research departments specializing in mobility issues, and practitioners.

Subsequently each of these definitions has been inserted into the existing structure of the Towntology ontology, which is organized according to specialization relations and disciplinary domains. For example, the term “road system” recovered from the group (Generality) indicates all the traffic lanes of the public domain. On the legal plan (legal), it denotes all the urbanism regulations and the local regulations which concern the ways of the public domain (source dictionary source of the road system).

The term “accessibility” in the group (Generality) defines the degree of ease with which users can reach a place or a network and use it depending on their needs. (PORTAL Consortium (2007))

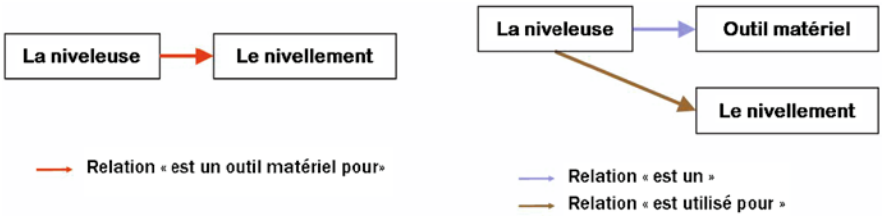

Fig. 14.1 Example of generic relations

From the sample of concepts and definitions, the development of semantic networks began by relying on the relations defined in the existing ontology. After several attempts, it turned out to be very difficult to organize these new concepts using the existing relations. Indeed, some relations were too precise, too specific, and impossible to reuse. This was particularly so for the relation: "is a material tool for". Other relations were redundant and ambiguous, entailing usage difficulties for example "is a" and "is a subset".

An important task in the definition of the relations was to simplify the usage: both by classifying the relations to eliminate ambiguities, but also to generalize them, to facilitate their re-use and avoid their duplication, and the semantic networks.

The study of the definitions of existing relations allowed us at first to identify a group of relations that can be decomposed into generic relations (Fig. 14.1).

This group consisted of the following relations:

is a material tool for
is a tool of study for
is a computing tool for
is a procedure concerning
is an operation for
is a document for
has an activity concerning
is a problem affecting

Then, with the help of the workgroup, it was possible to identify and to suppress useless, ambiguous and redundant relations like such as:

has material
is a subset of
is opposed to

The simplification and the generalization of the relations, entailed a reduction of their numbers from 21 to 12 and also involved the removal of some ambiguities, and created opportunities for re-use (Table 14.1).

From all the concepts, their definitions, and the new list of relations, the concepts were organized in semantic networks. To reach it, several successive methods were used.

Table 14.1 Meanings of relations

Relations	Signification
is a	Relation used to make the link between specific terms and their more generalized concept
is composed of	Relation used to describe the horizontal, vertical and structural composition
is use for	Relation indicating that an object is used for an operation or a particular function
is used by	Relation indicating that an object is used by a person or an organization.
is located … on, in	Relation of localization positioning an object with regard to the other one
work for	Relation indicating what sort of job works for other one.
is characterised by	Relation defining parameters or specificities characterizing an object, a material or a concept.
depends on	Synonymic relation of « is conditioned by » or " is the consequence of ". It can also be a relation between a procedure and it decision-makers or another procedure, which could be characterized by the relation "decided by".
can take the role of	Relation indicating that an object, a concept or a procedure can take a role, according to a particular situation
is coming from	Relation indicating the origin of an object, a concept or a procedure.
« tell for »	Relation used to connect terms or expressions specific in an object or a concept.

The concepts were grouped together in small groups presenting *a priori* interrelations. The double entry table below allows one to cross-compare, by relation, all the concepts, and to identify their interrelations (Fig. 14.2).

To complete this first approach, the definitions of the concepts were used, by verifying they did not contain new interrelations, to avoid possible oversights.

Finally, a set of graphs was built: (one for each relation) representing the semantic networks. This visual method allowed us to verify and to refine the networks easily (Fig. 14.3).

The final stage was to validate the networks by the previously constituted workgroup.

14.4.1 The Relation of Urban Mobility with Road System Ontology

The connection between urban mobility and road system ontology took place thanks to the concept "bridge" allowing connections between the new semantic networks built for the mobility to those existing around the urban road system (Fig. 14.4).

Roughly ten concepts were selected to connect the two ontologies. They are those concepts that qualified as a "bridge," such as: road system, car parking.

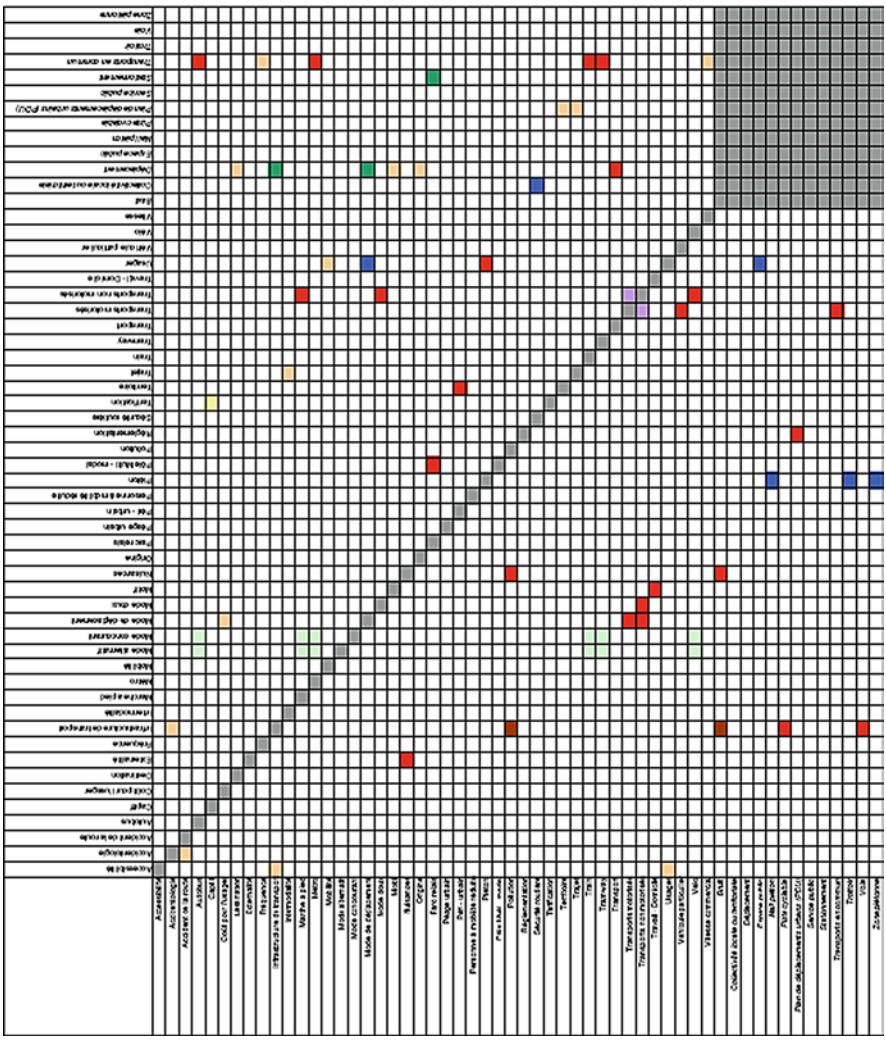

Fig. 14.2 The double entry table with interrelations

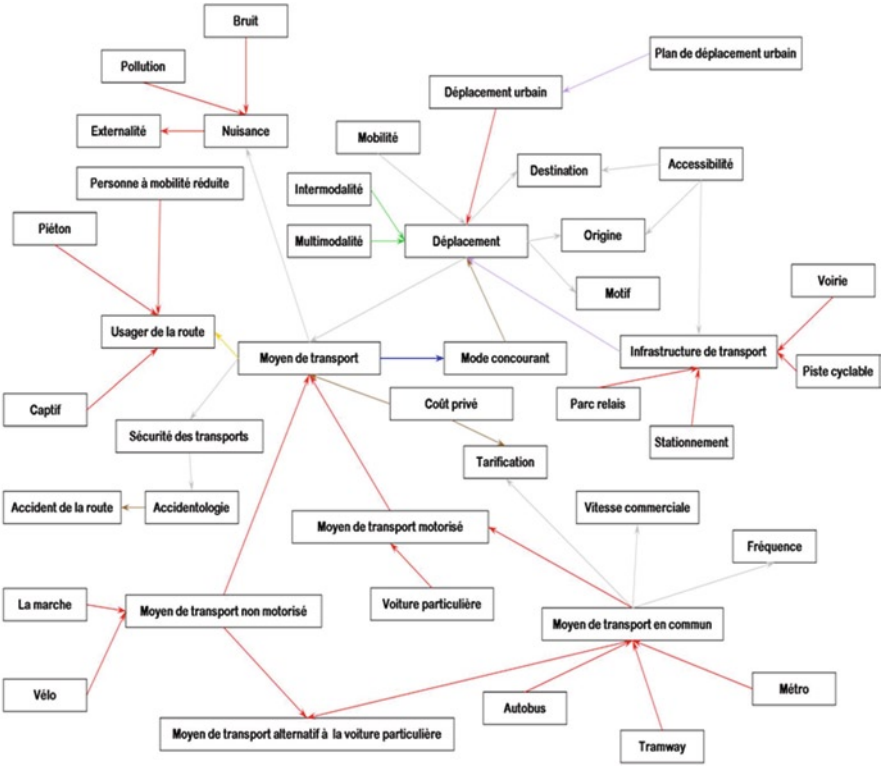

Fig. 14.3 Example of a relation graph

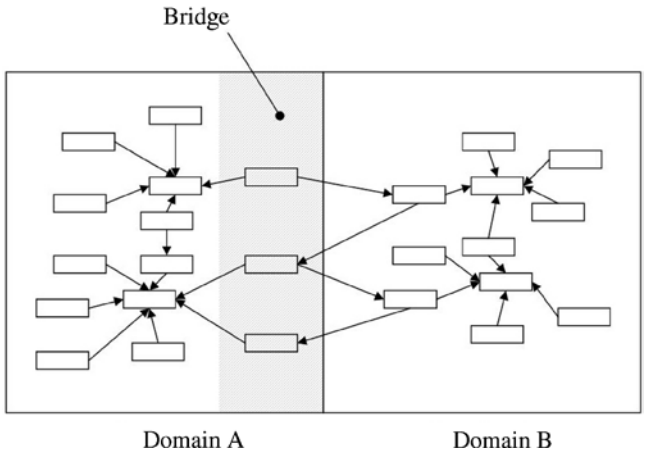

Fig. 14.4 The connection of both ontologies by "bridge concepts"

14.4.2 The Test Phase of the Prototype

The model was tested to gauge the general feeling on this type of tool and identify future improvements. It was a question of testing a prototype, containing all the definitions and network of associated relations.

To make this test, the ontology, stored in a database containing the definitions and relations, was distributed to the testers, accompanied by a questionnaire. The questionnaire concerned the function, the impressions felt during the use of the database, the errors it could contain, the identified dysfunctions, and suggested improvements.

Thirty questionnaires were issued and returned. The comments which went out again are rather homogeneous. All the testers were interested in this database, essentially because of its educational dimension, which confirms the advantages such a tool can present.

Several criticisms were formulated. They concerned:

- navigation and the layout (dysfunctions on certain pointers, typing errors, difficult navigation…);
- definitions: omissions and incoherence were noted, notably at the level of the illustrations. This indicates that it will be necessary to pay careful attention to the different browser rendering capabilities and to the association of illustration with concepts during the creation of the base;
- sources of definition which were considered vague. Some testers wanted to see more precise definitions, particularly references to the current standards and tests.

The adaptation of the precision levels of the definitions to the target audience for the ontology will be indispensable.

14.5 Lessons Learned

The experience gained during the construction of the first ontology was very useful. Indeed, it greatly aided the choice of the concepts and their relations. The construction of an ontology in the field of the urban mobility is possible. The experience with this workgroup demonstrates the educational potential of this tool. Besides, the evolutions envisaged for the current year as well as the new tests will address other types of usage, in particular for professional and individual applications.

However one aspect remains to be developed in the years to come: it is the question of the interoperability of the various databases used by different actors engaged in designing and planning cities.

The signs are promising for the development of this kind of tool:

- the museum, Cité des Sciences, Paris expressed its interest in this tool, and would like to use it within the framework of an exhibition on the city;

– the bibliographical searches made within the framework of this project, also showed that international organizations like the United Nations Organisation (UNO) or the European Union (EU) are trying to organize their vocabularies;
– finally, the test of the prototype also showed the interest of professionals towards this type of tool.

Reference

Berdier, C., Roussey, C.: Urban ontologies: The Towntology prototype towards case studies. In: Ontolgies for Urban Development Studies in Computational Intelligence vol. 16, pp. 143–155. Springer, Basel (2007)

Dictionaries and Glossaries

PORTAL Consortium: Promotion of Results in Transport Research and Learning. http://www.eu-portal.net/start.phtml?sprache=en (2007). Accessed 16 Feb 2011