SEMANCO

SEMANTIC TOOLS FOR CARBON REDUCTION IN URBAN PLANNING

A research project co-funded by the FP7 "ICT systems for Energy Efficiency" program of the European Union, 2011/2014

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SEMANCO News

Our Wiki, where you can find in-depth information relating to the concepts and methods of the SEMANCO project, is available via the SEMANCO website (http://semanco-project.eu/)

We have developed software tools for the semantic integration of database information into the SEMANCO energy model, the SEIF. These tools handle the mapping of local ontologies onto the SEIF's global ontology. You can read more about this important development in this Newsletter and in the reports menu on our website.

3D maps our three Case Study areas are available online: Manresa in Spain; Newcastle in the UK; and Copenhagen in Denmark.

SEMANCO partners presented a conference paper in Reykjavik at the 3rd Workshop on eeBuildings Data Models (Energy Efficiency Vocabularies) at 9th European Conference on Product and Process Modelling in July.

Also in July, the project was represented at an Information Workshop for EU R&D Funding in the field of ICT by FP7 in Stuttgart.

Finally, the SEMANCO project has undergone a highly successful first year review process.

Welcome to the second SEMANCO newsletter. December 2012 finds the SEMANCO project team busy with a number of exciting technical challenges at the very heart of the project. We are focussing on the development of the core technology: the semantic tools that will enable policy makers and other stakeholders to make meaningful assessments of the energy and carbon implications of urban planning decisions and of urban developments.

The integration of the SEMANCO work plan is increasingly important as we enter this second phase of the project. There are many complex inter-relations between the various activities in the different work packages and we are developing the interacting components of the project simultaneously. In the coming months we will be: specifying case study requirements relating to carbon reduction; designing the ontology that is at the heart of the energy model; specifying the tools that users will require and by which they can interact with the semantically modelled data; obtaining data from public and private data sources that will be required by the energy model at different geographic scales; and designing and implementing the tools and methods to perform specific functions required by stakeholders. Together, this represents the on-going development of the SEMANCO platform, and I look forward to the opportunities for the project team to showcase these elements in the near future.

We have had a particularly busy and fruitful summer and autumn in which we have produced a number of high-quality reports detailing the work of the project to date. These are available on the project website.

I am personally very excited to see that the tools we are developing are coming on apace and I look forward to working with you in the coming months to see how the project will be able to help you in your transition towards a low carbon urban environment.

Leandro Madrazo, SEMANCO Project Coordinator.

Update on SEMANCO technology development

The overall objective of the SEMANCO project is to support the decision making of the different stakeholders involved in energy related urban planning at the neighbourhood, municipal and regional level, specifically with a view to carbon reduction. The project aims to achieve this through the design, implementation and evaluation of a semantic-based energy information framework and a suite of decision support software tools. These tools will be deployed throughout the different stages in the lifecycle of buildings and places, from planning to day-to-day building operation.

The core technological objective is the creation of a SEIF (the Semantic Energy Information Framework – see Newsletter number 1 for definitions of key concepts, or see our Wiki) and associated tools that can be applied in specific realms to improve energy efficiency at the urban level.

At the heart of the SEIF is a global ontology that integrates the local ontologies specific to the databases and domains of interest to SEMANCO platform users: in essence, the SEIF acts as a translation service so that concepts from a variety of sources can be related to and understood centrally.

A methodology to foster integration of data, tools, domains and stakeholders

Building ontologies is a complicated process that requires the integration of a variety of components – data, tools, users, stakeholders, etc. – and demands an approach which enables the different dimensions of the project development to be viewed simultaneously.

We have facilitated this integration by developing a methodology based on Use Cases to provide the link between the different strands of research and between the research and the demonstration aspects of the project. But what is a Use Case? It is conceptually distinct from a Case Study. Whereas the latter is a geographical area with a defined set of problems, stakeholders, methods, etc., a Use Case represents a specific research problem which can be applicable to one or more Case Studies. Within the scope of the SEMANCO project, a Use Case has a strategic goal concerning carbon reduction and encompasses data, services and actors and the relationships between them. An indicative example of a Use Case is: "the municipality wants to identify buildings below/above benchmarks of energy consumption and CO_2 emissions." This is, of course, applicable to any of our Case Studies.

Within each Use Case is a set of activities which need to be performed in order to achieve the strategic carbon reduction goal. So, a Use Case brings together information about actors, policies and activities in order to fulfil its goal at a particular scale: it is a generic statement of a complex problem dealing with carbon reduction in urban planning, a problem which requires a set of discrete activities to be undertaken.

The ontologies, which are so central to the SEIF, are built from the specifications captured through Use Cases. Ontology development is an iterative three stage process involving capture, coding and evaluation.

The capture stage gathers information from the Use Case and from the specifications of its activities, as well as gathering information from relevant standards. In the coding phase this information is encoded as an OWL DL $Lite_A$ ontology. In order to do this, the SEMANCO team has developed a dedicated ontology editor that is designed to accommodate the needs and expectations of both ontology experts and domain experts, such as building engineers, who are not ontology experts. The evaluation phase will follow the first release of the ontology and will assess the completeness, intelligibility (to users and domain experts) and computational integrity and efficiency of the ontology.

New tools to design ontologies in a collaborative manner

Tools for collaborative ontology mapping have been developed by the SEMANCO project team to create a prototype environment that supports the semantic data integration process. This process has been validated using data provided by ICAEN, an organisation of the Catalan Government which collects the energy certificates of newly planned buildings. This prototype helps users from different backgrounds to carry out semantic data integration tasks in collaboration.

The SEIF is the nexus between the different data sources and the range of tools that will be using the data. Hence, the data within the SEIF is semantically specified so that concepts are not obscured by differences in terminology between databases. This means that the local ontologies of the individual data sources need to be mapped onto the global ontology of the SEIF: each concept of the local ontology corresponds to a concept in the global ontology.

Within this prototype environment are two tools. The SEMANCO Ontology Extractor is a Java-based command line program that can be used by the owner of a relational database to create an ontology file and a mapping file from the database. SEMANCO's Ontology Mapping Collaborative Web Environment enables domain experts and ontology engineers to redefine the data source ontology and to map this ontology onto the global ontology of the SEIF. Using the files generated by the Ontology Extractor tool, the Collaborative Environment allows the users to edit how an ontology is mapped and presents a visual representation of the ontology. Using this visual representation, users can explore the classes and properties of a local ontology and of the global ontology at the heart of the energy model. Finally, exporting the work from the Collaborative Environment creates a new portion within the SEIF's global ontology. In this way, the energy model grows and improves.

Although the new tools have been created specifically for the SEMANCO project they are generalizable and will be useful in any project where semantic data integration is required.

Designing and implementing demonstration scenarios

The impact of the SEMANCO tools will be evaluated through their application in three urban Case Studies, in Spain, the UK and Denmark (more details about the Case Study locations can be found on the SEMANCO website and in Newsletter number 1). The specific implementation of a Use Case at a particular geographic scale and context is referred to as a Demonstration Scenario. In the SEMANCO project, Demonstration Scenarios will be carried out by implementing Use Case activities in the three specific Case Study areas.

Assessing and monitoring CO_2 emissions reduction performance is central to managing the emissions associated with urban planning choices and, hence, to an assessment of the impact of which the SEMANCO tools are capable. To this end, urban planning schemes must have a monitoring strategy. However, a challenge for assessing the impact of energy efficiency in urban planning is that the urban environment and its energy system consist of a complex, interacting hierarchy in which elements at the same level interact with each other and with elements in other levels of the hierarchy. This means that individual elements of the urban system cannot be treated in isolation and, as a result, energy efficiency planning at any particular hierarchical level may be inadequate or counterproductive at other levels. Furthermore, the characteristics of the urban system are also a function of the background/interests of the observer. This is where ontologies come into play, providing a mechanism to interrelate the various perceptions of a complex problem as understood from the perspective of different domains and/or experts.

Our accounting framework is able to deal coherently with a multi-dimensional set of performance indicators that operate across hierarchical levels. In doing so, it envisages the urban environment as a system in which an inflow of resources is transformed into an outflow of products and waste in order to maintain the integrity of the whole: the urban environment is a metabolic system. The tools developed using this framework will be capable of using different methods with different degrees of detail, relevant to the detail required by the different hierarchical layers. For example, the detail required for energy performance calculations of buildings is different depending on whether one is interested in the city level of the individual house level of detail. The latter would require much more detail. The SEMANCO tools will be capable of moving between these hierarchical levels as required by the user.

As well as handling the multidimensional complexity of the urban environment, this accounting framework gives us the ability to make direct comparisons between urban areas, cities, etc. – that is, to directly compare performance. We can also compare performance between socio-economic groupings and are able to interpolate in the case of missing data.

Within this multidimensional accounting framework the SEMANCO team have developed a set of strategies to monitor emissions and a set of indicators to measure the performance of CO_2 reduction strategies. The carbon and energy management strategies supported by the SEMANCO platform will involve classical carbon management approaches of establishing a baseline, selecting indicators, setting a target for reduction, defining an action plan for reduction and setting up monitoring protocols.

The indicator list has been defined and compiled in such a way as to make explicit the data input requirements and the calculation methodology for the indicator. Importantly, the indicators are linked to a set of key questions relevant to the Use Cases and therefore to the strategies involved in planning, designing and implementing carbon reduction technologies in the built environment.

Although it is based on the needs and specific requirements of the three case studies, the indicator set is a general resource and will be built into the SEMANCO platform in such a way as to allow it to evolve over time in response to changing requirements of the platform and the user community.

This development work to outline the monitoring and verification of emissions reductions and the accounting framework that allows us to deal with the multiscale challenges of urban planning is an important step towards full implementation of the SEIF and the development of the tools that will form the SEMANCO platform.

Visit the SEMANCO website for more details: www.semanco-project.eu

If you would like to become a member of the SEMANCO Dissemination Network, please contact Chris Ennis at c.ennis@tees.ac.uk