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STSM SCIENTIFIC REPORT

Action: COST TU0801
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COST STSM Reference Number: COST-STSM-TU0801-5171
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STSM Topic: Semantically enriched model for underground cables and pipes
Host: Sisi Zlatanova,Tu Delft, OTB Research Institute for Housing, Urban and Mobility Studies Section GIS technology, Delft(NL), s.zlatanova@TUDelft.nl

Contents of the report :

1- Purpose of the visit

Today activities around underground cables are getting more and more interesting. There is a strong need to properly locate buried cables not just to show them graphically but to add an extra value to the created model. At the end of the process there is a need to maintain underground cables and to create a new capital over it. Facing the questions regarding cables we have tackled the urban area and questions like, how to better manage the construction phase of cables, how to create common environment for multidisciplinary and how to connect ground and underground cables, there is a trend and a real need to add rich semantics to current models so they can effectively deal with urban issues for the underground cables. The created model is giving answer to some of those questions.

The purpose of the visit was to explore semantic enrichment of the urban ontology's and more specifically to:

-investigate the existing models about urban underground cables IMKL and CityGML extension for the utilities
-to understand the principle reason and use of such model
-identification of the commons between models
-Interco relation with other people connected with the underground cables
-proposal of new model and writing of a paper
-identify the possible ways to strengthen the collaboration (currently within COST TU0801) between University of Liège and TUDelft relatively to these aspects.

2 Description of the work carried out during the STSM

2.1 Presentations of research works

Research performed at TUDelft

The specific of the field of the underground cables is the need and the urgency in today existing mess of the data and legislation. Problems faced over the construction phase of the underground cables, which is meeting multidisciplinary, uncertainty and lack of data has implied a deep thinking over the solutions for such demanding buried assets.

Therefore the overview of the situation and problems are described in the first published paper "A way to improve management of underground utilities", which is the part of the title of the whole Phd research "Ontology based model of underground cables". Work is presented to the Section of the GIS technology of OTB Research Institute for Housing, Urban and Mobility Studies, which was the beginning of the research work.

The main issues of the research at TUDelft were undertaken as follows:

- Problems of the construction site are similar to that of a current urban centre in a perspective of a sustainable development. Indeed, in spite of the roughness of the job, the utilities have to be maintained and registered. Then, a demographic increase or urban planning, a less good management and perhaps a disasters may unbalanced the system, with consequence that the amount of the incidents is creating the need for better care over the utilities and faster finding of the buried cables
- thus the use of ontology's to represent different points of view; clarifying the naming of the object due the multidisciplinary approach
- description and understanding of the existing models, finding the gaps

IMKL Model

IMKL model produced by the Dutch Kadaster is an exchange model and aims to provide information about utilities for excavation purposes. The idea of the model is that each underground network has a Network ID based on the owner. The model considers different types of network, also recognizes different construction material serving the need to know what kind of utility is underground. In brief Netherland has online services click-on-line which are serving the end users for the purpose of the location of the cables. Maintenance of the cables is devoted to the owners of the cables, and the main idea of the register of the property rights is the creation of the Network ID.

IMKL Model and the Network Id is based on the Owner and his legislative rights. The centre of the model is the basic product which is Theme Map, which is a collection of all the cables and pipes that belong to one Network operator. Please have in mind that the owner and the network operator can be different. Each Network has one Network operator, opening the possibility to add to the Theme Map the topography elements that refer to the utilities such as detailed map, relative position to topographic objects (dimensioning), house connection, etc.

The most important class is the Utility class. This class in the super class holding information about the location of the cables and pipes, depth of the network and possible deviations, material, type (electricity, gas, water, etc.). Further this class has specialisations with respect to the characteristics of pipes, cables, trenches, etc.

The model provides also instructions on the colour the different utility networks have to be visualised via on a common map. The large topographic map of Netherlands is used as a background map for visualisation.

Model of the CityGML extension for the utilities

The CItyGML extension for the underground utilities, which is developed on the basic of many other utility maintenance models, is giving different definition of the networks. Model is based on the Interior and Inter feature connections which is giving possibility to store network and complex connexions and classification of different networks. It has a great solution of the exterior and interior nodes and its purpose is maintenance at the first place and its use is adjusted mainly to the maintenance companies.

CityGML with the extension for the utilities is developed based on the compares of many models together and its purpose is the register and maintenance of the cables based on the understanding of the complex underground network interconnections, it names two types of networks the inside and outside networks so it is very good for the complex connection points.
It actually recognises the need to better define the complexness of the interconnection between different networks. Network Id is here detailed since it recognizes the physical objects as node-point and edge-curve is.

Network components are pipe and connector and it really defines the underground network up to the details. Emphasise of this model is on the possibility of the visualisation, topologically in depth represented idea, but the visualisation of the complexness of the certain network, register and maintenance dedicated to the owner or the maintainer of the network.

Proposed model

My proposed model is offering the possibility to increase the exchange of the data about underground utilities through the understanding of the different overview of the situation in the construction phase of the utilities. Model is facing the communication problems in the management of the construction of the utilities between different professions that are actors in the construction. The base of the model is the connectors that are objects on utilities visible above ground (hydrants, shaft and house connectors). Accepting the both ideas of here explained models and adding the use through the objects represented as a node to node ID, as a part of the Network ID. Need for the exterior and interior nodes as the complexity of the many connections at the one point is recognized so it's not implemented in my model.

Objects on utilities that are implemented as the core data are here giving the opportunity to extend the registration to the above ground utilities, since there is physical ground object that is connecting it to. The further research should be taken in this area.

2.2 Meetings

With Prof. Sisi Zlatanova

The main topic of the discussion is Brainstorming through PhD proposal and clarification of the task that will be performed at TUDelft in the frame of the COST Action and the semantic enrichment.

The main issues of the discussion were:

- Identification of common features for underground utilities hat are important for registration: the creation of a model based on understanding of existing models for underground cables
- identification of the existing data and the problems that should be faced and modelled
- identification of the important queries to be performed ion this model and clarification of the tasks
- a joint paper that will be submitted to a congress
- discussing the ontology's and the difference in use between ontology and UML

To start the collaboration on the defined task the presentation of the research work was performed in front of the colleagues from the Section, it was briefly explaining the work up to now emphasising of the important questions and clarification of the tasks

With Prof. Peter Van Oosterom

The main topic of the discussion is the brainstorming over the imposed ideas based on the submitted paper about previous research. This implies:

- finding the interesting commonalities between different models for underground utilities
- 3d cadastre and definition of the legal rights, together with main visualisation tasks and possibilities
- discussing possible technical, legislative and 'ideal' solution, definition of the important task to be modelled
- discussing the ontology's and tasks regarding the visualisation

A possible application of urban ontology's is the construction phase of the building field with aspects such as: multidisciplinary approach, different definition over the same objects, and management of building sites.

With Prof. Jaap Zaverbergher , Jantien Stoter, Garwin van den Haag (visual data department)

The main topic of the discussion was the explanation of the Dutch registers, NSDI, visualisation techniques and idea of 3D cadastre

- explanation of the register processes, existing legislation and role of the profession in Netherland
- going in depth of the technical and legislative definition of the 3d cadastre in national and international context
- NSDI development in the Netherland, its use and further visions
- Acknowledgement with the visualisation techniques, introduction of the possibilities of the visualisation of the model

Following the Training school '3D geoinformation for Disaster Management' 05.10-10.10.2009

The intensive and educative workshop over the management of the disasters, together with the practical problems and solutions in 3d modelling.

Practical tasks undertaken were:

- Completing task of the creation of disaster management of the Flood
- brainstorming through 7 different cases of flood at different areas, mind map
- UML schema of flood
- Ontology of Flood for the chosen class of Actors from flood
- Change of UML based on ontology model conclusions

3- Description of the main results obtained

The main results obtained are directly related to the work carried out and described in the previous sections. The work is carried through meetings, practical draft of the model and the carried research.

Results issued from the creation of the model

- Understanding of the proposed existing models
- Developing a model based on the investigation of the existing models, IMKL and CityGML
- Proposal of the extension of the models by the adding the use of the model based on the practical data and understanding of the process

- Paper about created model that will be submitted to a congress
- Thematically semantic enrichment of the urban data models so they can effectively deal with urban issues for the underground cables.
- Identification of a multidisciplinary approach over the construction of the underground cables as a possible application field of current tools and methods: Geographic Information Systems, 3D models and UML-models plus ontology's. Ontology are particularly suited to represent the different possible interpretations related to an construction site or object;
- identification of a centre of interest, the creation of a model for the urban space, that will lead to a common research, investigation of possible means and ways to perform this research, need for using the tools and methods quoted above in an interdisciplinary way

4- Future collaboration with host institution

Several types of collaborations can be envisioned between the two universities (University of Liège and TU Delft):

- Direct exchanges of researchers: funding to be found (possibly through research projects already worked out by the institutions);
- collaborations through publications : on international journals or through joint participations in international workshops;
- collaborations through specific STSM actions to be investigated further;
- collaborations through research projects

5- Projected publications / articles resulting or to result from the STSM

A paper on a created model of ground and underground cables with the purpose of the register and the maintenance which will be submitted to the congress (maybe 3d GeoINFO next year TuBerlin)

6- Confirmation by the host institute of the successful execution of the mission

On behalf of the host Institute, TU Delft, OTB Research Institute for Housing, Urban and Mobility Studies Section GIS technology. I (Dr. S. Zlatanova national delegate in this COST action) confirm the successful execution of the STSM by Ivana Sainovic (PhD candidate at the University of Liege).

This report prepared by Ivana Sainovic shows that:

- all the activities done in Delft (meetings, discussions, etc.) develop the research ideas at the basis of the STSM proposal;
- these research ideas present a real added-value to the current COST action TU0801 by providing in-depth view on underground utility models and also to potential new collaborations (notably between the University of Liege and TUDelft)

Current lack of information about underground utilities and clear legislation requires an urgent attention. Problems exist in each phase of laying-down underground networks, from the construction phase to the integrated registration and management. There is strong necessity for understanding the existing company models (electricity, water, swage, etc.) to be able to derive a generic network model to be used for various purposes and many users. In this respect, it is expected that 3D and ontology will greatly contribute to establishing links between different models. The various meetings, discussions, understanding the tools and the importance of the third dimension, make possible to create a semantically enriched model, which can serve specific tasks of network providers and surveyors as defined in the Croatian legislation..

I strongly believe that this STSM is the starting point of future collaborations (e.g. within current TU0801 Cost Action), since they re giving opportunity to a researcher to meet new environment, different styles of

work and philosophy and to face a questions from a different points of view that are maybe not so highly named in basic environment, where the benefits of the research and personal could be measured through the practical results. Dynamic in research work is highly recommended.

Delft, December 18th , 2009 Signed: prof. Sisi Zlatanova

7- Other comments – conclusion – perspectives

As a matter of conclusion, this two months spent at the TUDelft provided a very good opportunity of discussions with various people coming from various backgrounds and horizons, opening many questions related to my PhD work and giving very precise answers.

It was also very rich in terms of the knowledge and perception of the people at the TUDelft over the various matters; I highly appreciate this international environment because it gives tremendous richness to the analysis and overview of the ideas.

As a matter of perspectives for future work, it is possible to say that:

- Multidisciplinary approach is mandatory to execute a wider use of the models
- Further improvement of the model
- Various disciplines would gain in value to use 3D models enriched with semantics and using ontology's as a tool to overcome the gap between different disciplines;