3D City Models and urban information: Current issues and perspectives

European COST Action TU0801

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Cover Figure

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Foreword

COST – the acronym for European Cooperation in Science and Technology – is the oldest and widest European intergovernmental network for cooperation in research. Established by the Ministerial Conference in November 1971, COST is presently used by the scientific communities of 36 European countries to cooperate in common research projects supported by national funds.

The funds provided by COST – less than 1% of the total value of the projects – support the COST cooperation networks (COST Actions) through which, with EUR 30 million per year, more than 30 000 European scientists are involved in research having a total value which exceeds EUR 2 billion per year. This is the financial worth of the European added value which COST achieves.

A "bottom up approach" (the initiative of launching a COST Action comes from the European scientists themselves), "à la carte participation" (only countries interested in the Action participate), "equality of access" (participation is open also to the scientific communities of countries not belonging to the European Union) and "flexible structure" (easy implementation and light management of the research initiatives) are the main characteristics of COST.

As precursor of advanced multidisciplinary research COST has a very important role for the realisation of the European Research Area (ERA) anticipating and complementing the activities of the Framework Programmes, constituting a "bridge" towards the scientific communities of emerging countries, increasing the mobility of researchers across Europe and fostering the establishment of "Networks of Excellence" in many key scientific domains such as: Biomedicine and Molecular Biosciences; Food and Agriculture; Forests, their Products and Services; Materials, Physical and Nanosciences; Chemistry and Molecular Sciences and Technologies; Earth System Science and Environmental Management; Information and

Communication Technologies; Transport and Urban Development; Individuals, Societies, Cultures and Health. It covers basic and more applied research and also addresses issues of pre-normative nature or of societal importance.

The Action TU0801 is called: "Semantic Enrichment of 3D city models for sustainable urban development" and is one of the actions of the COST TUD domain (www.semcity.net). TU stands for Transport and Urban Development (www.cost.eu/domains_actions/tud) and is one of the COST key domains. It fosters research coordination in the fields of transport and the built environment, which play a strategic role in the modern society and economy. The Domain is by definition cross-sectorial and multidisciplinary, encompassing a wide range of scientific expertises within the transport and land use planning, design, and management activities with a special emphasis on the strong interrelationships among the relevant policy fields as well on all aspects related to sustainable development.

Web: http://www.cost.eu
Action Website: www.semcity.net
Action COST page: http://w3.cost.esf.org/index.php?id=240&action_number=TU0801
wiki: http://semcity.unige.ch/semcity/doku.php/start

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Chapter 1
Introduction

1.1. Context

Many urban or environmental models are defined with the objective of helping practitioners and stakeholders in their decision-making processes. Models which represent in three dimensions the geometric elements of a city are called 3D city models. These models are increasingly used in different cities and countries for an intended wide range of applications beyond mere visualisation. Indeed, unlike maps and drawings, 3D visualisation reflects a view of the environment that a lot of people are familiar with and acts as a communication tool. Non geometrical data (such as social, historic or acoustic data or statistics, for example) can be associated to urban geometrical objects (such as buildings or streets) that can be represented and visualized in 3D, leading to a localization as well as a better understanding of these data. By associating a domain (energy consumption, air quality, etc.) to these 3D models, we obtain richer 3D representations that can be used for simulations and reasoning (visual reasoning).

Considering sustainable development of cities implies investigating cities in a holistic way taking into account many interrelations between various urban or environmental issues. Could the above mentioned 3D City models be used to integrate urban and environmental knowledge? How could they be improved to fulfil such a role? We believe that enriching the semantics of current 3D city models would extend their functionality and usability; therefore, they could serve as integration platforms of the knowledge related to urban and environmental issues allowing a huge and significant improvement of city sustainable management and

development. But which elements need to be added to 3D city models? What are the most efficient ways to achieve such improvement/enrichment? How to evaluate the usability of these improved 3D city models?

1.2. Presentation of the action

The action started in November 2008 and has ended in November 2012. The main motivation of the action was to explore ways to semantically enrich 3D models with urban knowledge and models, so as to extend their functionality and usability in a perspective of sustainability. It was an active research network of 75 permanent members gathering people from academia, industry, administration and regulation bodies from 23 participating countries (comprehensive lists are presented in annex 1).

The Action's Memorandum of Understanding (MoU) can be summarized as follows:

"Considering sustainable development of cities implies investigating cities in a holistic way taking into account many interrelations between various urban or environmental issues. From that respect, 3D modelling is a possible axis of integration of the knowledge related to these issues and a powerful basis for interactive exploration. We believe that enriching the semantics of current 3D city models with urban knowledge would extend their functionality and usability in a perspective of sustainability. The Action will identify knowledge (concepts) relevant for sustainable urban development and concepts related to 3D city models (top-down approach relying on literature and publications/ bottom-up approach coming from real problems and scenarios). Then, means for integrating or interconnecting these concepts either directly either by defining articulation patterns will be investigated. A particular attention will be put on the use of knowledge representation techniques such as ontologies to integrate or interconnect urban data and models within 3D city models".

In particular, the Action addresses conceptual issues related to the nature of the information and knowledge that must be added to the current models, technical issues about the feasibility of using 3D models as knowledge integration platform and issues related to the use, usage and usability of such enriched models.

The scientific goals are:

- To identify knowledge (concepts) relevant for sustainable urban development that could enrich current 3D city models.
- To investigate means for integrating or interconnecting these concepts either directly either by defining articulation patterns (such as ontologies).
- To assess the usability of enriched 3D city models, relatively to various urban issues.
- To promote the creation and use of enriched 3D city models.
- To provide a contribution towards European standards relative to 3D city models in relation with sustainable development.

- To provide a methodology for creating and maintaining enriched 3D city models.
- To produce recommendations for decision makers, scientists and for education purposes.

This Action is highly interdisciplinary, target groups are the scientific communities dealing with urban issues (planners, geographers, sociologists, etc.), computer scientists, designers, engineers, environmentalists or any actor of the urban field, decision makers, mapping agencies and data providers.

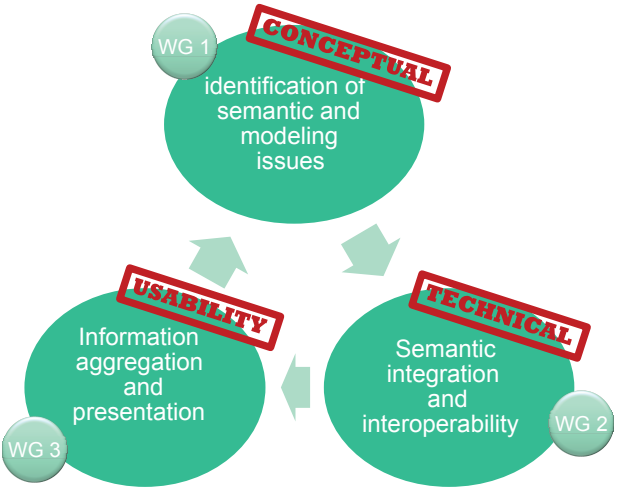

Fig. 1. Working groups of TU0801.

Three working groups (Fig. 1) were established:

- WG1 is an exchange and reflection platform about semantic and thematic 3D nature of urban space. Semantic and modelling issues were identified and analysed. This group is composed of urban experts as urban planners, urban geographers, sociologists, environmentalists, and of researchers from the spatial information field.
- WG2 focuses on integration and interoperability issues when combining semantic information and models with 3D city models. This group is composed of researchers in information sciences and representation techniques.
- WG3 addresses the stakes of information integration into decision processes to support urban development and sustainability. This implies a thorough understanding of those decision processes for a representative set of urban development and management processes, the identification of the users' needs for related information and knowledge on the urban fabric.