

# Chapter 16

## Challenges of Semantic 3D City Models: A Contribution of the COST Research Action TU0801

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### ABSTRACT

*This technical paper is a contribution to the identification of current challenges of semantic 3D city models. They are presented in four parts, namely 3D enriched city models and their connection with urban information models and smartcities, urban models integration, urban analyses and data. This work is an output of the COST Action TU0801 “Semantic Enrichment of 3D city models for sustainable urban development”.*

### 1. INTRODUCTION

Cities are complex systems constituted of physical elements interrelated into elaborated spatial relations, with a complexity increasing as the shape and the structure are changing and evolving. To try to understand the dynamics and the processes shaping our cities, we must coherently make models according to the dynamic and complex nature of cities, but also models should remain understandable and simple enough to be operationally useful. Hence, any attempt to model the spatial system and the dynamics of the cities should involve this non-determination and instability of the cities and this theoretical frame-

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## **Challenges of Semantic 3D City Models**

work as one of its basic features. In the same time it should be followed with a strong knowledge and data management providing a necessary coherence with the nature of the city. To do all that, we have to search for a new paradigm in the way of modelling urban form, thus allowing to free the process of representation from fixed types and pre-determined shapes of elements of the model and to introduce a concept that will be generative as much as it is analytical.

The future of cities based on the idea of a creation of a society of knowledge lies in the creation of semantically enriched 3D city models as powerful tools for gathering, storing, evaluating and using urban information through a comprehensive open and accessible system coherent with the nature of the cities and the way we see and understand them. Urban Information Models can emerge from the horizontal and vertical integration of different information sources with an active contribution of institutions, companies and individuals creating a complex network of urban knowledge. This in return will enable cities to act as facilitators for the exchange of urban information with a high level of details and usability. This would also help to become more effective and efficient in the way of providing policies for city management and urban planning suited to the best interests of their citizen.

3D city models must be seen as powerful tools for the integration of information coming from a wide range of levels of detail and backgrounds, from buildings and activities representations to ground and underground infrastructures. A high level of integration and interoperability between existing data and GIS related information and simulation capacities of the model can be achieved. 3D city models can become an urban analytical tool capable of harvesting information from different fields of activities. They can also become tools to generate new information and understanding through a complex urban knowledge about the conditions of the city, revealing the future in a most comprehensive way for future users. This will be considered as the true beginning of the concept of smart cities and the society of knowledge.

This paper presents some of the outputs of the COST Action TU0801 called: “Semantic Enrichment of 3D city models for sustainable urban development” which started in November 2008 and ended in November 2012 ([www.semcity.net](http://www.semcity.net)). COST- the acronym for European Cooperation in Science and Technology - is the oldest and widest European intergovernmental network for cooperation in research ([www.cost.eu](http://www.cost.eu)). This action was part of the Transport and Urban Development (TU) domain ([www.cost.eu/domains\\_actions/tud](http://www.cost.eu/domains_actions/tud)). 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 sustainable development. It was an active research network of 75 permanent members gathering people from academia, industry, administration and regulation bodies from 23 participating countries. More details about the action can be found in the final report (Billen *et al.*, 2014).

The paper is structured as follows: section 2 presents the challenges we faced at the beginning and during the Research Action about 3D city models, in terms of their use, the context of their use and the related benefits/drawbacks of their use, thus leading to the elaboration of research agendas organised according to the main axes that can be built from the figure below. The paper ends with the description of some of the most important issues and perspectives as identified by the Action.

## **2. CHALLENGES OF SEMANTIC 3D CITY MODELS**

The role of 3D city models as integrators of the urban and environmental knowledge has been strongly acknowledged all along the activities of COST TU0801 (Billen *et al.*, 2012; Leduc *et al.*, 2012; Billen *et al.*, 2014). This emerging vision will have major impacts on the one hand on standardisation bodies,

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