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## Opening up the subsurface for the cities of tomorrow The subsurface in the planning process

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### Abstract

COST (European Cooperation in Science and Technology) Action TU1206 Sub-Urban has explored sustainable use and management of the urban subsurface, and the use of subsurface information in urban planning and development. A part of the Action (Working Group 1) has assessed the ‘state-of-art’ in cities; another part (Working Group 2) has evaluated practices and techniques. Both have considered access to subsurface knowledge in cities. A network was established by the Action with more than 100 participants in total; and in Working Group 2, there were more than 50 participants. Working Group 2 has resulted in 6 full reports and a summary report. The Action’s Working Group 1 undertook comprehensive city studies. These established that the subsurface was in effect virtually ‘Out of mind, out of sight’ with respect to planning and management and there was a significant knowledge gap to fill. The task for Working Group 2 was to improve this situation. This paper is based on the work drawn together in the Working Group 2 Summary report ‘Opening up the subsurface for the cities of tomorrow’. This deals with good practices in urban subsurface planning and management; and how the urban subsurface planning and management processes can be improved in the future.

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**Keywords:** Urban Planning; Subsurface; Geoscience; Integrated modelling; Systemization; Knowledge; Collaboration

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## 1. Introduction

COST (European Cooperation in Science and Technology) Action TU1206 Sub-Urban has explored sustainable use and management of the urban subsurface, and the use of subsurface information in urban planning and development ([http://www.cost.eu/COST Actions/tud/TU1206](http://www.cost.eu/COST%20Actions/tud/TU1206)). Appreciation of the importance of the ground beneath cities may seem self-evident, but studies by the Action's Working Group 1 have confirmed that the urban subsurface is in fact still largely 'out of sight, out of mind' [1]. It does not present a daily concern to city planners and managers, and when it does, this is often because a problem related to the subsurface has developed. The Action has confirmed that there is a knowledge and communication gap between subsurface experts on the one hand, and urban planners and decision makers on the other [1]. In developing COST Action Sub-Urban, it has been argued that the only possible way to bridge this gap is to provide the right type of subsurface information, in the right format, and at the right time; and then to make sure that the people receiving the information (urban planners and decision makers) are able to understand and use it in making decisions.

The Action's Working Group 2 has explored the technical abilities of providing this subsurface information by an evaluation and integration of techniques [2]. The results are presented in this paper; starting with the strategic considerations of planners and geoscientific needs, followed by evaluations of existing techniques and practices. Finally, there is an analysis and discussion containing data communities of practices, and a systemic approach to achieve the right types of information required to support planning processes.

## 2. The challenges for the cities of tomorrow

Over recent decades, increased urbanization has created more pressure – not only on the outskirts – but also on the inner core of cities, putting important environmental issues such as water management and cultural heritage under stress. In 2016, The World Economic Forum assessed potential economic impacts on cities in The Global Risk Report [3]. Failures in climate change mitigation and in urban planning both emerged with rankings that further substantiated the earlier findings of the Action's Working Group 1 (see Fig. 1). The above observations, together with the observed trends in both climate change and urbanization, highlight the necessity to use subsurface information in urban management and planning far more than hitherto, and in more ways than at present.

## 3. Evaluation of practices and techniques

### 3.1. Strategy to meet user needs

The overall challenge for Working Group 2 has been to:

- On the one hand - understand and identify the city needs in order to develop/provide appropriate knowledge and products/tools for the municipality, city region, water board or other end-users, and
- On the other hand - identify good practice and relevant technologies when mapping and modelling the subsurface of the urban areas to enable improved and sustainable use and management of the urban subsurface.

Taking the perspectives both of urban planning and subsurface geoscience, Working Group 2 has identified urban needs, and examples of current good practice and best efforts for a wide range of subjects: from identifying city needs; to methods to achieve, store and visualize geological and geotechnical information; and to ways in which subsurface-related issues can be brought into urban planning. The examples provided describe practices both on municipal and national scales for different geographical settings/typologies. Working Group 2 has also identified key knowledge gaps in relation to each topic. The good practices and key knowledge gaps are presented in summary tables (see Appendix A and B). The results of Working Group 2 evaluation are summarized in a Summary report supported by detailed sub-reports [2, 4-10]. The sub-reports evaluate best practices and knowledge gaps within the following topics: Subsurface information and planning; Data acquisition and management; 3D geological modelling and visualization of the subsurface; Groundwater and geothermal monitoring and modelling; Geotechnical modelling and hazards; Subsurface geochemistry; and Cultural heritage.

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