

## Editorial Preface

# Special Issue on Serving our Cities: Towards a Research Community for Buried Infrastructure

Léon olde Scholtenhuis, University of Twente, Enschede, the Netherlands

Carl Schultz, Aarhus University, Aarhus, Denmark

Subsurface construction operations require accurate and reliable information about underground conditions. Utility owners in nearly all developed cities face the challenge of obtaining and integrating such information in their professional planning, construction and maintenance processes. Meanwhile, smart city initiatives proliferate, and potentially make cities' underground infrastructures even more dense, complex and entangled. Such developments are pushing society to create underground data models, to populate these models, and to mobilize them in subsurface engineering and urban planning practices. This not only makes streetworks more efficient, but also helps to avoid damage to existing infrastructures, and to avoid harm to construction workers and the public.

To manage the underground better, we argue that a diverse set of 'underground research communities' should be brought together. Specifically, there exists a need to (a) establish methodologies to extract information about underground conditions from the field; (b) develop models that capture underground ontologies, and contribute to standardization and interoperability between next-generation IT-systems; and, (c) advance the use of such systems to support planning, design, engineering and maintenance of the underground infrastructure life cycle. This special issue is a first attempt to develop these varying perspectives together into an underground infrastructure research community.

This IJ3DIM special issue includes contributions from a range of disciplines covering informatics, geophysics, construction management, and urban planning. The three distinct perspectives included in the issue studied the underground realm, each focusing on various stakeholder and stages of the lifecycle of an underground network. Contributions elaborate processes from analysis and onsite data collection; through modelling and representation of subsurface utility information; and communication in construction project stakeholder dialogues. It also covers multiple lifecycle stages of assets by looking at the planning, design, construction and maintenance of a utility. The issue's first contribution addresses remote sensing, and geographic information systems as tools and methods for utility surveying. The next contribution addresses how data models should subsequently register obtained network data as part of advanced visualization and simulations. The third contribution studies how end-users eventually engage with 2D and 3D models of the underground to facilitate architectural design and urban planning.

Specifically, Tabarro, Pouliot, Losier, and Fortier developed an approach to using existing geographical data from the web to facilitate utility surveying. Their WebGIS approach integrates geographical utility data models on-the-fly with sensor data from ground penetrating radars (GPRs). In an exploratory implementation study, the authors investigate how the approach helps localizing, marking and geo-annotating utilities, and how it creates benefits for potential end-users in Canada and Brazil. This showcases how GPR can become a more widely used tool to map city undergrounds.

Next, Kutzner, Hijazi, and Kolbe take a step further in the workflow of underground utility engineering by extending the existing CityGML Utility Network ADE. They define and test use cases for 3D multi-utility network data models. To this end, they also refine their existing conceptual model of subsurface utility data, explain linkages between network components and city objects, and include a new electricity network data model.

Finally, Hooimeijer and Campenhout present the role of low and high resolution 2D and 3D visualizations in spanning the knowledge domain of various stakeholders in the urban underground design process. Through the framework of distributed agency, they elaborate on the relationship between 3D technicians and subsurface specialists, and argue that a boundary spanning facilitator is key for bridging wide gaps between intersecting disciplines and fields of knowledge.

As a step towards a scientific community, the contributions in this special issue build momentum for mutual research interests that centre on the subsurface utility construction and management field. The collection of three main research areas related to lifecycle management of buried utilities contributes to shaping a multidisciplinary research agenda, and inspiring construction management and information scholars to dig deeper into the underground as part of their research area.

*Léon olde Scholtenhuis*  
*Carl Schultz*  
*Guest Editors*  
*IJ3DIM*

## **ACKNOWLEDGEMENT**

We would like to sincerely thank the IJ3DIM editorial board – in particular Umit Isikdag, Sisi Zlatanova and Jason Underwood - for providing the opportunity to host this special issue. We also gratefully acknowledge the anonymous reviewers for their diligent reading and extensive feedback, and all authors that contributed to this special issue.