

ide3a: A Digital Campus for Transdisciplinary Research on Interconnected Urban Critical Infrastructure Systems

Siling Chen^{1,1}, Dóra Hegyi^{1,1}, Margaux Huth^{1,1}, Florian Brokhausen^{1,1}, Ongun Türkcüoğlu^{1,1}, Philipp Wiesner^{1,1}, Jochen Rabe^{1,1}, Sangyoung Park^{1,1}, Lauritz Thamsen^{1,1}, Paweł S. Hachaj^{2,2}, Yan Delaure^{3,3}, Franz Tscheikner-Gratl^{4,4}, Andrea Castelletti^{5,5}, Jossekin Beilharz^{6,6}, Paul Uwe Thamsen^{1,1}, and Andrea Cominola^{1,1}

¹Technische Universität Berlin

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³Dublin City University

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⁵Politecnico di Milano

⁶Hasso Plattner Institute

November 30, 2022

Abstract

Urbanization and climate change are exacerbating stress on aging urban critical infrastructure systems, including water, energy, mobility, and telecommunication networks. Simulation tools and scenario analyses able to capture the interdependencies among these different infrastructure systems are crucial to support decision making and realize sustainable and resilient development. Yet, existing simulation tools are mostly developed within the boundaries of individual application sectors and information often remains siloed, despite the increasing data and computational opportunities offered by the digital transformation of many infrastructure sectors. In this work, we present how the ide3a project (international alliance for digital e-learning, e-mobility and e-research in academia – <https://ide3a.net>) addresses this research gap. ide3a is building a digital campus to support digital learning, research, and mobility in collaboration within a network of six European partner universities. Several senior and early career researchers with multidisciplinary backgrounds in water management, IT systems, mobility, energy, urban planning, sustainability, and psychology, work together to integrate state-of-the-art research on critical infrastructure and digitalization into traditional higher education curricula. As part of the ide3a portfolio of digital tools for learning and research, we present a prototype of “ConnectiCity”, an open-source simulation-based serious game that integrates multi-sectoral models to perform simulations of interconnected critical infrastructure systems and quantify cascading effects under various climate, social, and technical scenarios. Along with other ide3a activities, it is used to train early career researchers and students alike to enrich their transdisciplinary knowledge, foster critical system thinking, drive research on urban critical infrastructure dynamics, and ultimately working across disciplines to tackle contemporary urban challenges.

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December 16, 2021

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. RESEARCH-BASED TEACHING

- Interdisciplinary topic “Critical Infrastructure & Digitalization”
- Digital education platforms (Moodle)
- Digital tools, incl. a new serious game **ConnectiCity**



ide₃a-Ambassadors



E-learning Analyst

Icons created by Delwar Hossain, Gregor Cresnar from the Noun Project

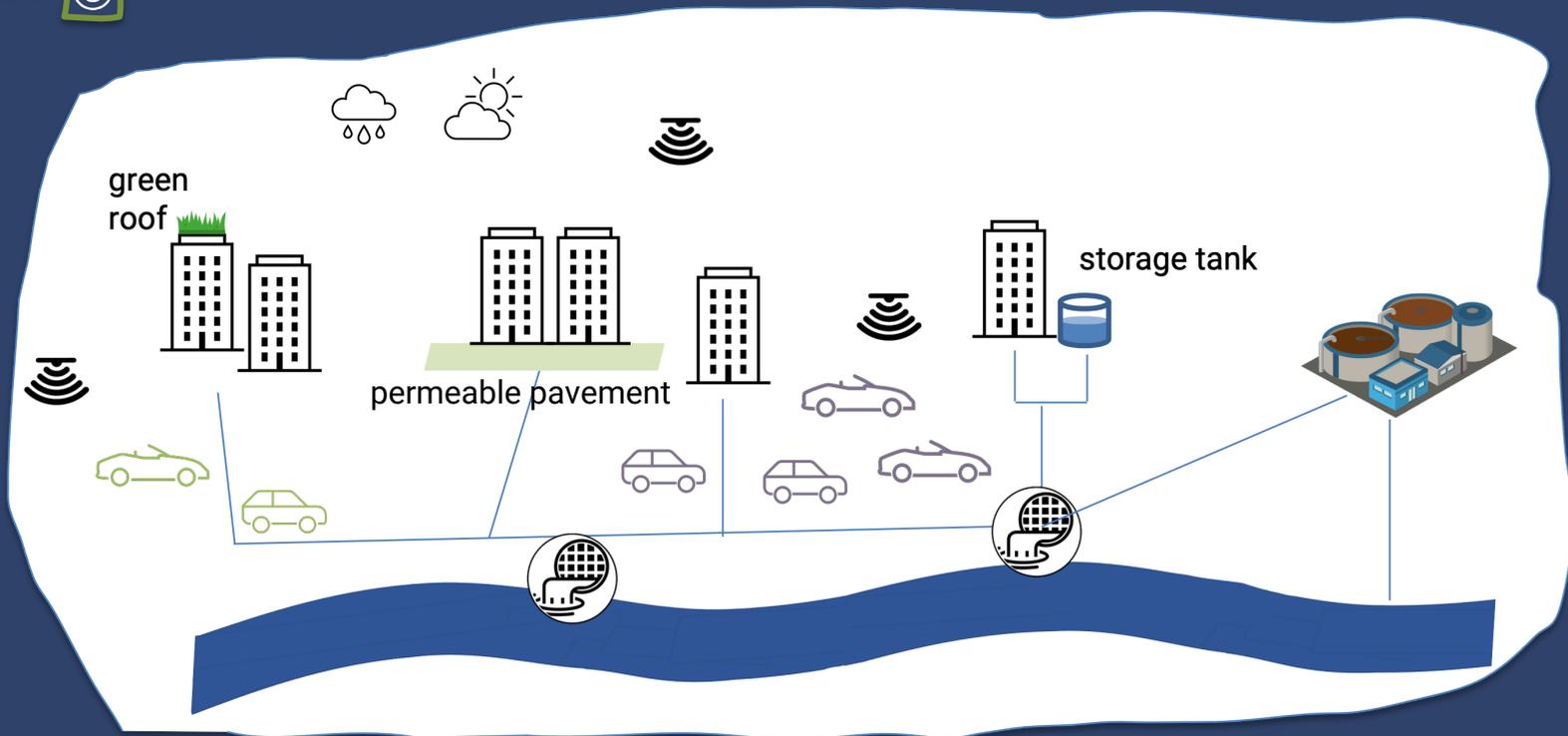


ConnectiCity

- Open-source, simulation-based serious game
- Integrates multi-sectoral models
- Simulates interconnected critical infrastructure systems
- Quantifies cascading effects under various climate, social, and technical scenarios



Credits: SWN TU Berlin

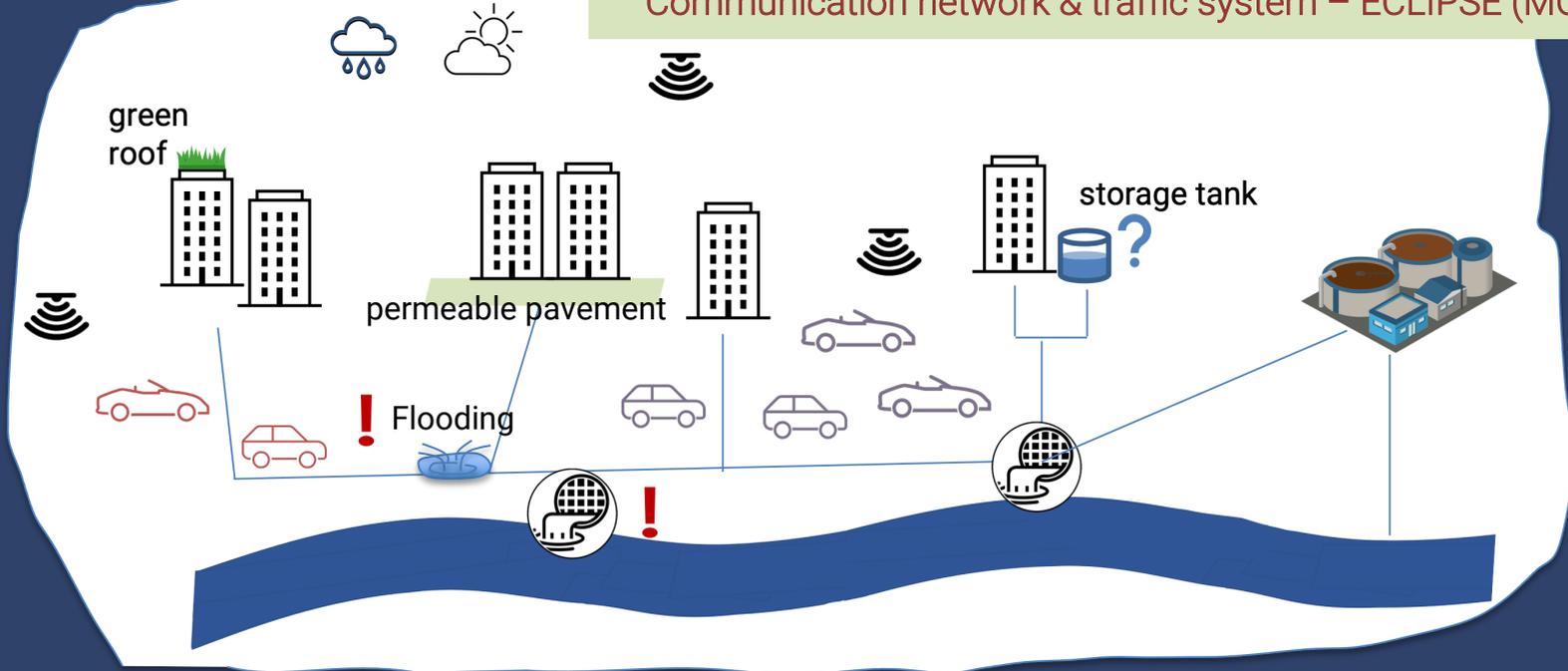


Icon of CSO from <https://www.blue-siren.com/collections/overflow-alarming>, WWTP from <https://pngio.com/images/png-a2274640.html>



Stormwater (BGI, CSO, flooding) – SWMM¹

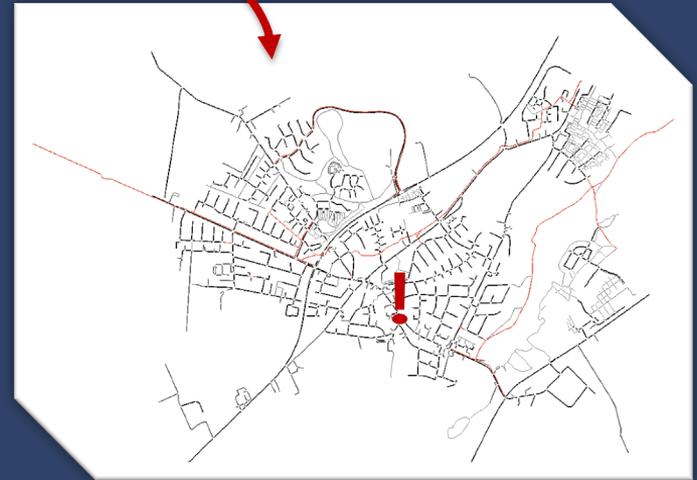
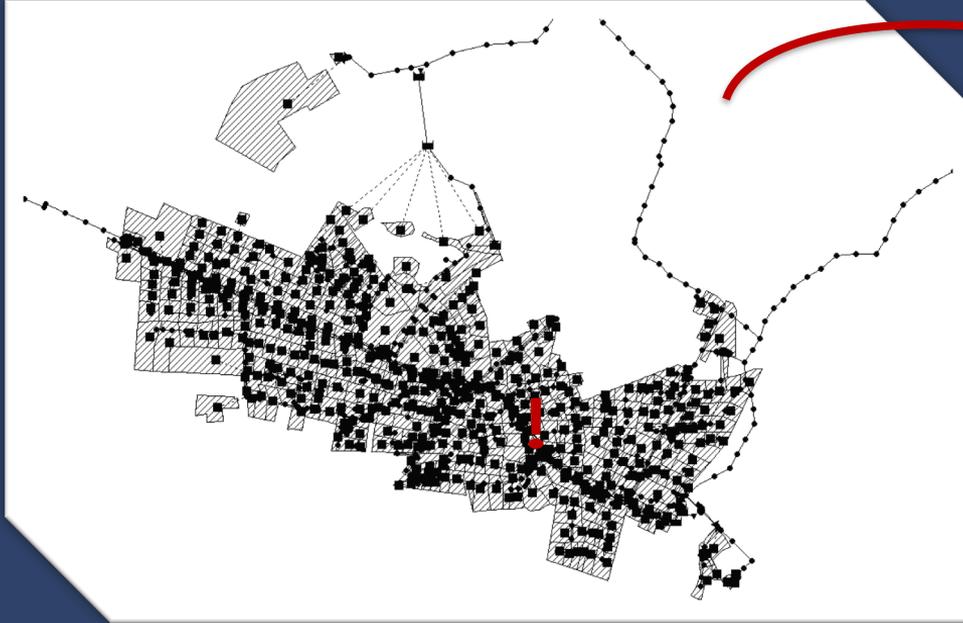
Communication network & traffic system – ECLIPSE (MOSAIC)²



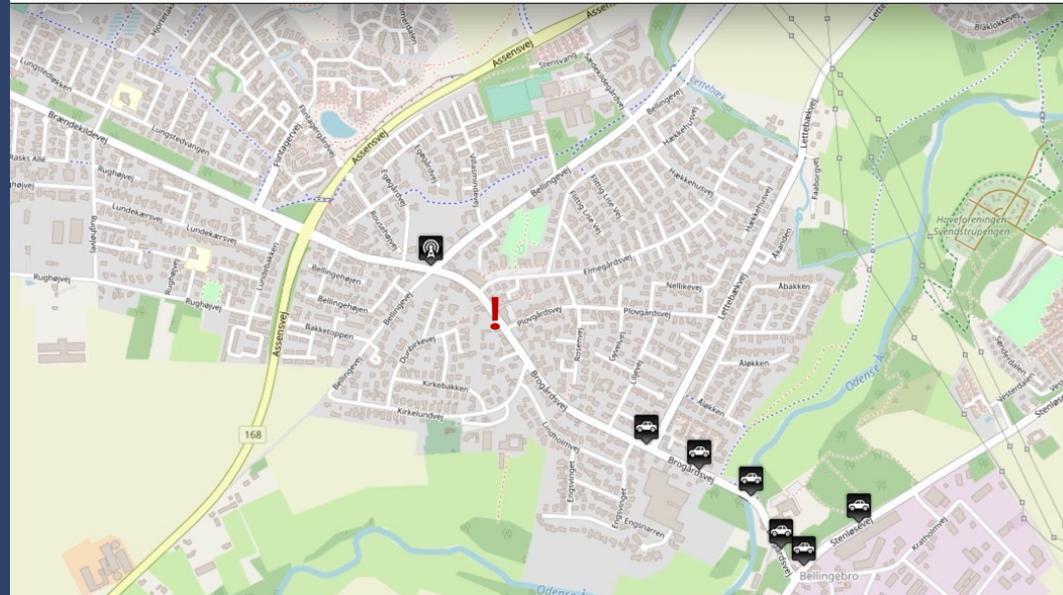
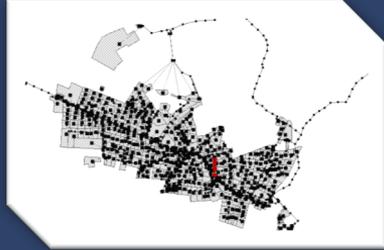
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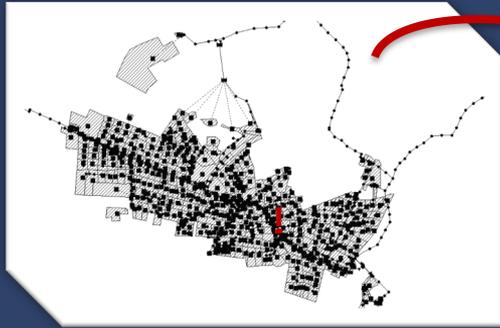
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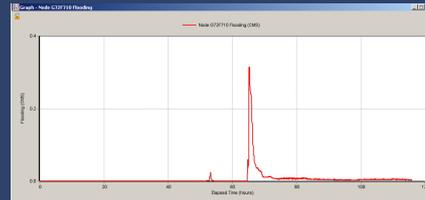


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Workshops from the course **Critical Infrastructure and Digitalization**, 2021

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- Challenge: couple street inundation models with SWMM

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“Critical Infrastructure and Digitalization”, summer 2021



Digital Water Networks and Interconnected Urban Infrastructure

– Prof. A. Cominola^{1,2}

Future Pumping Stations

– Prof. P. U. Thamsen¹

Modern Leakage and Erosion Monitoring

– Prof. K. Radzicki³

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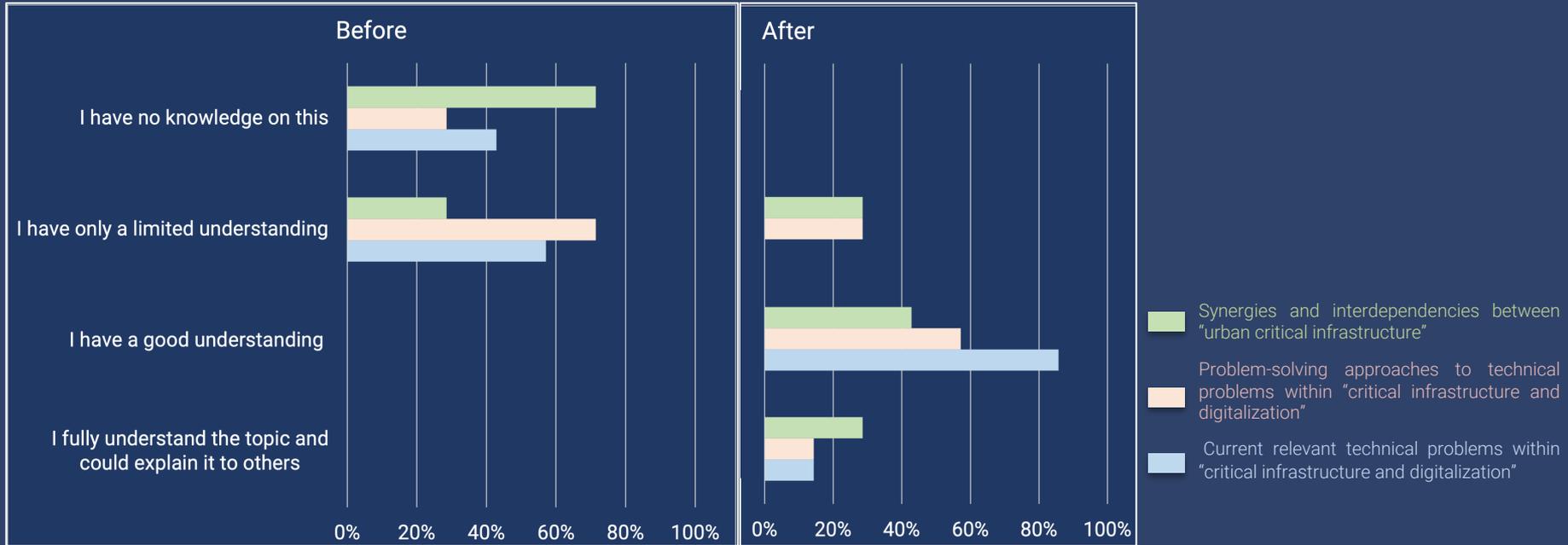
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Envision



Challenges

WHICH learning formats? (digital/blended/classroom)

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WHAT are the lessons learned in providing effective training programs to students with very heterogeneous backgrounds?



Thank You

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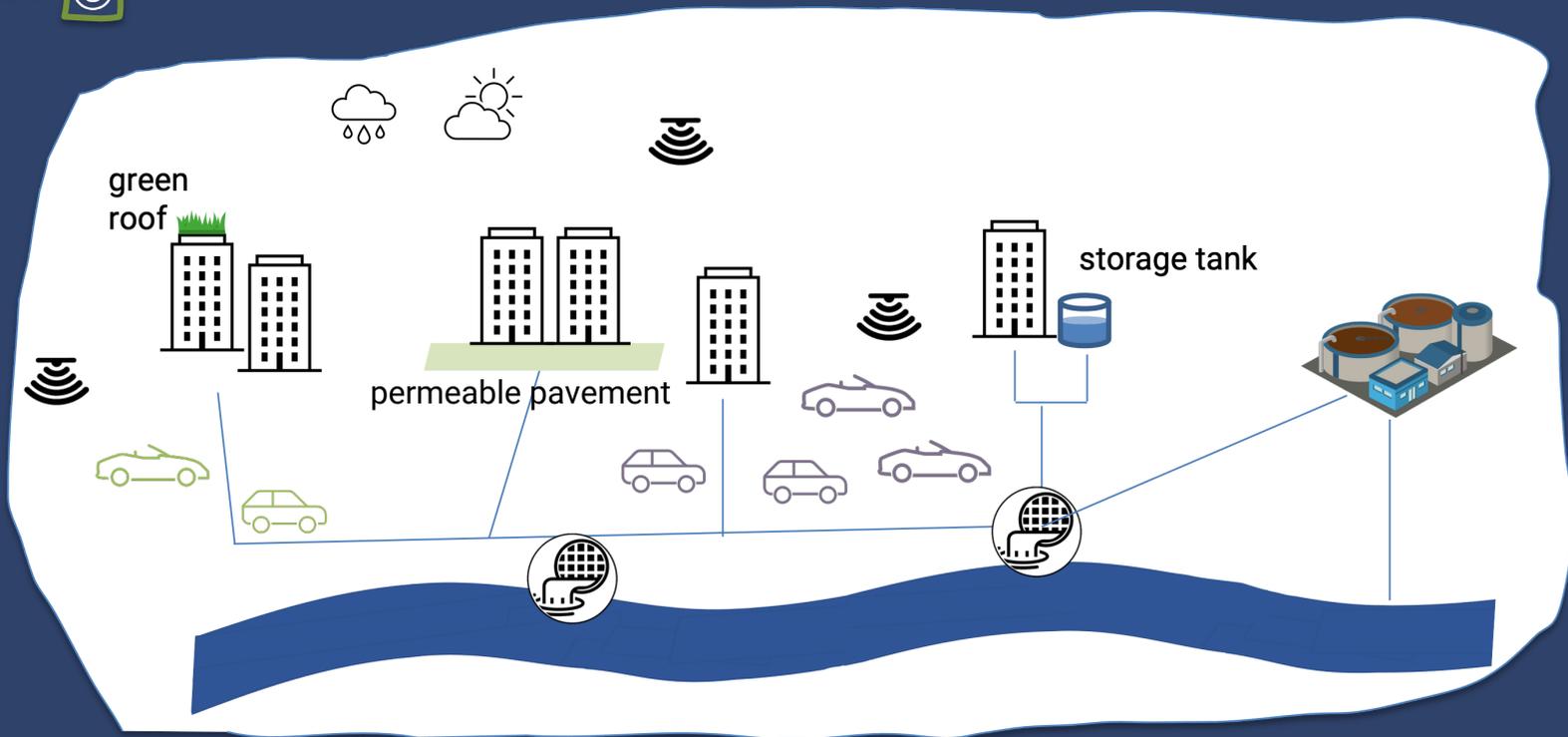


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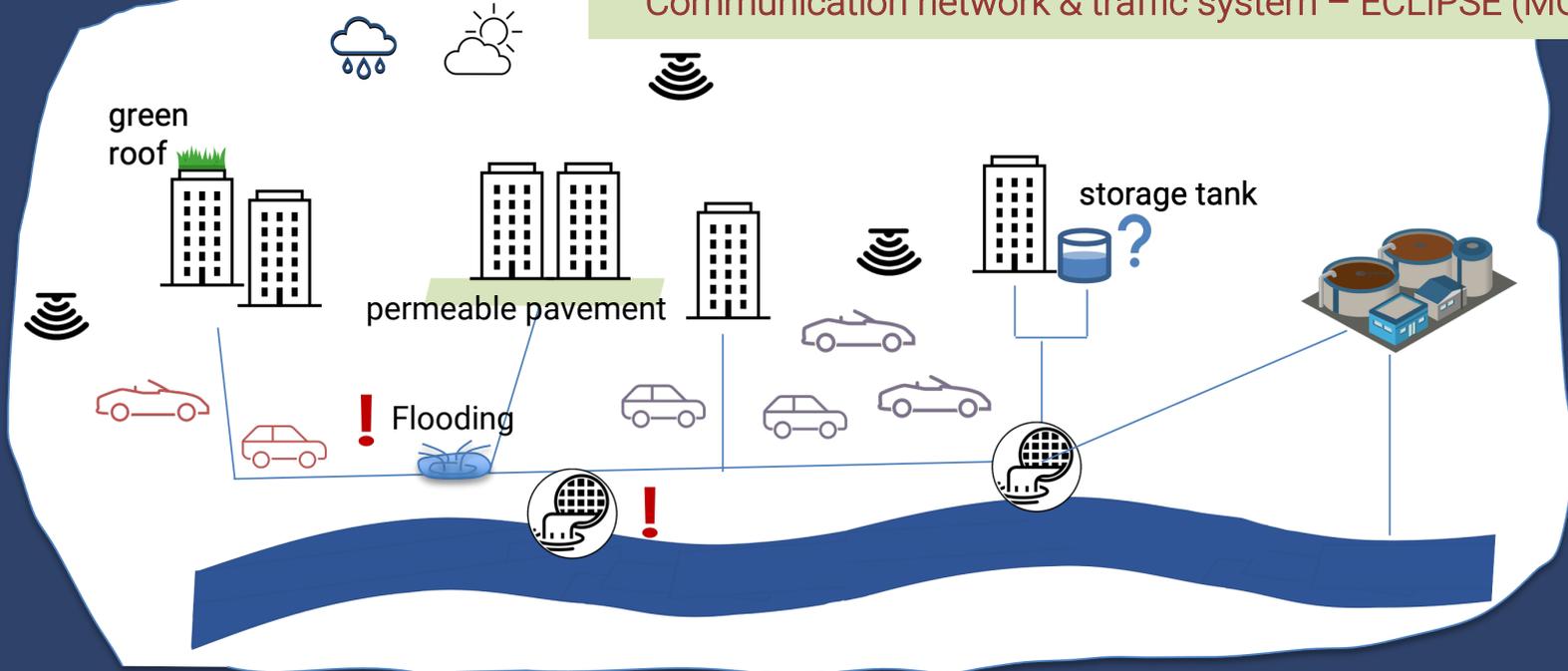


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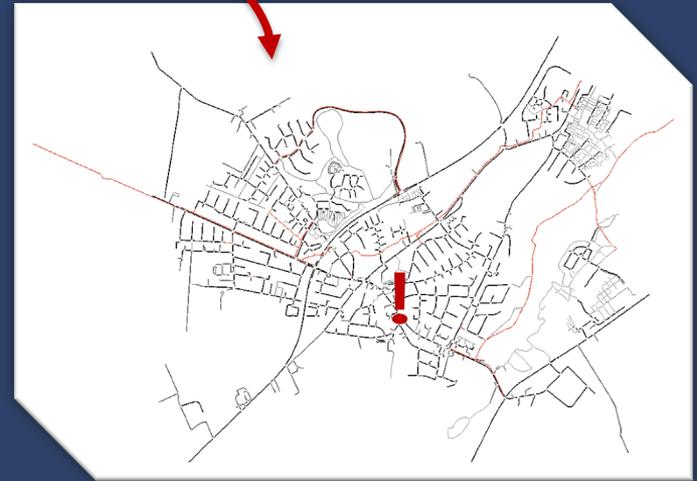
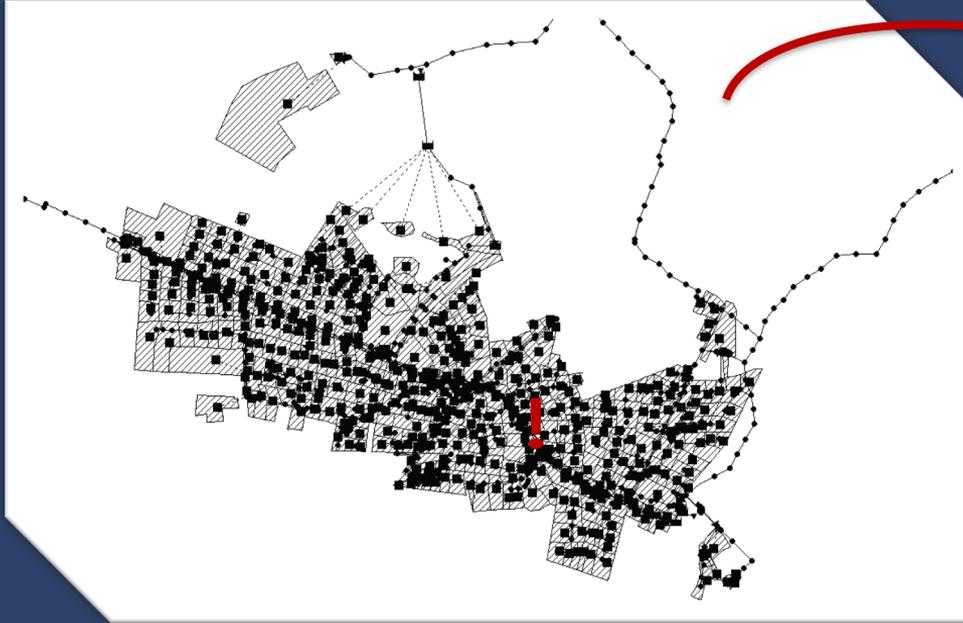
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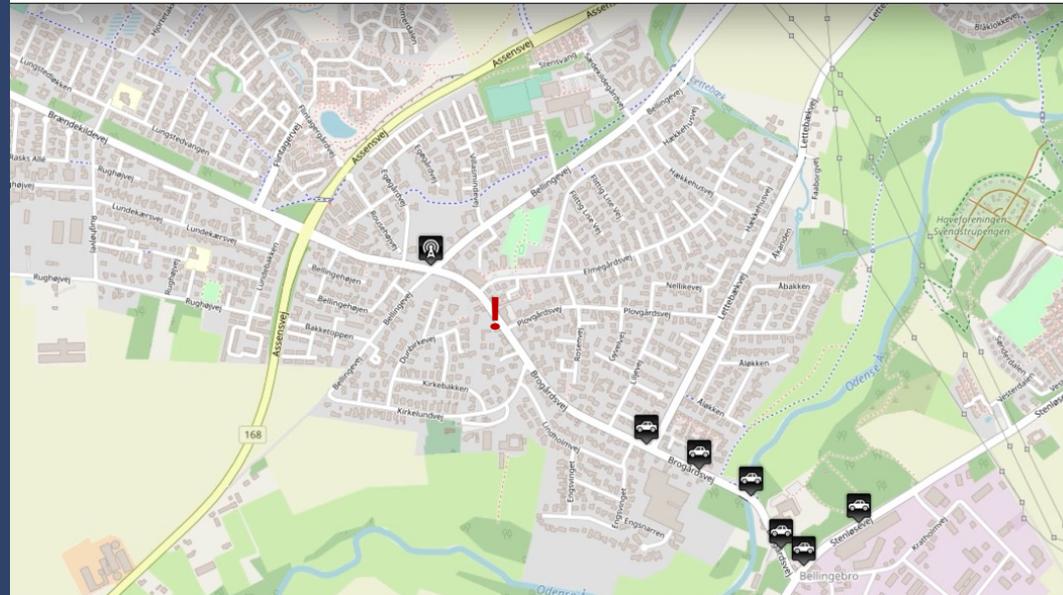
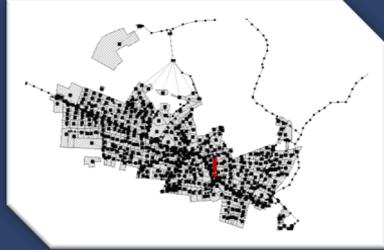
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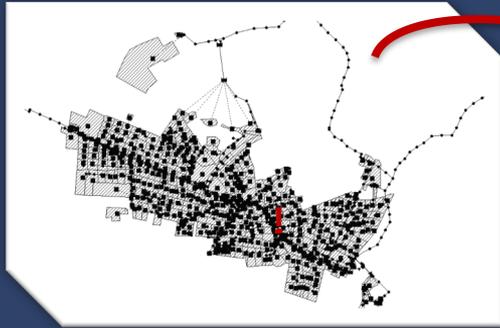
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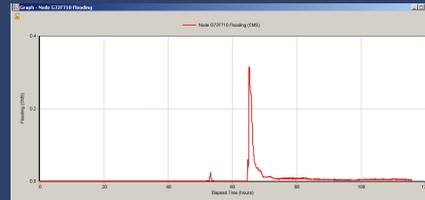


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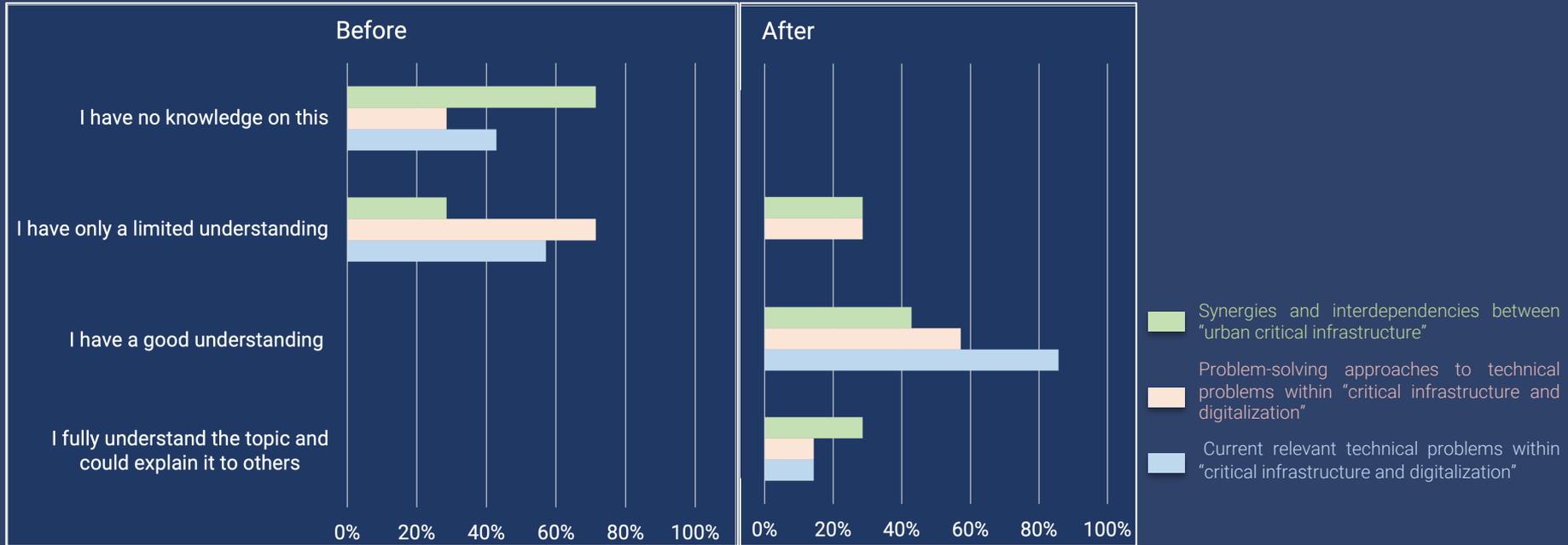
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