Designing Systems for Informed Resilience Engineering (DeSIRE)

By 2050, 80% of the world population will live in urbanized areas. Cities and adjoining regions are incubators for innovation, yet their vital interconnected infrastructures are vulnerable to shocks. The 2017 energy blackout in Amsterdam and the 2018 storm had major consequences on transport, telecommunication and health systems. Engineering faces the need to design social-technical-environmental (STE) systems that are adaptive to changing trends, and enable agile reactions to shocks. Engineering needs "resilience lenses". Resilience is the capacity of a system to sustain its functions and become better – through absorbing, adapting and self-organizing – under conditions of chronic stresses, abrupt shocks or disruptive innovations.

DeSIRE aims to conduct excellent research of societal value by connecting advances in resilience engineering (RE) with adaptive principles of economic and societal resilience. Within this programme, 15 new tenure track positions at 12 faculties across all four technical universities of 4TU will be created. This ambitious research and capacity building program will support a new generation of engineers and practitioners – 100 Resilience Fellows – to be trained to design, build and integrate infrastructures that are fit for the challenges of the 21st century. We established partnerships with several public and private organizations, PP-networks and NGO's (e.g. Water Envoy Henk Ovink, Ministry of Infrastructure and Watermanagement, Waterboard Vechtstromen, NG Infra (incl. Schiphol Group, Port of Rotterdam, Rijkswaterstaat, ProRail, Alliander, Vitens), Arcadis and CARE Nederland).

Strategic activities of the DeSIRE program will address the 3 RE challenges and corresponding questions:

1. **Resilience thinking and design**: What constitutes resilience of complex adaptive social-technical-environmental (STE) systems? To what extent can resilient futures be engineered? How can we generalize from the resilient design of individual engineering projects and systems? Where are the limits of existing methods? What are the directions for future development and testing of new design methods and approaches?
2. **Measuring resilience**: How can state-of-the-art technologies and methods be used to model, measure, and monitor resilience of coupled STE systems? How should resilience measures from engineering, environmental and socio-technological domains be adapted and expanded to fit coupled STE systems? How does resilience propagate across scales over time in multi-level systems?
3. **Resilience coordination and governance**: How do different governance models and approaches (e.g. centralized vs. decentralized) impact resilience of STE systems? How do social, environmental and institutional factors suppress or amplify the vulnerability of engineering systems? What is the role of citizen science in shaping resilient futures of STE systems?