

Future Resilient Systems

Enhancing the resilience of urban systems by combining engineering, design and social research

Why Resilience?

The urban environment is a complex system made up of interconnected socio-technical systems, such as transport, energy, and financial systems, as well as human and community networks. Rapid urbanisation and densification of population and infrastructure have led to the emergence of high-density urban systems, which tend to be vulnerable to disruptions and cascading failure.

Meanwhile, digitalisation has led to the evolution of infrastructure systems into cyber-physical systems. These physical systems have integrated data acquisition, analysis, and intelligent advisory abilities that interact with users and operators. This calls for new approaches to make these systems more resilient.

At the same time, to improve social resilience, we need to improve our sense-making capabilities and understand how humans and organisations interact. The development of human sensors and data science has made distributed cognition possible by acquiring data from human and technical systems in real time.

Our Mission

To improve the resilience of high-density urban infrastructure systems and systems of systems against ambiguous and unexpected hazards and threats, thus making Singapore a demonstration platform for the world.

Research Modules

Cyber-Physical Systems (CPS) Resilience

Module 1: Resilience Modelling of CPS

Module 2: Design of CPS Resilience

Urban Resilience

Module 3: System-of-Systems Resilience

Module 4: Urban Climate Resilience

Sensemaking for Resilience

Module 5: Social and Financial Resilience

Module 6: Distributed Cognition for Social Resilience

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Our Approach

The Future Resilient Systems programme provides a cross-disciplinary and cross-cultural environment, bringing together researchers from engineering, social sciences, and design and planning disciplines from ETH Zurich, Nanyang Technological University, National University of Singapore, University of Illinois Urbana-Champaign and the Stevens Institute of Technology.

Researchers develop approaches and models to be applied to real-world cases, such as a digital twin to analyse the resilience of energy systems and a dynamic mobile sensing platform for infrastructure monitoring. Network models of supply and demand as well as input-output flows will improve our understanding of interdependencies of infrastructure systems.

Tapping on the availability of human sensors and development of data science analytics, researchers develop ways to improve sensemaking and social resilience. Outcomes include a software that detects weak signals in mobility and social media data and tailored recommendations to foster social as well as financial resilience.

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Programme Director

Dr Jonas Joerin is the Director of Future Resilient Systems, and stationed full-time in Singapore. He is involved in research on social, community and food system resilience.

The Singapore-ETH Centre

Future Resilient Systems is the second programme of the Singapore-ETH Centre, established by ETH Zurich – the Swiss Federal Institute of Technology Zurich and Singapore's National Research Foundation (NRF), as part of the NRF's Campus for Research Excellence and Technological Enterprise (CREATE).

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