School of Sustainability
Arizona State University

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

Yeowon Kim

Will defend her dissertation

Safe-To-Fail Infrastructure for Resilient Cities under Non-Stationary Climate

Abstract

Motivated by the need for cities to prepare and be resilient to unpredictable future weather conditions, this dissertation advances a novel infrastructure development theory of “safe-to-fail” to increase the adaptive capacity of cities to climate change. Current infrastructure development is primarily reliant on identifying probable risks to engineered systems and making infrastructure reliable to maintain its function up to a designed system capacity. However, alterations happening in the earth system (e.g., atmosphere, oceans, land, and ice) and in human systems (e.g., greenhouse gas emission, population, land-use, technology, and natural resource use) are increasing the uncertainties in weather predictions and risk calculations and making it difficult for engineered infrastructure to maintain intended design thresholds in non-stationary future. This dissertation presents a new way to develop safe-to-fail infrastructure that departs from the current practice of risk calculation and is able to manage failure consequences when unpredicted risks overwhelm engineered systems.

This dissertation 1) defines infrastructure failure, refines existing safe-to-fail theory, and compares decision considerations for safe-to-fail vs. fail-safe infrastructure development under non-stationary climate; 2) suggests an approach to integrate the estimation of infrastructure failure impacts with extreme weather risks; 3) provides a decision tool to implement resilience strategies into safe-to-fail infrastructure development; and, 4) recognizes diverse perspectives for adopting safe-to-fail theory into practice in various decision contexts.

Overall, this dissertation advances safe-to-fail theory to help guide climate adaptation decisions that consider infrastructure failure and their consequences.

The results of this dissertation demonstrate an emerging need for stakeholders, including policy makers, planners, engineers, and community members, to understand an impending “infrastructure trolley problem”, where the adaptive capacity of some regions is improved at the expense of others. Safe-to-fail further engages stakeholders to bring their knowledge into the prioritization of various failure costs based on their institutional, regional, financial, and social capacity to withstand failures. This approach connects to sustainability, where city practitioners deliberately think of and include the future cost of social, environmental and economic attributes in planning and decision-making.

Thursday, July 12, 2018
10:00 a.m.
Wrigley Hall, Room 481

Faculty, students, and the public are invited.

Supervisory Committee:

Dr. Mikhail Chester, Chair
Dr. Hallie Eakin
Dr. Thaddeus Miller
Dr. Charles Redman