School of Sustainability
Arizona State University

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy
Thomaz Carvalhaes

Will defend his prospectus

Transitioning into Complexity-Driven Resilience Assessments for Urban Systems

Monday, October 19, 2020
3:00 pm
On Zoom: 981 441 8311

Faculty, students, and the public are invited.

Supervisory Committee:
Dr. Mikhail V. Chester, co-chair
Dr. Agami T. Reddy, co-chair
Dr. Braden R. Allenby

Abstract

The future is highly prone to increasing threats due to the highly complex and interwoven technological, social, and ecological infrastructure along with their dynamic shifts as modern cities and regions evolve. These threats are largely characterized by extreme weather events and climate change, but also include intentional and unintentional physical, biological, and cyber threats. Resilience is then an imperative that urban stakeholders, infrastructure managers, and community leaders need to incorporate in urban planning and strategizing to meet 21st century infrastructure demands and necessary community capacities. Resilience speaks to the adaptive capacity and flexibility of urban systems, the interconnected human networks and physical infrastructure that support essential urban functions, to cope with and recover from unexpected disturbances. Cities and regions are characterized by growing complexity that is increasingly difficult to

capture and make sense of toward resilience enhancing efforts. Meanwhile, resilience metrics and indicators that reduce such complexity in an actionable way, especially when geographically explicit, are in demand by stakeholders and decision makers. It is thus important to map where and how resilience emerges when beset by extreme events, in order to leverage existing assets and capacities as exemplars, or supplement them as needed. However, current approaches for such resilience indicator schemes do not adequately capture the complexity of urban systems, and oversimplify socio-technical models of urban infrastructure. While the resilience paradigm has continued to progress among several disciplinary fields, such as social science and engineering, as well as interdisciplinary efforts to understand and leverage resilience enhancing capabilities and structures, a major challenge remains regarding the integration of social and technical approaches toward socio-technical models for resilience research. Such shortcomings can lead to misinformative or inadequate strategies that undercut extant resilience capacities, or ultimately result in maladaptative infrastructure, greater social hardship, and sunken investments. This proposal will contribute toward integrating social and technical resilience domains, and transitioning disaster resilience assessments into complexity perspectives by asking the overarching question: How can a multiplicity of resilience assessments be integrated by geographic and network mapping approaches toward better capturing the complexity of urban systems? Considering the devastation during and after Hurricane Maria in Puerto Rico in 2017 as a case study, this proposal will leverage complexity and resilience theory, socio-technical network modeling, and a mixed-method digital geographic mapping (i.e., thick mapping) methodology to address this question in terms of three different areas of exploration. These outcomes will then be synthesized into a holistic multi-perspective assessment of resilience in Puerto Rico, a discussion of respective limitations concerning the methods and framing of the system in question, and an outline of future work.