Introduction and Background

Recent events like Hurricanes Harvey, Irma, and Maria highlight the limitations of traditional response mechanisms and have illustrated the major challenges that extreme weather events continue to pose to our infrastructure systems.

Lock-in - constraint of today’s systems by past decisions, even in the context of changing conditions or the emergence of more effective alternatives, and

Path dependency – the idea that it is often very costly and difficult to alter an infrastructure system from its current trajectory.

Lock-in and path dependency apply to physical infrastructure as well as institutional elements such as the way we design, operate, and protect our infrastructure. Thus, a critical aspect of enhancing the resilience of our infrastructure systems will be to address the lock-in and path dependency that have resulted in increasingly inflexible, rigid, and vulnerable physical and institutional systems.

This research uses a combination of literature review and conceptual framing to explore how the characterization of infrastructure as Social-Ecological-Technological Systems (SETS) – rather than traditional characterizations as purely technical or socio-technical systems – can help infrastructure managers more effectively understand:

i) the development and evolution of lock-in/path dependency over time
ii) the relationships and properties that emerge between S, E, and T domains
iii) expanded solution sets for addressing vulnerability, lock-in, and path dependence

SETs as a Lens to Identify the Evolution of Vulnerabilities

- As complexity and interconnectedness increase, S, E, and T systems increasingly cannot be decoupled from one another.
- Ecological and social systems continually interact with and influence each other via technological systems.
  - T systems are often the mechanism by which social systems affect ecological systems via pollution, resource consumption and land use.
  - T systems are often mechanisms that enhance services provided by ecological systems (to social systems) (e.g., water purification & delivery).
  - T systems are often the primary mechanism for protecting social systems from ecological ‘disservices’ (e.g., air conditioning, dams, etc.)
- At varying times and scales, each of the SETS domains has ‘agency’ and exerts influence on the other systems

Beyond Technologically-Focused Resilience Strategies

- A SETS lens to infrastructure can also help open the design and decision space to more than just technologically-focused resilience strategies.
- Incorporation of SETS strategies – as opposed to ‘T’ or ‘S-T’ strategies – can add flexibility and agility to the system.

References


Acknowledgements

This material is based upon work supported by the National Science Foundation under grant number SES-1444755 Urban Resilience to Extreme Weather Events Sustainability Research Network (UREx SRN)

Contact: Sam Markolf // smarkolf@asu.edu