Smart (Resilient) Communities for Planetary Health – Dr. Elizabeth Hewitt
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As an urban planner and a social scientist, my approach to *engineering planetary health* deals with finding links between people and the planet, through the lens of technology and engineering, and finding ways to leverage those links to make more resilient communities.

One important aspect of planetary health is resilience, especially in the face of climate change and natural disasters. It is necessary to first frame resilience in this context, because definitions of resilience vary greatly based on the field. Broadly, when we think of a resilient planet, we mean that a planetary system can return to equilibrium, or some balanced state, after a disruption. From an ecological perspective, we might also examine tolerance thresholds, or how *much* disturbance a system can take while still remaining operational.

However, we can't examine planetary resilience in a vacuum. The resilience of planetary systems are linked to and interdependent with human systems.

Our step as researchers is to find the crucial overlaps between ecological (planetary) and engineering (infrastructure) resilience. In my work, the key overlap between the two rests with people – human agents, decision making, and social networks. My focus is on communities and the people within them.

Conceptualizing resilience in this way requires a return to our framing of resilience. Instead of a static "return to equilibrium" approach, which is not a good match for the dynamic nature of communities, we need to conceptualize resilience in what is termed "evolutionary" resilience, or the ability of a system to change, adapt, and – most importantly -- *transform* under conditions of stress or disruption, to an entirely new state. For communities, this is a crucial approach. People are inherently dynamic and unpredictable, and also adaptable and transformative under stress. And people comprise communities.

Using this lens, the strongest resilience efforts for communities and the planet that are *evolutionary* in nature, will be nested. Nested efforts include differentiated approaches and responses based on geographic scale (local to regional to national to global), human scale (individual, household, group/organization, industry), and policy scale.

Importantly for this theme, how can technology and engineering help us link resilience efforts for both people and the planet?

A good way to think this through is by framing two human infrastructure systems that are important for resilience: Buildings and transportation. Why these two systems?

First, both of these systems create serious global problems. Combined, they are the two largest contributors to GHG emissions. In short, they are fueling the climate change impacts that people are needing to seek shelter ***from*** and build resilience ***for***. However, if key decisions are made, and these systems are leveraged in ***smart*** ways, they can serve as key assets during disasters.

Buildings provide shelter, and transportation networks *link* building-to-building, by providing mobility. **Buildings and transportation are both the problem and the solution.**

But how do we leverage these systems, as assets, to make us better prepared during disasters? The key missing link here is people. Information is needed about social networks and decision makers *within* these systems in order to better understand how to leverage these systems.

Specifically, understanding social networks means analyzing and and examining things like: Who makes decisions? What are the power dynamics? How do actors interact with one another and with external forces? What choices are made during disasters to deploy assets strategically?

This process of human agents in communities making key decisions about how to mobilize resources can be conceptualized as a spectrum between ***resourcefulness and robustness***. Making decisions in the moment to meet immediate needs can be considered being *resourceful*. Ongoing resourcefulness, however, can increase a community's *robustness* – permanently – leading to more resilience in future disasters.

As an example, consider a local community. Community version 1.0, in some baseline state, has a set of characteristics – both social and technological – that shape its ability to respond to disasters and deploy resources. Some disruption or shock may occur. During that disruption some strategic decision making occurs, and the community exhibits some level of resourcefulness. That, in turn, leads to essentially a ***new and different*** – or evolved – version of the community. Community version 2.0, perhaps. Some of the adaptations made during the disaster have transformed the community, potentially making it more ***robust*** for the next disaster.

From a research perspective, the key question then becomes – How do we ***measure*** this robustness, or quantify it in some way. **How do we replicate best practices of community learning?**

One tool that can be useful here is an analysis of Network Similarity Methods.

Essentially, this approach (which encompasses a number of different graphing and pattern recognition methods and quantitative tools), would allow for the application of network analysis methods to communities, acknowledging that communities ***are*** networks. They have nodes, such as people, groups, and organizations, connected by links, such as relationships, flows, and transactions, and this approach can draw from and build on network theory that tells us all effective and well-organized networks share similar characteristics and properties.

Essentially it would give us a tool to *quantify changes* to networks in communities – before and after disasters – in order to measure and assess community learning and evolution, ultimately with the goal of being able to apply and extend best practices to other communities.

ENGINEERING PLANETARY HEALTH:

COMMUNITY NETWORKS FOR RESILIENCE

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RESILIENCE FOR PLANETARY HEALTH

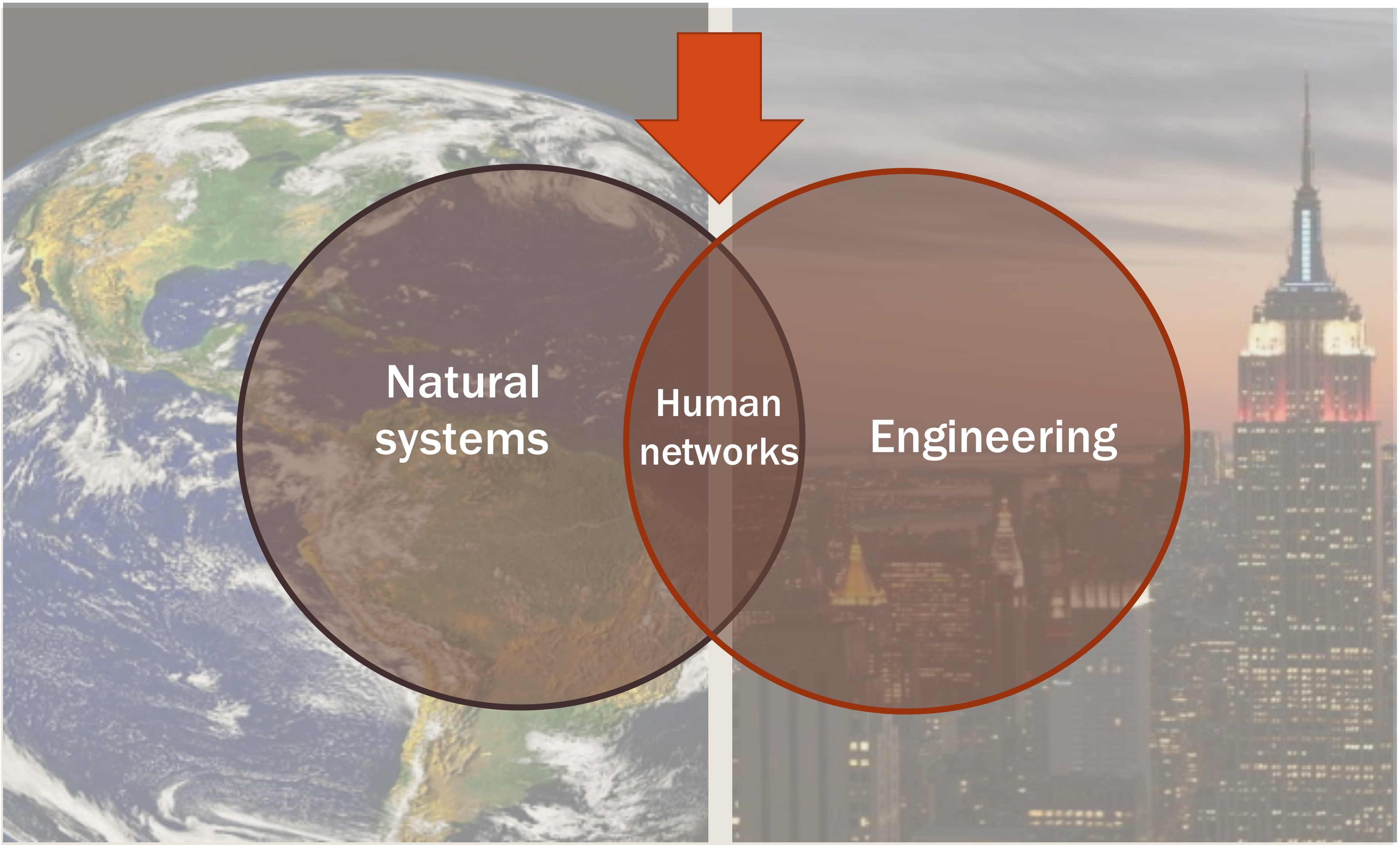
"Ability of a **system** to return to **equilibrium** or a steady-state after a disturbance." (Holling, 1973; Davoudi, 2012).

RESILIENCE FOR PLANETARY HEALTH

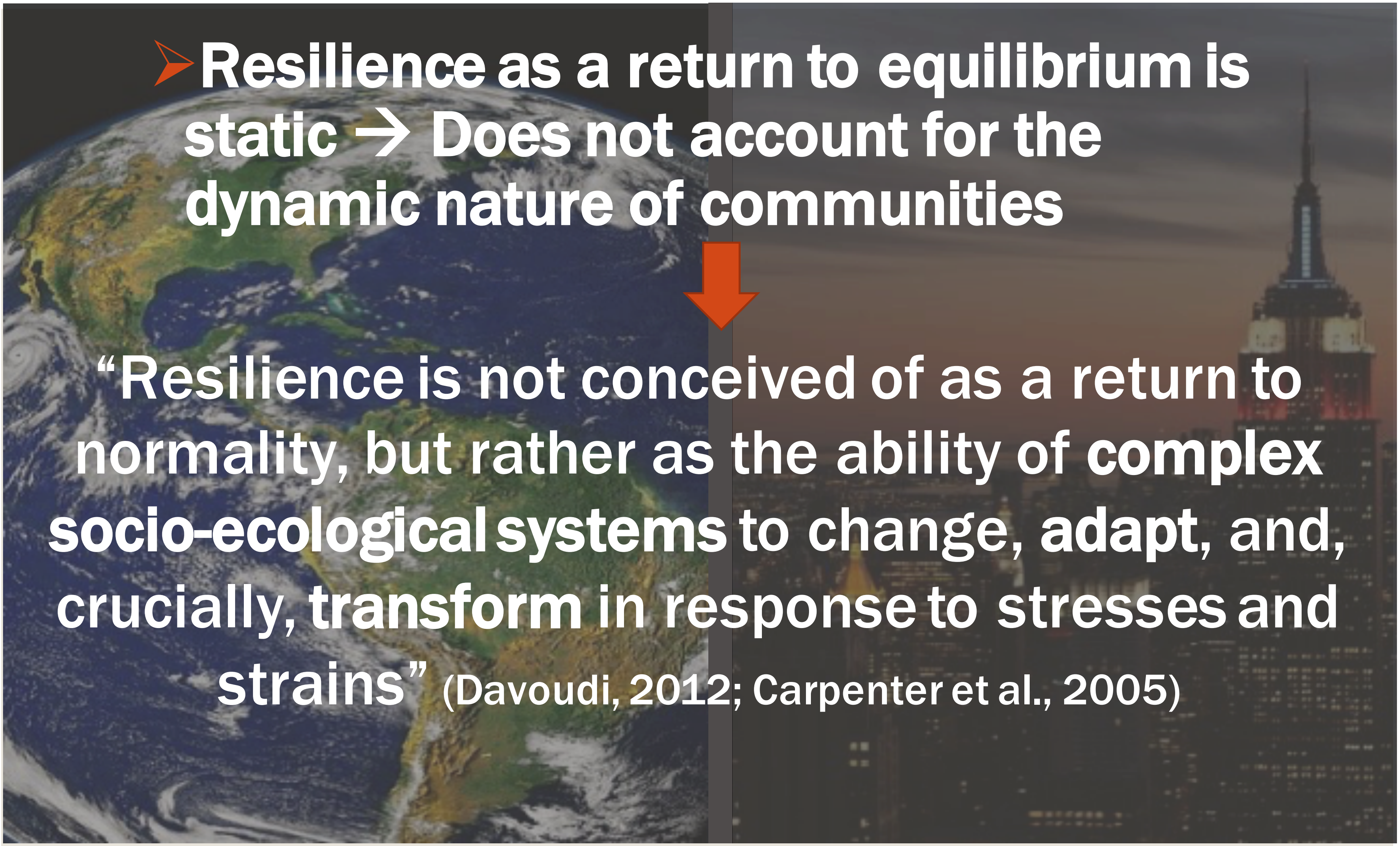
"How much **disturbance** the system can take and remain within **critical thresholds.**" (Davoudi, 2012, based on Holling).

RESILIENT PLANET AND PEOPLE?

FINDING THE OVERLAPS



EVOLUTIONARY RESILIENCE



DYNAMIC RESILIENCY IS NESTED

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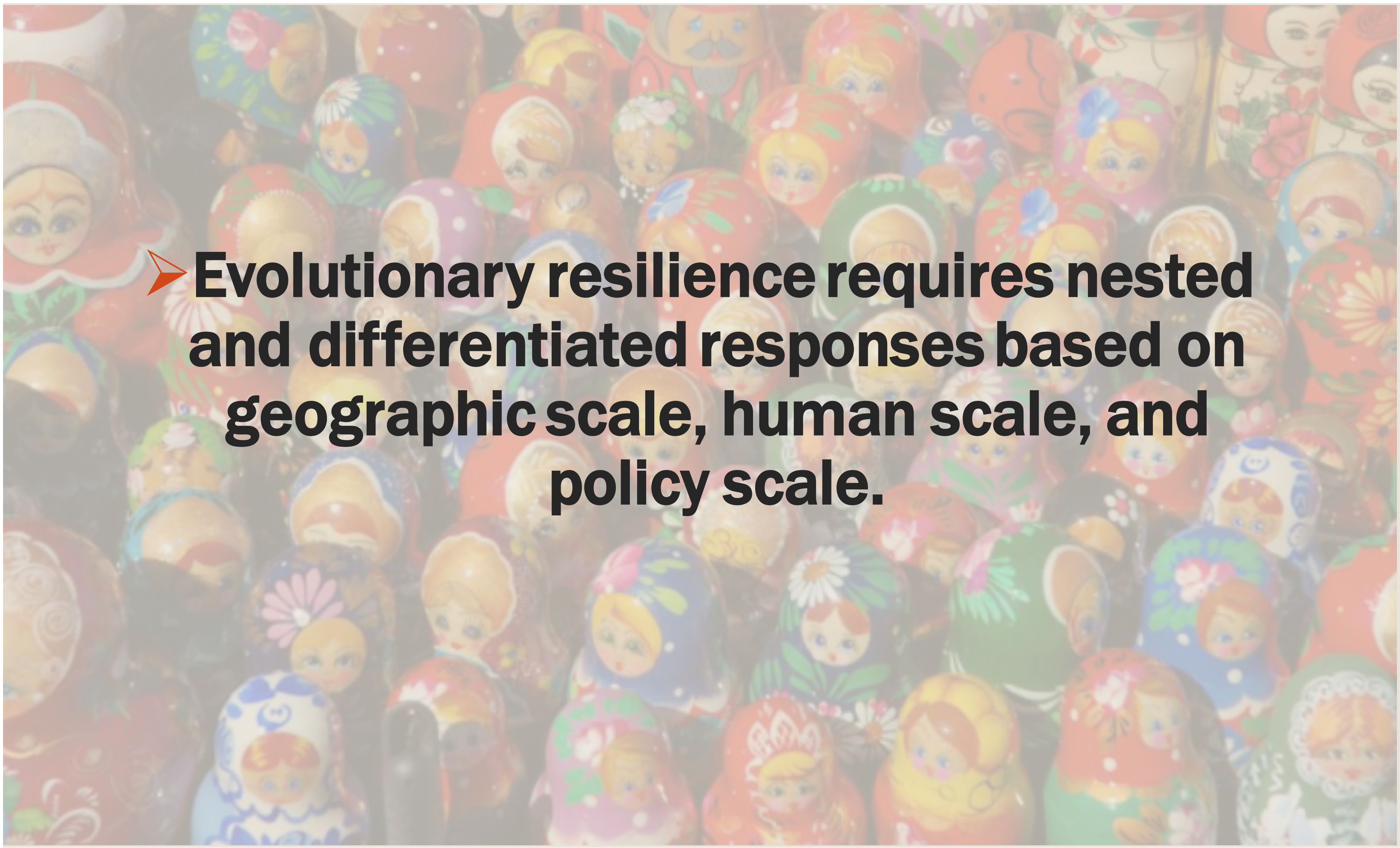
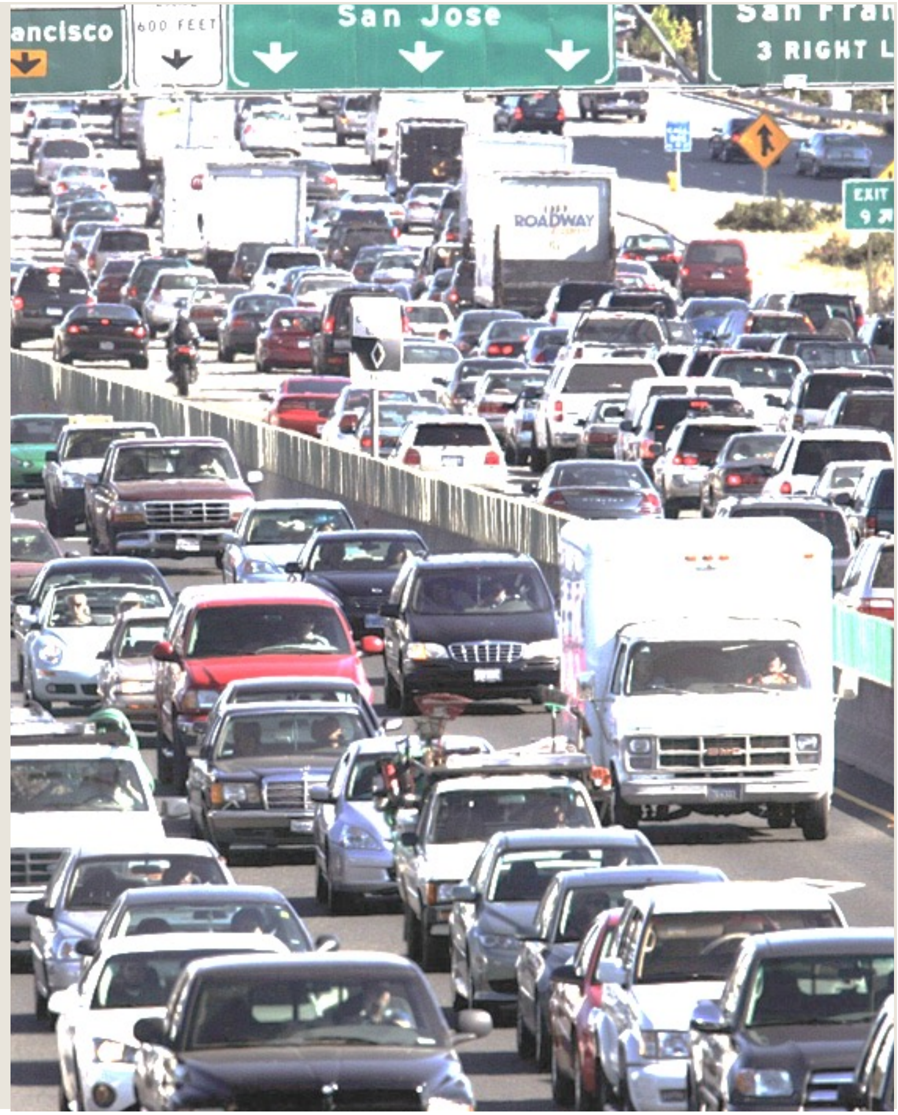


- **Evolutionary resilience requires nested and differentiated responses based on geographic scale, human scale, and policy scale.**

THE ROLE OF HUMAN SYSTEMS



THE ROLE OF HUMAN SYSTEMS

Two crucial infrastructure systems for resilient communities:

Buildings and Transportation

THE ROLE OF HUMAN SYSTEMS

Buildings and transportation systems are the primary contributors to GHG emissions globally, fueling the climate change impacts that people need to seek shelter from…

BUT

If adequately prepared, buildings and transportation networks can serve as key assets during disasters, providing shelter and mobility

BUILDINGS and TRANSPORTATION ARE THE PROBLEM + THE SOLUTION

HOW TO CAPITALIZE ON ASSETS?

In order to leverage building systems and transportation networks to advance resilience, information is needed about the social networks within these systems

HOW TO CAPITALIZE ON ASSETS?

- Who makes decisions and what are the power dynamics?
- Who takes on leadership roles?
- How do actors interact with other community members and other communities?
- What choices are made to deploy strategic assets to aid in disaster resilience?

RESOURCEFULNESS TO ROBUSTNESS

Making decisions during a disaster to meet immediate needs exhibits ***resourcefulness***

In turn, ***resourcefulness*** can increase a community's ***robustness*** during a ***subsequent*** disaster

RESOURCEFULNESS → ROBUSTNESS

RESOURCEFULNESS TO ROBUSTNESS

COMMUNITY 1.0 (BASELINE)

- Social networks
- Leaders
- Power dynamics
- Community resources
- Technology decisions
- Infrastructure characteristics

RESOURCEFULNESS TO ROBUSTNESS

RESOURCEFULNESS TO ROBUSTNESS

Mobilizing resources

Strategic decision-making

RESOURCE-FULNESS

RESOURCEFULNESS TO ROBUSTNESS

COMMUNITY 2.0 (EVOLVED)

- New or different network and community characteristics

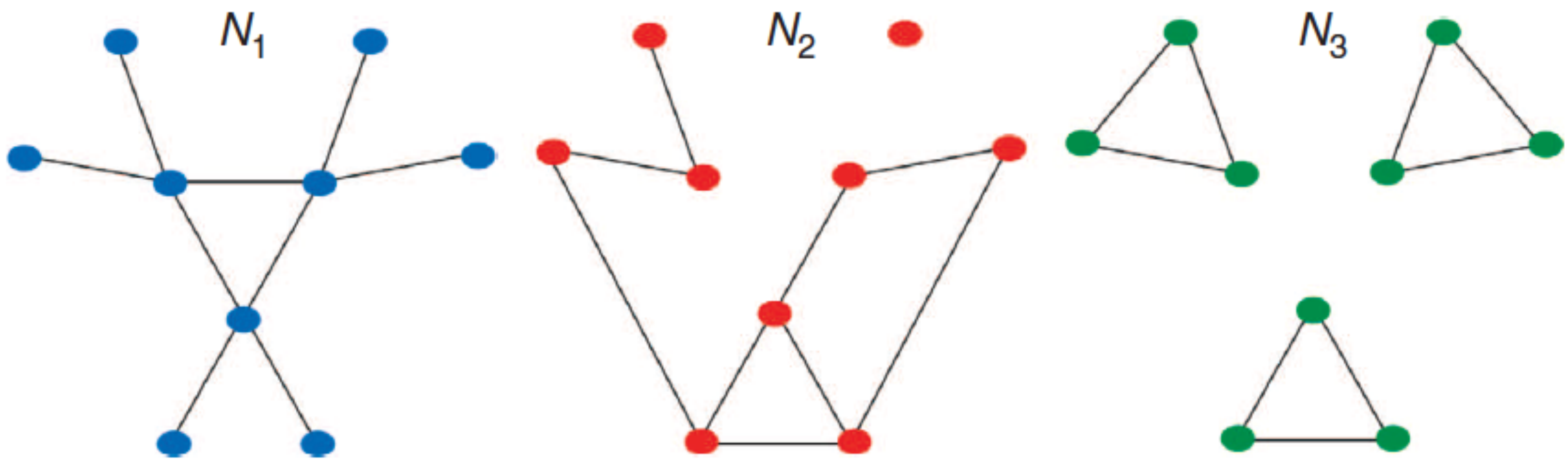
ROBUSTNESS

HOW DO WE MEASURE COMMUNITY EVOLUTION?

- Can robustness be measured in some way?
- Can changes in community networks be quantified in order to replicate best practices?
- Tools such as ***Network similarity methods*** begin to offer direction (also graph matching and pattern recognition)

NETWORK SIMILARITY METHODS

Schematic example: 3 networks with the same number of nodes and links



- Community networks have **nodes** *(people, groups, organizations)* and **links** *(relationships, flows, transactions).*
- All effective and well-organized networks share similar properties

Sources: Schieber et al. (2017). Quantification of network structural dissimilarities;
Krebs & Holley (2006). Building smart communities through network weaving

NETWORK SIMILARITY METHODS

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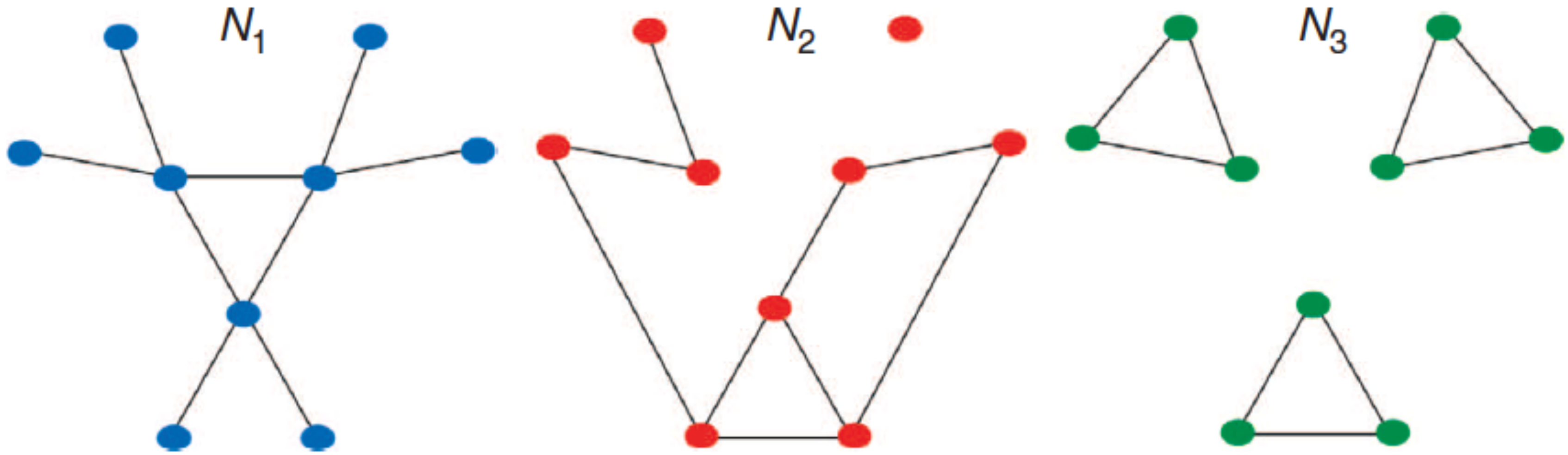

- Network similarity methods would provide a unique lens to resilience and our understanding of characteristics in communities that support resilience

Sources: Schieber et al. (2017). Quantification of network structural dissimilarities;
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THANK YOU!

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