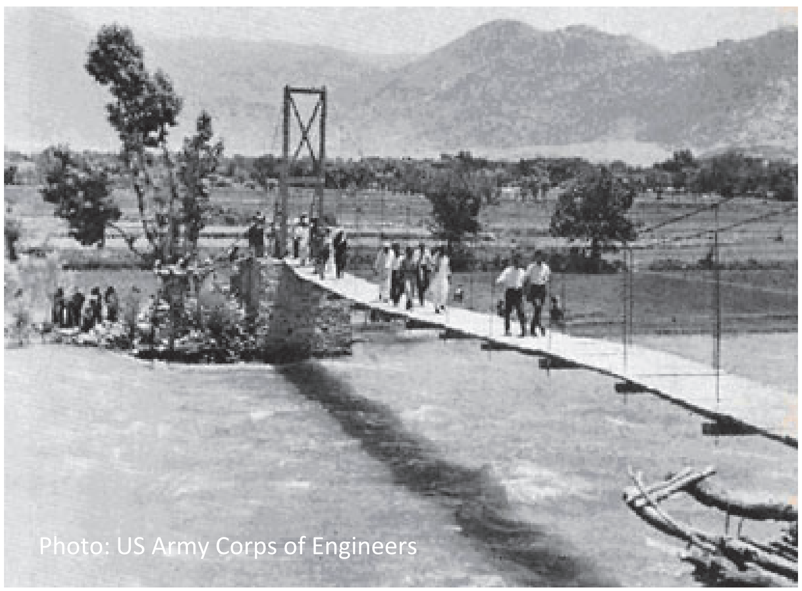
IMPROVING RESILIENCY BY DESIGNING FOR COMMUNITY NEEDS

16TH U.S.-JAPAN-NEW ZEALAND WORKSHOP ON THE IMPROVEMENT OF STRUCTURAL ENGINEERING AND RESILIENCY

JUNE 27, 2016

VERONICA CEDILLOS | ASSOCIATE DIRECTOR OF PROJECTS
APPLIED TECHNOLOGY COUNCIL | REDWOOD CITY, CALIFORNIA

Civil Engineering: Fundamental Purpose



Increasingly Complex Built Environment

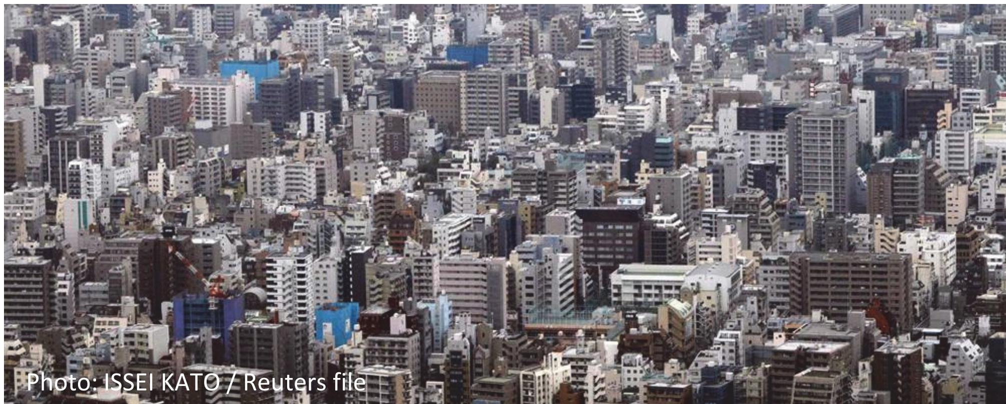


Photo: ISSEI KATO / Reuters file

Photo: The European Magazine

Photo: National Geographic

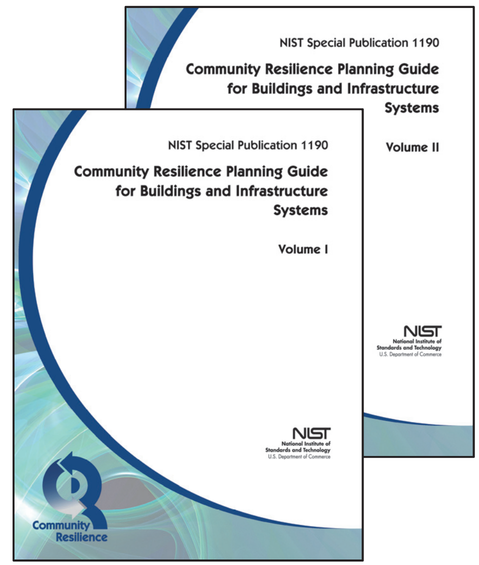
Ultimately, the built environment is a means to an end—buildings and infrastructure enable services, provide protection from the elements, facilitate transportation and communication, and ultimately enable and sustain society.

Community needs are particularly important following a disaster—it is these needs that need to drive performance targets.

Recent Efforts Highlight this Need

National Institute of Technology and Standards (NIST) *Community Resilience Planning Guide for Building and Infrastructure Systems* (2015)

"…social functions and needs of a community should drive the requirements of the built environment for a community to be resilient."



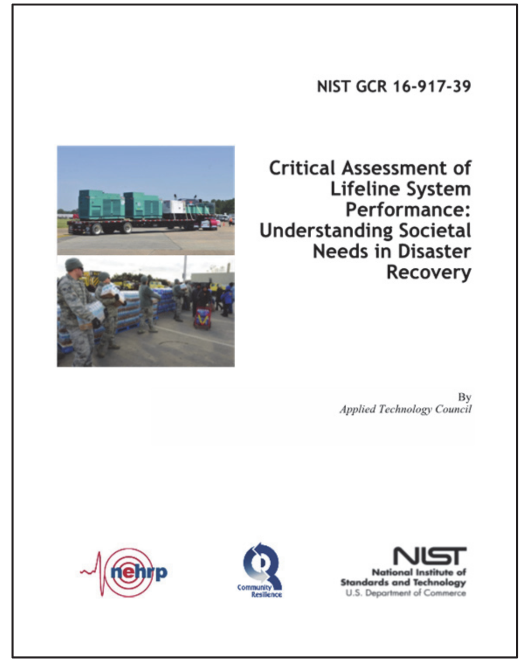
What does society expect and need following a hazard event?

Are there gaps between the level of performance that our codes and standards indicate versus what society expects and needs following a hazard event?

Recent Efforts Highlight this Need

NIST GCR 16-917-39, *Critical Assessment of Lifeline System Performance: Understanding Societal Needs in Disaster Recovery* (2016)

- multi-hazard study
- key lifeline: electric power, natural gas and liquid fuel, telecommunication, transportation, and water and wastewater systems
- Interdependencies
- focus: overarching societal considerations

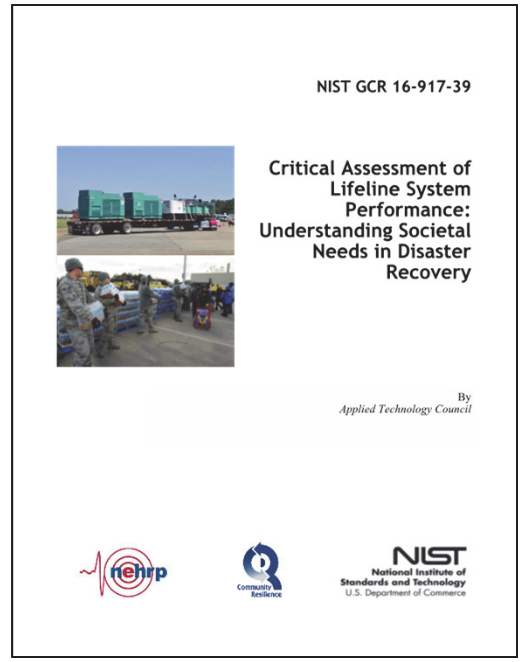


Recent Efforts Highlight this Need

NIST GCR 16-917-39, *Critical Assessment of Lifeline System Performance: Understanding Societal Needs in Disaster Recovery* (2016)

Recommendations around:

- Lifeline codes, standards, and guidelines
- Research
- Modeling
- Operations of lifeline systems



Societal Expectations

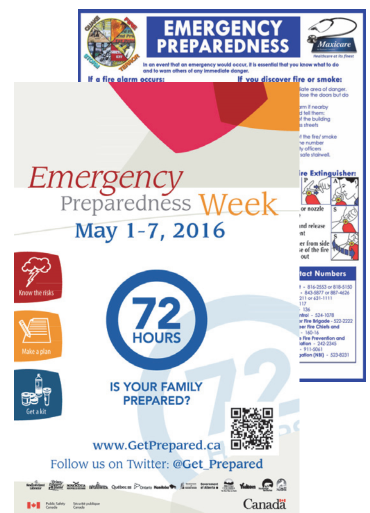
Understanding societal expectations is not an easy task:

- Highly diverse
- Dynamic
- Changing at an increasingly fast rate
- Highly-dependent on many factors
- Very little empirical data on the subject

Societal Expectations: Potential Indicators

Examples

- Lessons regarding societal impact from past disasters
- Major programs and regulatory changes triggered by events
- Emergency preparedness information to provided to communities



Protocols are needed to communicate expected performance to emergency management agencies and service providers, in order for communities to make informed decisions and to properly prepare

Learning from Other Systems

Other systems face similar challenges…

What strategies have they used to overcome them?

Lessons from Telecommunications

- Post-disaster reports: backup plans did not work as anticipated
- False sense of resiliency: Presumed redundancy either never existed or was inadvertently eliminated due to engineering decisions

Do we really expect for our built environment to perform as modeled and anticipated? How can we better foresee unexpected failure modes and cascading failures?

Learning from Other Disruptive Events

Particularly important for rare events because systems are not regularly tested

Have these disruptive events exposed critical interdependencies? What was the societal impact of losing certain services and functions that the built environment supports?

Learning from Other Disruptive Events

Importance of reliable electric power:

- Northeast Blackout of 2003
- Examples of siting decisions being influenced by power quality and reliability

Los Angeles Times | ARTICLE COLLECTIONS

← Back to Original Article

Power Crisis Is Likely to Short-Circuit Intel Expansion in California

Technology: CEO says the computer-chip maker probably will build where energy is reliable and cheap.

January 09, 2001 | From Bloomberg News

SANTA CLARA, Calif. — Intel Corp. Chief Executive Craig Barrett said the No. 1 computer-chip maker is unlikely to expand in California any time soon because the state's energy crisis has made power supplies unreliable and costly.

"Would I OK the expansion of anything in Silicon Valley right now? Not a chance," Barrett said.

"Will I build my new facilities in Oregon and Arizona and New Mexico and Ireland, and even Hudson, Mass., and Israel, where I can get an assured supply of power? Absolutely, yes, and that's where my expansion is going."

California's move to deregulate energy has backfired, resulting in higher costs while putting the state's two largest utilities on the verge of bankruptcy. Santa Clara-based Intel, the state's second-biggest company by market value, risks losing millions of dollars whenever power fluctuates even for a fraction of a second because chips being made can be ruined, Barrett said.

California lawmakers are considering a plan from state Treasurer Philip Angelides to sell $10 billion in bonds to purchase the power grid and build power plants. Barrett said he opposes that plan.

"I'm not a great fan of government getting involved in the private sector, especially delivering a key commodity to the private sector," Barrett said at the Consumer Electronics Show in Las Vegas.

"It's deregulation gone awry."

"I'd rather see supply and demand get in balance by expediting the permitting process to get more supply built if we have to and increase the grid infrastructure to import more power."

Barrett criticized government officials for blocking proposed construction of new power plants, citing the move by San Jose officials to deny Calpine Corp.'s bid to build a plant late last year.

"Nuclear power is the only answer, but it's not politically correct," he said.

Intel employs about 10,000 workers in California and has plants in Folsom, with engineering and other corporate offices in Santa Clara and San Diego.

The chipmaker has 80,000 employees worldwide.

The energy crisis could ultimately have a broader impact on the state's economy if companies such as Intel seek to add workers elsewhere.

In the meantime, Barrett said he leaves the lights off in his office during daylight hours.

Intel is seeking to trim energy consumption by 10% by taking measures such as dimming lights and turning off air conditioning in offices, Barrett said.

Think in Interconnected Systems

- Lack of consideration and understanding of interdependencies
- Design in isolation and very little consideration of system behavior and how components fit into the bigger picture

Methodology to link component-based design into system-level performance targets is needed

Consider Societal Impacts

Engineering decisions should consider societal impacts and corresponding consequences:

- Higher efficiency can mean lack of redundancy, concentration of vulnerability (e.g., lifeline collocation), and decrease in resiliency
- Properly siting buildings and infrastructure can have a huge impact
- Models that reflect how these decisions can impact society are needed

Conclusion

Addressing community needs is not a new concept for civil engineering—it is the very reason that this practice emerged.

Letting this fundamental concept drive engineering practice and frame the discussion around resilience can help us make more conscious engineering decisions that ultimately impact society.

Thank you!

NIST Study: Societal Expectations

- Community expectations and needs are highly diverse and dynamic
- Lack of empirical data on community expectations
- Potential indicators of community expectations
- Increasing reliability on electric power and telecommunications

Learning from Other Disruptive Events

Hurricane Katrina:

- Interruption of crude oil and refined petroleum product pipelines
- Highlighted vulnerability of critical liquid fuel supplies for the Midwest and Northeast U.S.
- Some of the same pipelines are also vulnerable to earthquakes in the New Madrid Seismic Zone

NIST Study: Selected Key Points and Recommendations

Think in Systems and Interdependencies

- Focus at the component level; system behavior considerations are lacking
- No direct link between design of system components to intended systematic targets
- Lack of considerations and understanding of interdependencies of systems
- To help address this:
  - Develop a methodology to link component-based design into system-level performance targets
  - Operators should share information and systematically think through dependencies

NIST Study: Selected Key Points and Recommendations

Consider potential societal impacts in decisions

- Higher efficiency can mean lack of redundancy, concentration of vulnerability, and decrease in resiliency
- Models l
- Recommendation: Develop models that reflect societal impacts

NIST Study: Societal Expectations

Are there any indicators on what they might expect? What might influence societal expectations?

- Major programs and regulatory changes that were triggered by performance
- Emergency preparedness information and recommendations will influence expectations and preparedness behavior

Communication needed between what emergency management organizations are telling people vs expected performance of infrastructure

NIST Study: Selected Key Points and Recommendations

Learn from other lifelines and other types of disruptive events

- Particularly important for rare events
- How do other lifelines address this?
  - National Pipeline Mapping System Public Viewer
  - “Chaos Monkey” approach
- What were the societal impacts from other events?
  - Hurricane Katrina of xxxx
  - Northeastern U.S. Blackout of 2003
- These can all help inform:
  - What communities need and expect following a hazard event
  - Programs and approaches that could potentially be applied to other systems

Learning from Other Disruptive Events

- Hurricane Katrina:
  - Long-term education interruption, not just school collapse or damage, can be detrimental to communities
  - Highlighted vulnerability of critical liquid fuel supplies for the Midwest and Northeast U.S. → some of the same pipelines are also vulnerable to earthquakes in the New Madrid Seismic Zone Hurricane Sandy:
  - Verizon used up to 1,500 generators, consuming 100,000 gallons of fuel each day → depended both on availability of fuel and transportation of fuel