NIST Commissioned Work on Resilience at MCEER

Advisory Committee on Earthquake Hazard Reduction

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Introduction

- NIST funded a grant to the University of Buffalo Multidisciplinary Center for Earthquake Engineering Research (MCEER) to establish a framework for developing resilience definitions and metrics at the community scale.
- The framework was intended to provide the basis for the development of quantitative and qualitative models for resilience metrics.
- In the longer term, the models would enable development of decision-support software tools to enhance disaster resilience of communities.

Research Plan
Tasks

1. A literature survey to analyze asset-based approaches for defining and measuring disaster resilience.
2. Identification of the gaps between asset-based approaches and community-scale approaches and development of a conceptual approach for defining and measuring disaster resilience at the community scale.
3. A technical report of findings from the research effort and proposing a path for future developments.

MCEER Research Summary

- This research establishes a holistic framework for defining and measuring disaster resilience for a community at various scales.

- Seven dimensions of community resilience have been identified, and are represented by the acronym

P E O P L E S

MCEER Research Summary

PEOPLES Resilience Framework

P
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P
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POPULATION AND DEMOGRAPHICS

Composition, Distribution, Socio-Economic Status, etc.

ENVIRONMENTAL/ECOSYSTEM

Air quality, Soil, Biomass, Biodiversity, etc.

ORGANIZED GOVERNMENTAL SERVICES

Legal and security services, Hygiene and health services, etc.

PHYSICAL INFRASTRUCTURE

Facilities, Lifelines, etc.

LIFESTYLE AND COMMUNITY COMPETENCE

Quality of Life, etc.

ECONOMIC DEVELOPMENT

Financial, Production, Employment distribution, etc.

SOCIAL-CULTURAL CAPITAL

Education services, Child and elderly care services, etc.

MCEER Research Summary

PEOPLES Framework Terminology

Working Definition of Terms used within the **PEOPLES Resilience Framework**:

Resilience Dimension – one of the seven realms of a community

Resilience Component – components within a dimension of a community; those can have interdependencies to resilience components of other dimensions

Resilience Indicator – quantitative measure of resilience/systems functionality based on quantitative and/or qualitative data sources

MCEER Research Summary

Quantification of Interdependencies

Functionality of Electric Power System

$$Q_{EP}\ t = \frac{N_{CP}\ t}{N_C}$$

where

N_{CP} =number of clients receiving power;

N_C =total number of clients of the community;

Functionality of Health System

$$Q_H\ t = Q_{QS}\ t \cdot Q_{LS}\ t$$

where

Q_{QS} =Qualitative functionality related to the quality of service (QS);

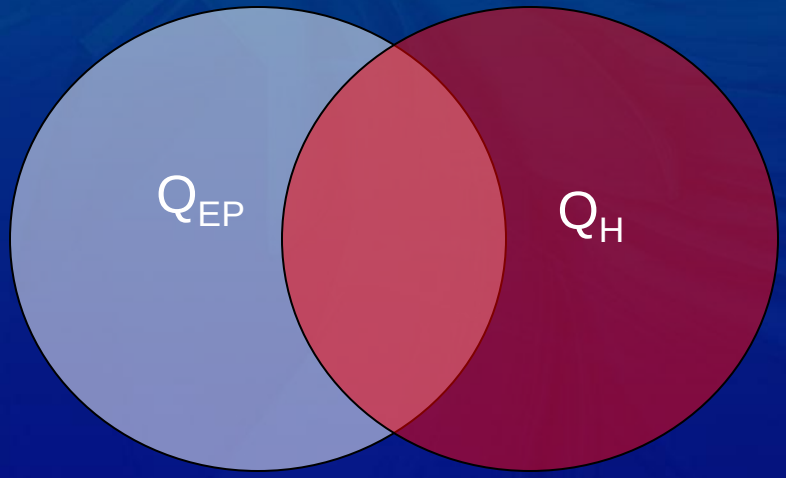
Q_{LS} =Quantitative functionality related to losses in healthy population;

MCEER Research Summary

Quantification of Interdependencies

Proposed Combination Formula

$$Q\ t\ = \frac{Q_{EP}\ t\ \cdot Q_H\ t}{Q_{EP}\ t\ + Q_H\ t\ - Q_{EP}\ t\ \cdot Q_H\ t}$$



The formula has been evaluated considering the functionality of the Electric power system (Q_{EP}) and of the Health system (QH), but it can be extended to more than two functionalities when they are quantified.

Status

- Grant was funded through the first task.
- Research was very broad in scope, incorporating social, environmental, lifestyle, and economic aspects in addition to physical infrastructure.
- Decision was made to end funding on this grant and redirect resilience work.
- NIST research is now focused specifically on physical infrastructure.

Questions?