

# EERI Business Resilience Survey

Napa, CA and Cushing, OK

# Committee membership

Diverse group of perspectives and experience:

- **Ibrahim Almufti**, Arup
- **Cynthia Kroll**, Association of Bay Area Governments
- **Mike Mieler**, Arup (previously Johns Hopkins University)
- **Anne Wein**, USGS
- **Yu Xiao**, Texas A&M University
- **Heidi Tremayne**, EERI

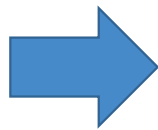
# Outline

- Background
- Development process
- Survey overview
- Napa pilot program
- Cushing pilot program
- Next steps



# A Shift in Paradigm...

Building and Infrastructure Centric

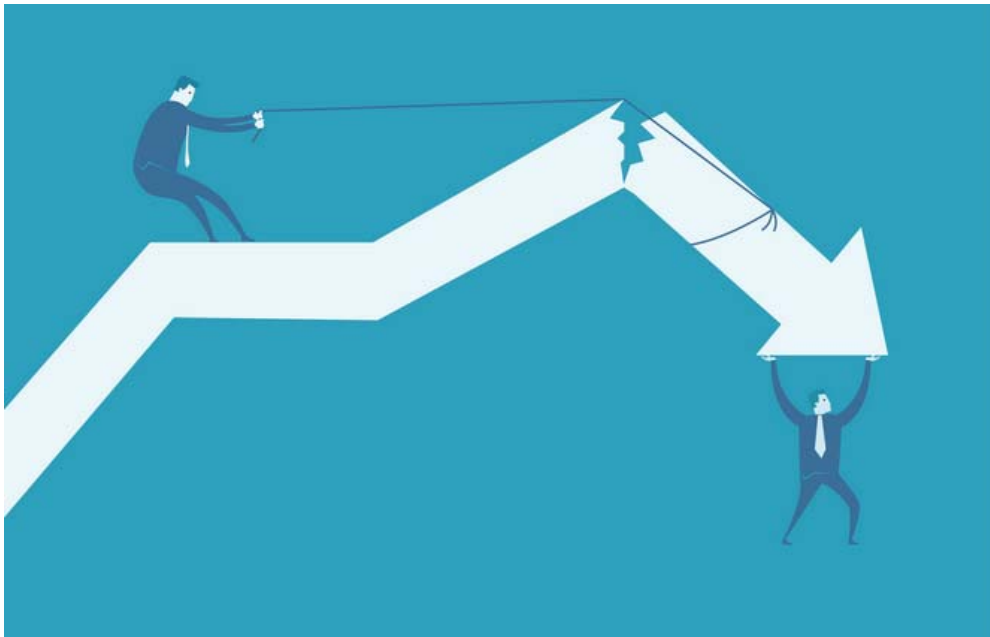


Resilience based



Image source: <http://www.cnn.com/2014/10/14/us/gallery/1989-california-earthquake/>

# What is “resilience?”



# What is “resilience?”



**National Ocean Service**  
National Oceanic and Atmospheric Administration  
U.S. Department of Commerce

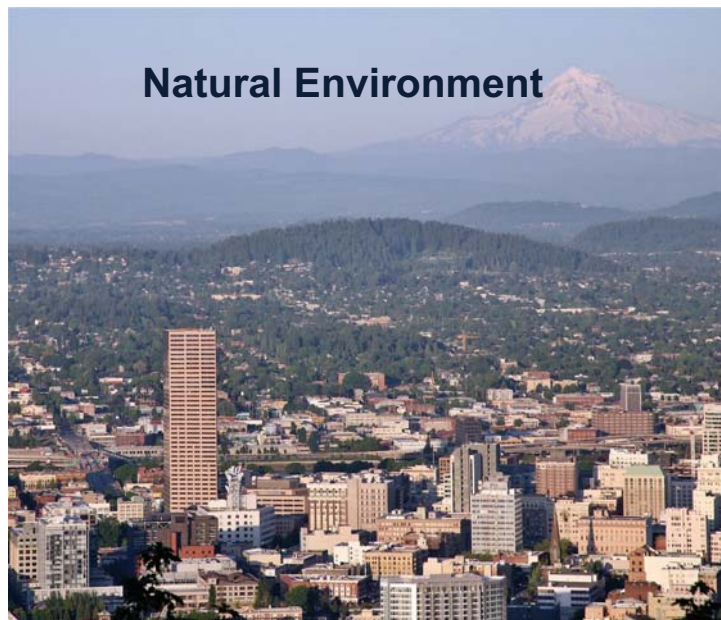
Sources: <https://www.dhs.gov/topic/resilience>  
<http://oceanservice.noaa.gov/ecosystems/resilience/>

“The term “resilience” refers to the ability to *adapt* to changing conditions and *withstand* and rapidly *recover* from disruption due to emergencies.”



Its communities, through mitigation and pre-disaster preparation, develop the *adaptive capacity* to maintain important community functions and recover quickly when major disasters occur.

# Resilience is a system concept



**Natural Environment**

**Built environment  
(buildings,  
lifelines, etc.)**

**Social, political, and  
economic systems**

# To measure resilience

- We should observe performances of multiple systems and their interdependencies
  - Natural environment
  - Built environment
  - Social, political, and economic systems
- We should take a long-run approach





# Motivation

- Resilience reconnaissance requires new tools and strategies
- Businesses are essential to community resilience but recovery process is not well understood



# Objectives

Develop a consistent set of survey questions to:

- Monitor business recovery issues in near real time
- Answer important longer term research questions
- Facilitate comparisons across different earthquakes

# Development process

- Assemble interdisciplinary team
- Review existing survey tools and identify research needs
- Develop draft set of survey questions
- Revise survey tool using feedback from technical review
- Conduct pilot study in Napa and Cushing to further refine survey

# Survey organization

○Comprises two different modules:

	Building damage survey	Business impacts survey
<b>Audience</b>	Engineer	Business representative
<b>Timeline</b>	Once, soon after earthquake	Several times after earthquake
<b>Relevant data</b>	<ul style="list-style-type: none"><li>• Extent and severity of damage</li><li>• Building placard</li><li>• Utility disruption</li></ul>	<ul style="list-style-type: none"><li>• Operational status</li><li>• Location changes</li><li>• Insurance coverage</li><li>• Cost of repairs</li></ul>

# Sample questions

33. Please indicate the current status of the following aspects of your business relative to before the earthquake. Select "N/A" if a particular aspect does not apply to your business.

	Decrease by 100%	Decrease by 75%	Decrease by 50%	Decrease by 25%	Decrease by 10%	No Change	Increase by 10%	Increase by 25%	Increase by 50%	Don't know	N/A
Revenue	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Costs of doing business	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Profit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Debt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Prices charged to customers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hours of operation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Hours worked from home	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inventory	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Product and service output	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Employee productivity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Customer demand	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of Employees	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

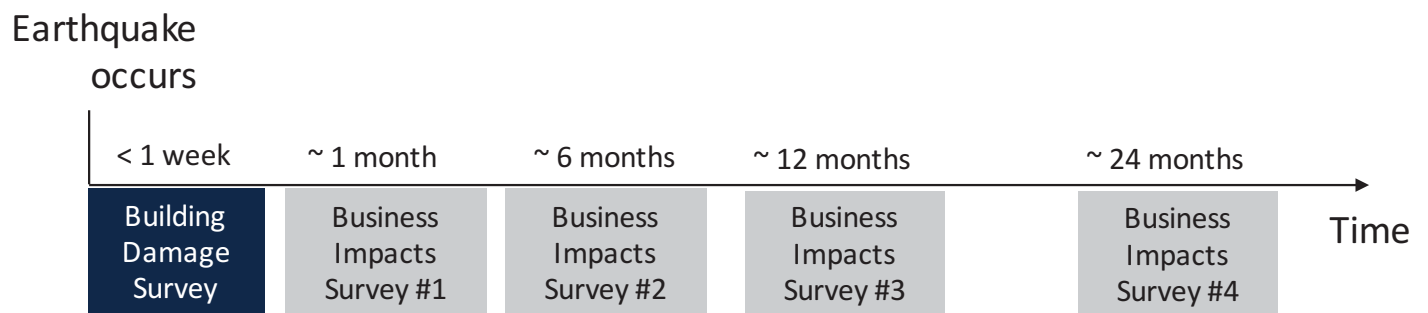
# Sample questions

45. If your business is currently experiencing or has experienced property damage, please indicate the degree to which it is impacting or has impacted business operations (or lack of operations in cases of temporary or permanent closure). Select "N/A" if your business did not experience property damage after the earthquake, and "No Impact" if you are currently experiencing or have experienced property damage but it is not currently affecting your business.

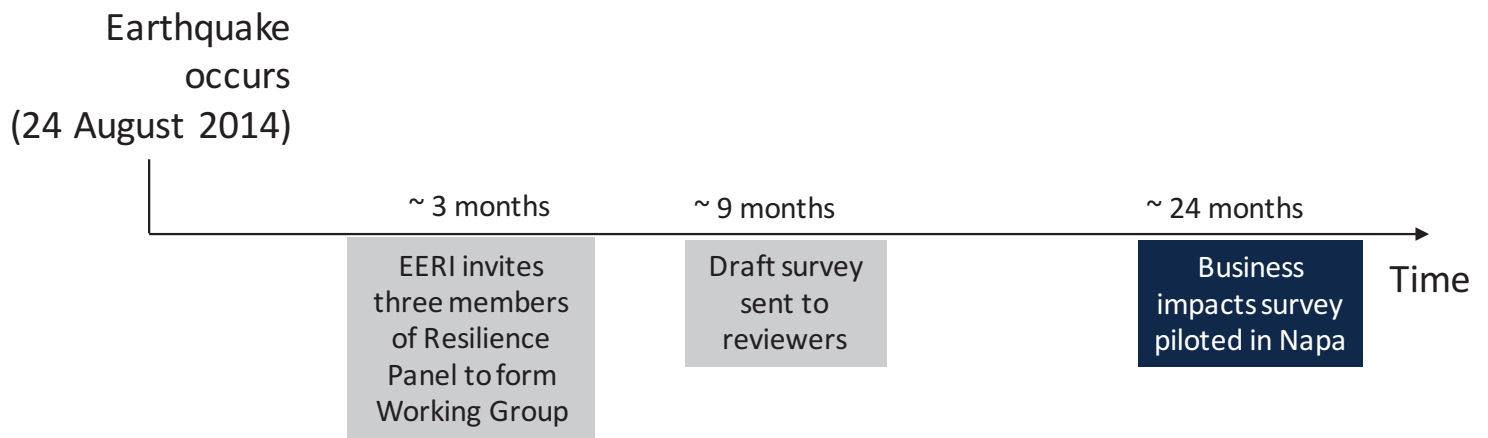
	No Impact	Minor Impact	Major Impact	N/A
Structural damage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Nonstructural damage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Inventory damage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Equipment damage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Contents damage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ground surface damage	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Other (please specify)

# Deployment strategy



# Deployment in Napa





# Pilot study in Napa

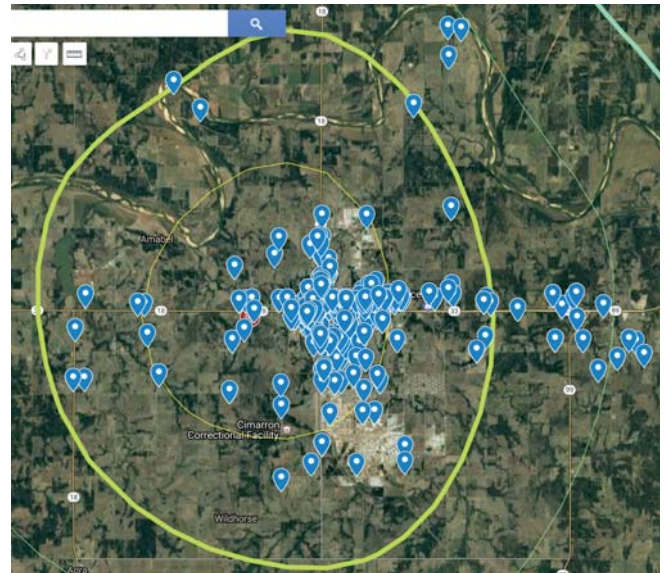
- Significant effort to survey diverse cross-section of businesses (cold calls, newspaper editorial, Twitter, Mayor's office)
- Yielded 20 complete survey responses (takes 20 min to 60 min to complete)
- Limited dataset due to:
  - Survey launch 2 years after earthquake
  - Not many significantly impacted businesses
  - Difficulty in engaging busy business owners
- Building damage survey was not performed – information taken from available sources such as ATC, SEAOC, EERI

# Challenges

- Addressing the wide range of business structures
- Avoiding survey fatigue
- Obtaining representative sample
- Deploying in developing economies
- Funding follow-up surveys

# Pilot Study in Cushing, OK

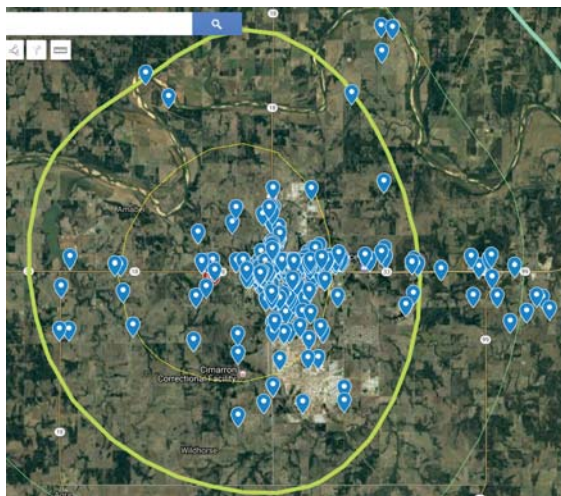
M5.0 earthquake in Cushing, Oklahoma, on November 7, 2016  
EERI Reconnaissance November 14-16, 2016



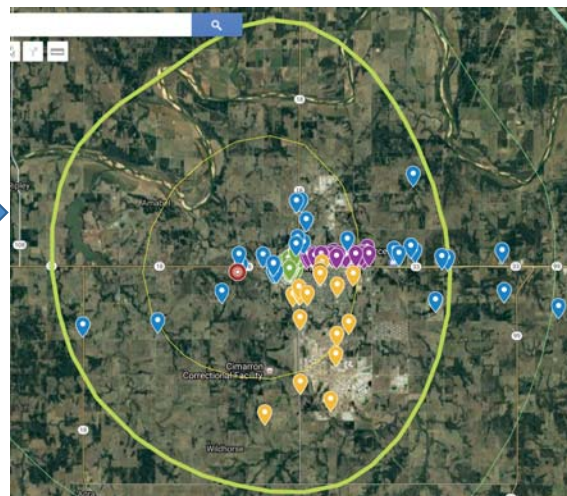
# Sampling

- Unit of Analysis: Individual Business
- Sampling Frame: Business List from ReferenceUSA
- Sampling Strategy: Random Sample

Full list of over 400 Businesses



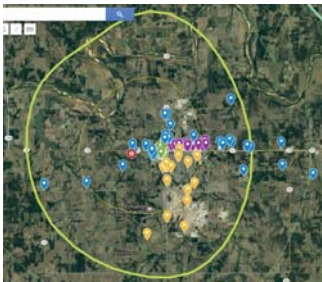
Random Sample of 150 Businesses



Day 1 Morning: Entire team met with City Manager

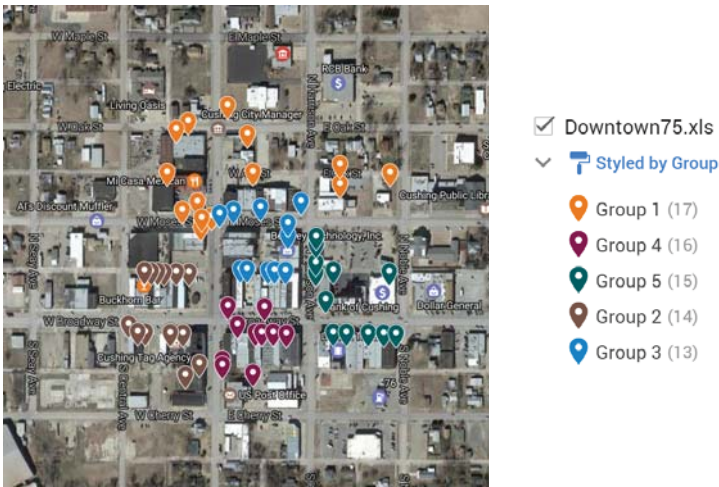


Day 1 Afternoon: Recon in smaller teams



Pilot survey work

Day 2: Business survey+ building damage assessment with adjusted sample



Day 3 Morning: Wrap up work  
Departed from Cushing after lunch.



# Team Composition

## Engineers + Social Scientists



# Team Composition

- Pair up one **Engineering** with one **Social Scientist**

Damage Assessment



Business interview



# Technologies

o Google Map



Quick-Tap Surveys



Building Damage Survey (FIN...)

- Please record time in using 4 digits and 24 hour format (e.g. 0230 for 2:30AM and 1425 for 2:25PM)  
Tap to enter
- Please record building PIN number if known  
Tap to enter
- Please enter your initials.  
Tap to enter
- What is your expertise in building design, construction or inspection?  
Select 1  
Tap to select
- Please provide the street address (or addresses) of the building for which this survey is being completed.  
Tap to enter

Business Info Survey -- Cushi...

Tap to enter

- Damage extent reported by owner for: Building damage  
0 1 2 3 4 5 6 7 8 9 10  
0 - Not likely at all 10 - Extremely likely
- Damage extent reported by owner for: Inventory damage  
0 1 2 3 4 5 6 7 8 9 10  
0 - Not likely at all 10 - Extremely likely
- Damage extent reported by owner for: Equipment/machiner damage  
0 1 2 3 4 5 6 7 8 9 10  
0 - Not likely at all 10 - Extremely likely
- Damage extent reported by owner for: Other damage (please specify type in next question)  
0 1 2 3 4 5 6 7 8 9 10  
0 - Not likely at all 10 - Extremely likely



# Results

*Table 3. Building damage assessment conducted by the EERI Reconnaissance Team for downtown Cushing, OK, categorized by severity of damage (source: EERI Reconnaissance Team survey).*

Building Damage	Numbers of Building	Percent
No damage	6	11.5
Minor damage	31	59.6
Moderate damage	9	17.3
Severe damage	6	11.5
Total	52	100.0

## Results (cont.)

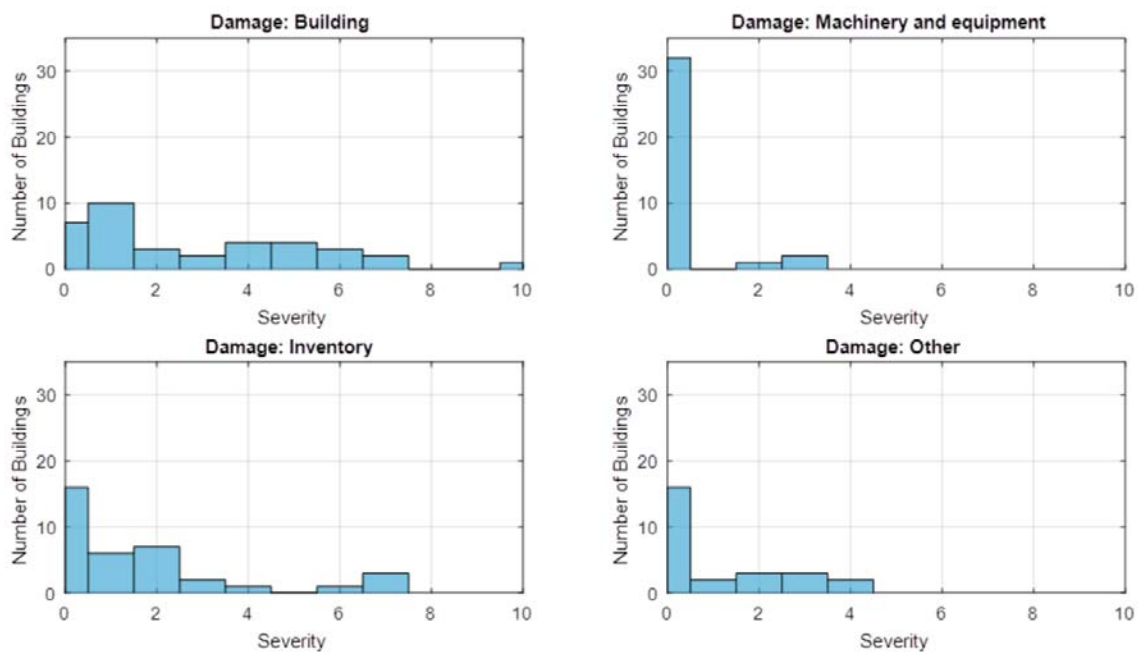


Figure 26. Self-reported severity of damage to various components of necessary for business operation by businesses in the downtown area of Cushing, Oklahoma (source: EERI Reconnaissance Team survey).

## Results (cont.)

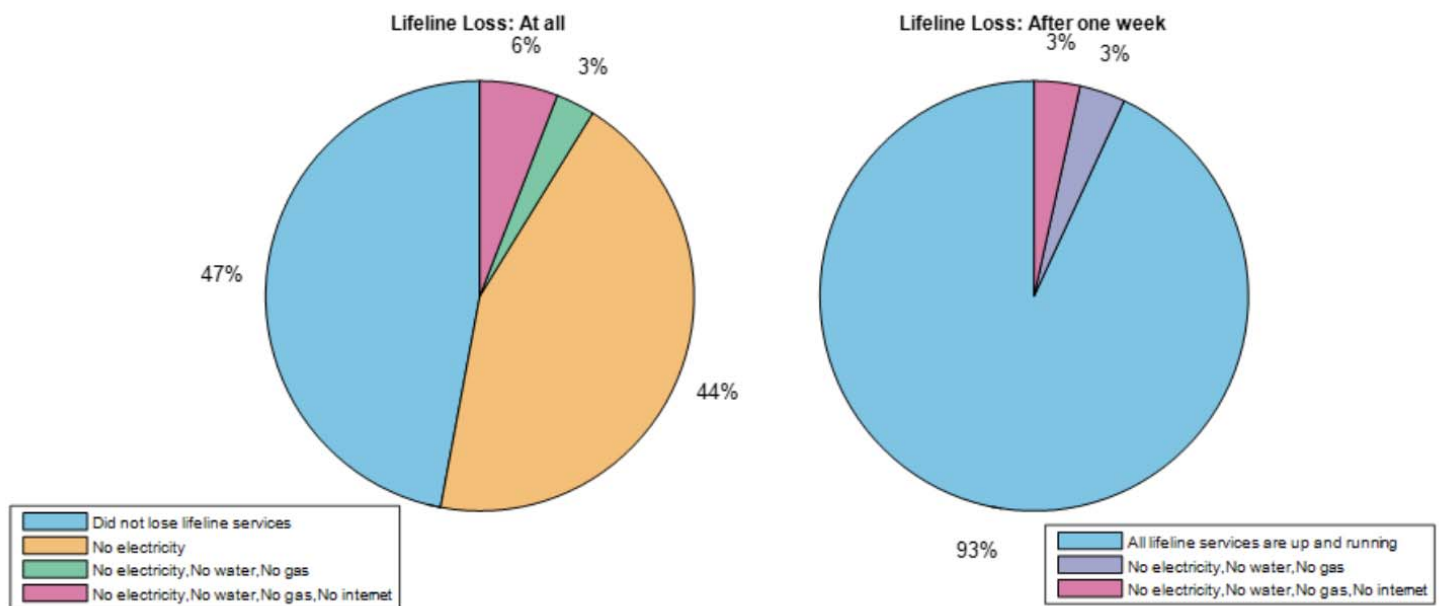


Figure 27. Lifeline loss as reported by business owners in the downtown area of Cushing, Oklahoma (source: EERI Reconnaissance Team survey).

# Results (cont.)

## Damage to Business Buildings



## Business Operational Status



# Follow-up surveys

- Oklahoma State University
- Follow-up business surveys in March 2017

# Lessons learned

- Systematic data collection allows for long-run observation of recovery
- Informed reconnaissance can increase efficiency
  - Maps of businesses and damaged properties help team navigate and find the appropriate places to go
- Engineer and social scientist worked well together