

NORTHRIDGE **30** 1994 2024

The Northridge Earthquake - 30 Years Later *A Catalyst for Engineering Resilient Communities*

Webinar Series

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Series Partners:

- [American Society of Civil Engineers \(ASCE\) Infrastructure Resilience Division](#)
- [ASCE Los Angeles Section](#)
- [Earthquake Engineering Research Institute \(EERI\) Southern California Chapter](#)
- [Structural Engineers Association of Southern California \(SEAOSC\)](#)
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The Northridge Earthquake - 30 Years Later *A Catalyst for Engineering Resilient Communities*

Episode 1: The January 17, 1994 Northridge Earthquake – Science & Engineering Aspects

K. Hudnut, J. Stewart, C. Davis, D. Cocke

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Episode 2: Insurance Issues and Impacts Following the Northridge Earthquake

C. Scawthorn, J. Maffei

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Episode 3: 30 Years of Progress in Quantification of Seismic Hazards

Y. Bozorgnia

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Episode 4: An Unexpected Milestone in Real-Time Loss Estimation

R. Eguchi, D. Wald

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Episode 5: Legacies of the Northridge Earthquake in Disaster Recovery Planning & Policy

L. Johnson and R. Olshansky

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Episode 6: Northridge: The Catalyst for Resilience of Healthcare in California

M. Lew

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Episode 7: Lessons learned about business losses and economic recovery – The Northridge Earthquake as a catalyst for research and application

Kathleen Tierney, Professor Emerita, University of Colorado Boulder

Dr. Cynthia Kroll, Regional Economist



Northridge 30

Business Losses & Economic Recovery: The Northridge Earthquake as a Catalyst for Research & Applications

Kathleen Tierney
University of Colorado Boulder

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Background

- **Very little known at the time about how businesses fare after disasters**
- **Economic research focused primarily on regional impacts, not at the firm level**
- **Need for a focus on large representative samples of businesses in disaster-stricken communities to capture impacts of multiple variables**

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The Disaster Research Center and Business Research

- **First study focused on businesses in Des Moines Iowa following the 1993 Midwest floods**
- **Related work focused on SBA loan decision making following the Whittier Narrows earthquake (1987)**
- **Subsequent studies focused on Northridge, business vulnerability and preparedness (Memphis), long-term recovery in Santa Cruz (Loma Prieta) and South Dade County (Andrew)**
- **All studies employed stratified random samples of businesses, using Dun and Bradstreet data**

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The Northridge Study

- **Mail survey of businesses in Los Angeles and Santa Monica**
- **Sample stratified by business size, sector, MMI intensity**
- **Initial sample of about 4,000, with 1,000 responses (25%)**



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Topics covered

- Owner characteristics, e.g. race, gender
- Business characteristics (e.g., age, single vs. multiple locations, rent vs. own)
- Pre-disaster preparedness
- Pre-disaster financial condition
- Damage to structure, contents
- Lifeline service disruption: type and duration
- Operational problems: blocked access, employee issues, local damage
- Post-disaster aid accessed
- Recovery outcomes: better off, worse off, about the same



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What influenced recovery outcomes? Some insights

- Business and owner characteristics
- Size and sector
- Operational challenges
- Infrastructure damage
- Local damage, disruption---independent of impacts at the business

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What didn't seem to matter

- Pre-event preparedness measures
- Post-event aid



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Caveats

- Study focused on business “survivors”---but we also know that the vast majority of businesses *do* survive
- Newer research has done a better job of following businesses that moved, went out of business
- Northridge occurred at the dawn of the Internet era: How do businesses that are entirely or partly on line fare in the aftermath of disasters?

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Northridge business research as catalyst

- Inspired many publications and a new line of social science disaster research
- Findings incorporated into macro-economic analyses, impact and loss assessments, scenarios
- More recently, influenced work on economic impacts of COVID-19 through CONVERGE work groups:

Chang, Stephanie E. and Brown, Charlotte and Dormady, Noah and Handmer, John and Kajitani, Yoshio and Keating, Adriana and Rose, Adam and Watson, Maria and Wein, Anne and Yamano, Norihiko, Economic Recovery: Enabling Comparative Research on COVID-19 CONVERGE COVID-19 Working Groups for Public Health and Social Science Research: Research Agenda-Setting Paper (June 22, 2020). Available at SSRN: <https://ssrn.com/abstract=3633093> or <http://dx.doi.org/10.2139/ssrn.3633093>

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NORTHRIDGE 30

Economic Research and Policy Since Northridge

Cynthia Kroll—Association of Bay Area Governments (Retired) and EERI, LFE Business Resilience Working Group

Anne Wein—US Geological Survey and Co-Chair, LFE Business Resilience Working Group

Drawing from Northridge research as well as work of multiple organizations: EERI, USGS, ABAG, USC, Çankaya University, and independent authors

Panel presentation November 13, 2024

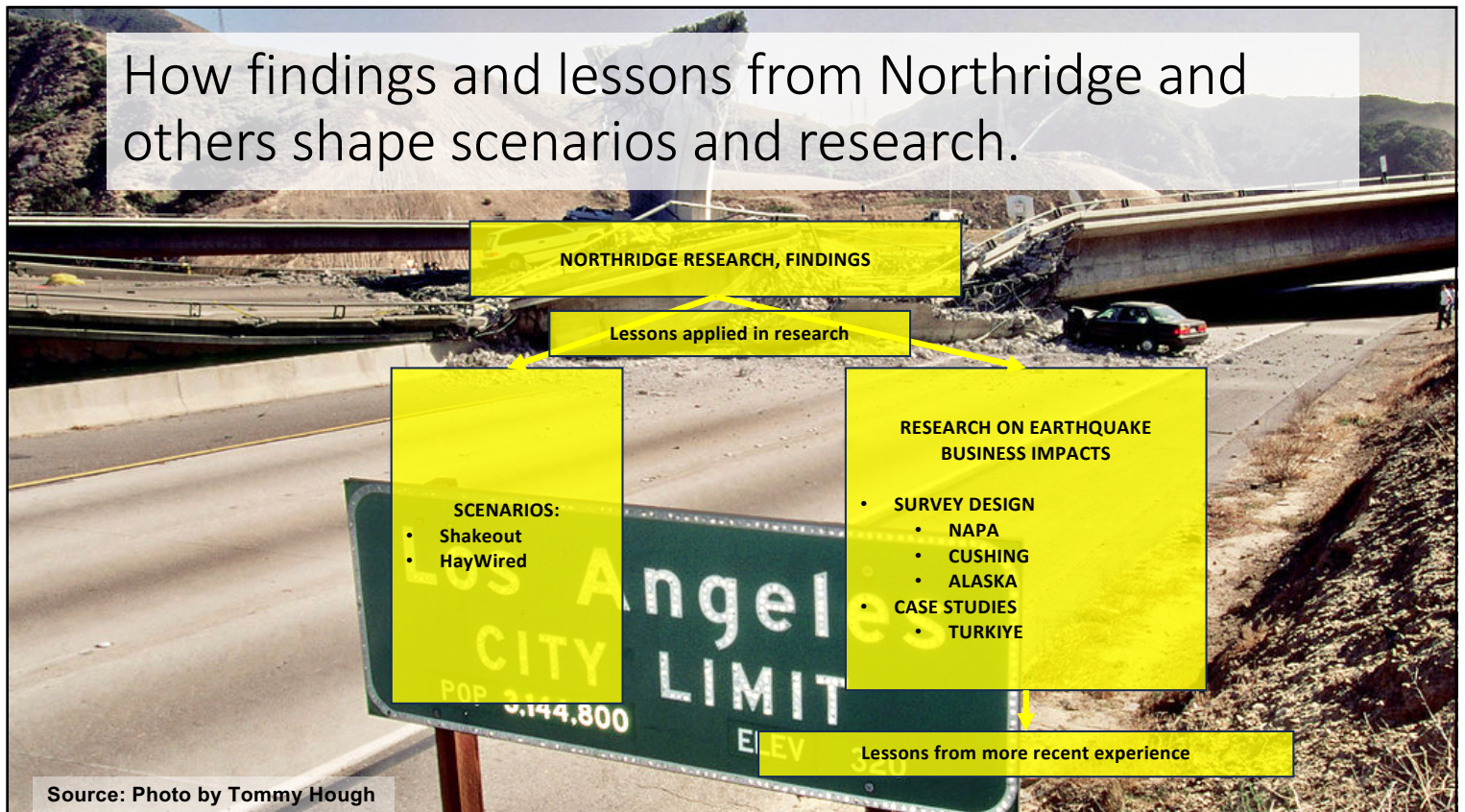
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Northridge and other historical streams

	LOMA PRIETA	NORTHRIDGE	SHAKEOUT SCENARIO
Location and timing	Northern California, 1989	Southern California 1994	Southern California scenario 2008
Earthquake magnitude	6.9	6.7	7.8
Major economic challenges	<ul style="list-style-type: none"> • Access (customers, employees, shipping) • Building damage • Network (utilities, transportation) • Prices • Inventory • Credit access 	<ul style="list-style-type: none"> • Access (customers, employees, shipping) • Other operational challenges • Network (utilities, transportation) • Local damage, disruption—irrespective of damage at business location 	<ul style="list-style-type: none"> • EQ and fire damage • Water service outages • Commutes and goods movement • Ports indirect impacts • 1-10% losses insured across counties
Major lessons	<ul style="list-style-type: none"> • Local vs regional impact • Business redundancy • Infrastructure redundancy (eg transit) • Rapid service restoration critical (power, water) 	<ul style="list-style-type: none"> • Owner and business characteristics (e.g. size, sector, race, gender) affect recovery outcomes • Preparedness and post-disaster aid insufficient to influence outcomes 	<ul style="list-style-type: none"> • Business interruption losses (vs damages) • Economic Resilience (modeled vs discussed) • Economic disaster vs human catastrophe

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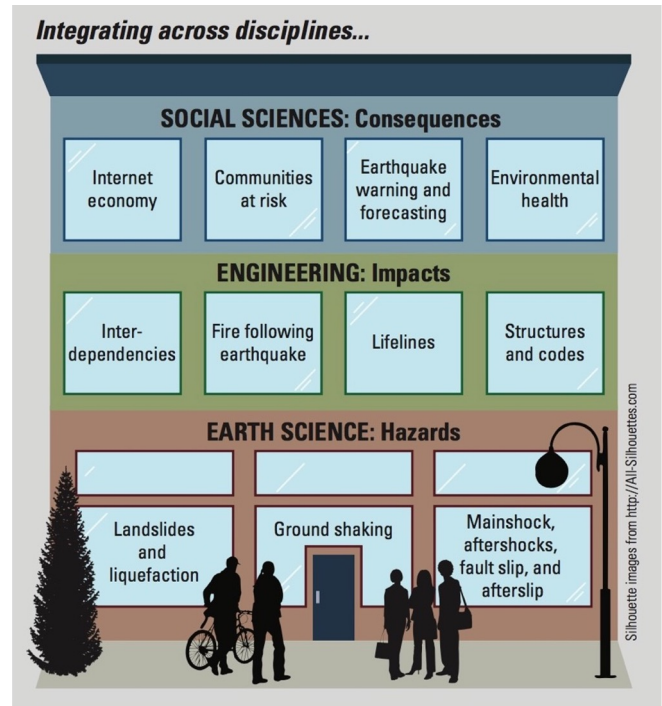
How findings and lessons from Northridge and others shape scenarios and research.



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HayWired

- ▶ Wired (or wireless) technology of communications and data services
- ▶ Cascading effects of earthquake hazards that cause damage that disrupts our lives and livelihoods
- ▶ Interactions in space and time compound at each level of:
 - ▶ Hazards
 - ▶ Engineering damages and restoration of function
 - ▶ Economic and community recovery
- ▶ Tests and strengthens our connectedness



Source: Hudnut et al, The HayWired earthquake scenario—We can outsmart disaster: USGS Fact Sheet 2018–3016, <https://doi.org/10.3133/fs20183016>.

Building the HayWired Scenario

Chapter	Major Topic and Approach
V2: Economic Consequences	Macro Analysis of Resilience
V3: HayWired in ABAG forecast	Regional Analysis of impacts over a 20 year period
V4: Building damage and business disruption	Comparison of Business Characteristics and Damage Distribution
V5: Spatial Analysis	Expanded impacts from the interactions of household, business and travel impacts
V1: Summary and Policy Implications	Lessons from HayWired economic analyses and earlier and concurrent disasters

Northridge Input in Analyzing Haywired Economic Consequences

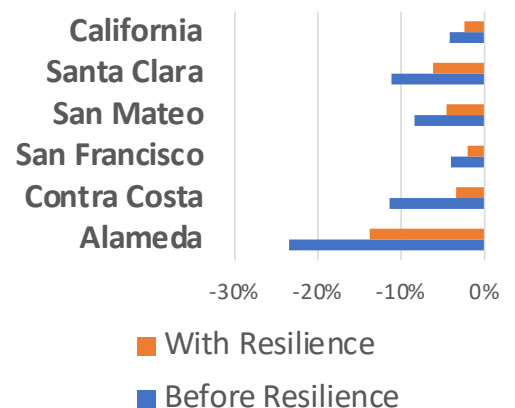
- Water service losses affected 18% of customers
- Business Interruption beyond structural and nonstructural damage (utilities, transportation)
- Most disaster planning involved storing supplies, not relocation
- Long term effects in damaged areas even if building undamaged
- Smaller and younger businesses more vulnerable
- Businesses owning their buildings fared better than renters
- Pre-disaster business circumstances matter.
- Compounding challenges reduce ability to recover

A large downturn moderated by resilience actions:

(Economic model of the first 6 months: \$2014)

- Before resilience, statewide economic losses -4% \$44.2 B
- More severe economic impacts in the quake area
 - 8% GRP loss for the San Francisco Bay region
 - Alameda: 24% GRP loss
 - Contra Costa and Santa Clara: 11% GRP loss
- Economic impacts and duration can be reduced (almost half) through resilience actions, planning
 - Input substitution
 - Temporary power sources
 - Conservation
 - Rescheduling
 - Relocation

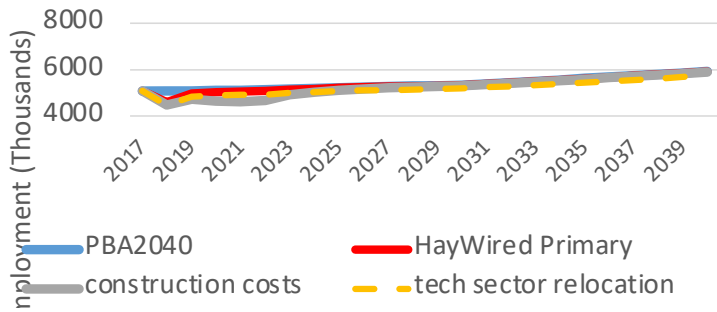
GRP 6 month Change with and without resilience



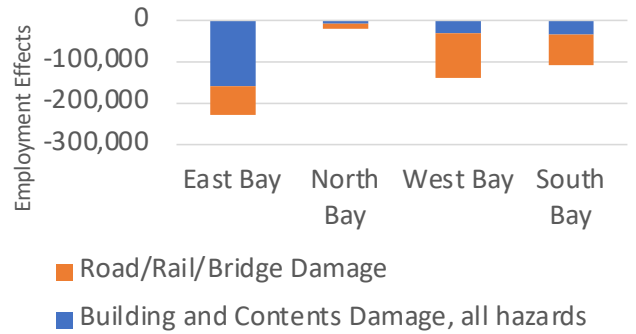
Source: CGE model with microeconomic resilience (Sue Wing, Wei, Rose, Wein)

Longer Term Analysis compared to ABAG forecast

Employment Levels, PBA 2040, HayWired, and Sensitivity Test



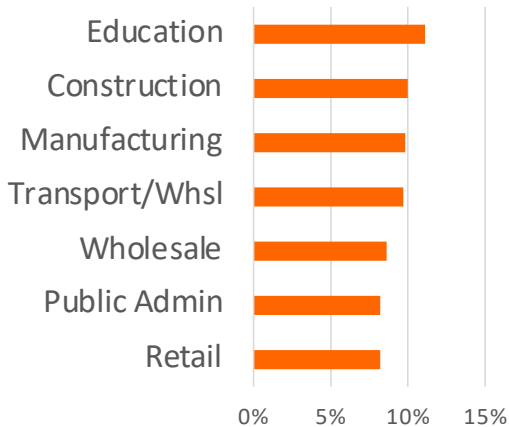
Impacts of Building and Additional Roadway Damage Output Loss on Employment



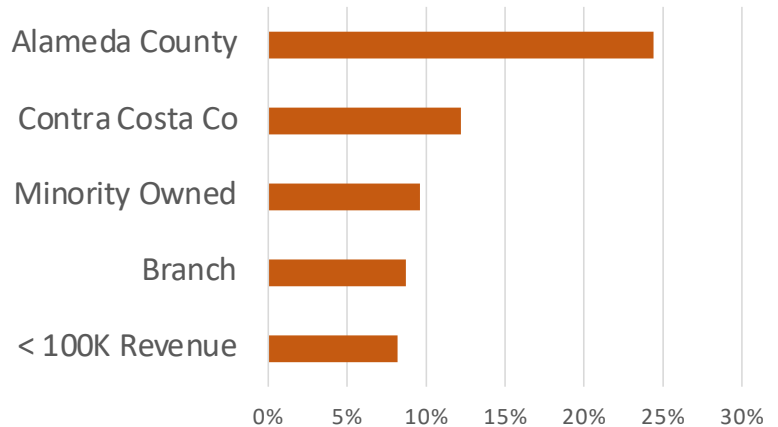
Source: ABAG/MTC analysis using REMI model version 1.7.8

Employment at Above Average Risk from Quake and Fire by Location, Sector, Business Type (>7.6% in high risk areas)

Sector

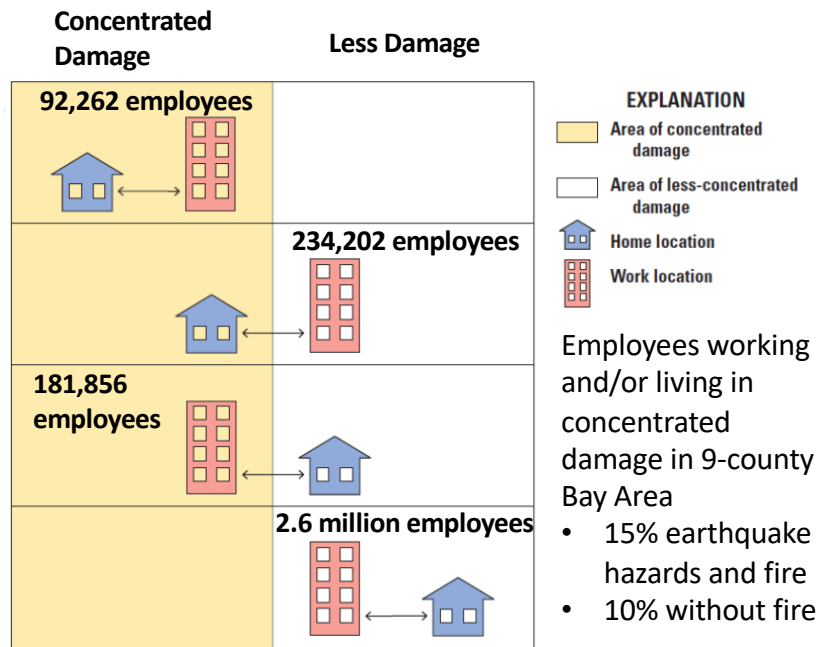
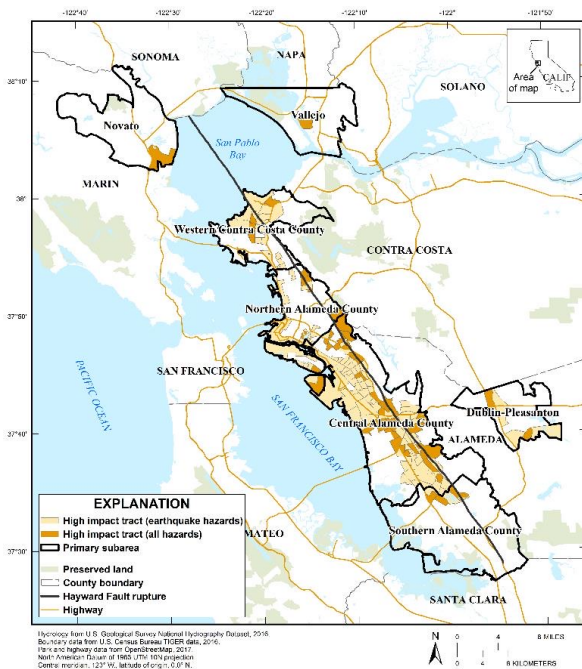


Location and Business Type



Source: Analysis by Jon Haveman of National Establishment Time Series data.

Impacts spread from areas of concentrated damage



Source: Strategic Economics and USGS; Haywired Scenario Vol 3, Ch 5, Spatial Analysis...

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What does a scenario like HayWired bring to the table?

- **Vulnerable resources:** Aspects of the economy vulnerable to building and infrastructure damage, including water and transportation systems.
- **Interconnectedness:** Housing and business damage are interlinked. Economic disruption may spread from concentrated damage areas more broadly due to commute flows.
- **Local vs Regional consequences:** Types of businesses most vulnerable ...
- **Recovery vs Long term changes:** Include what if's in modeling and planning
- **Resilience measures:** Built in resilience can bring about a stronger, shorter recovery
- **Learning from other events:** The COVID experience may inform policy implications as well as likely outcomes of scenarios

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Extending Research on Business Resilience

- EERI LFE Business resilience working group established after 2014 South Napa earthquake, with engineers and social scientists.
- Initial focus: to build a survey tool to connect damage to buildings and surrounding areas to business impacts and recovery
- 3 pilot studies (Napa, CA 2014, survey 2016; Cushing, OK 2016, Anchorage and Eagle River, AK 2018)
- Survey modifications and first effort at collaboration with university project.
- Outcome: a consistent set of questions to apply post-earthquake, perhaps multiple times, available to academics, government agencies or community groups



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Methodology Insights from the Pilot Studies

- These were not major earthquakes.
 - In 2 cases (Napa, Anchorage/Eagle Pass) the area of concentrated damage was small
 - In the 3rd case, damage was light and sporadic, not really concentrated.
- Finding the sweet spot for conducting surveys was not easy
 - Conducting surveys immediately after an earthquake can be disruptive and seem irrelevant or intrusive to business owners/managers
 - 2 years later businesses may have moved on literally, memories are short for surviving businesses, difficulty answering detailed questions
- Survey length and detail may be needed to understand the engineering/ social science nexus, but may lead to poor response rates.
- Respondents want to tell their story rather than answer structured questions
- Open-ended discussion brings up different types of experiences, new policy questions not covered by the structured survey.

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LFE Business Resilience Working Group Projects

- Expansion of working group with a broader range of researchers



- Extension and adjustment of approach and working group roles:
 - Virtual research on observed economic conditions following quakes, including outside the US
 - Adding observation, informal discussion, interviews, focus groups
- Further collaboration with local academic institutions and other groups in fielding research
 - Sharing questions for a Oaxaca study
 - More extensive collaboration in Türkiye



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A different approach: Kahramanmaraş earthquakes in Türkiye

- Began with virtual reconnaissance of economic impacts, gave little information on business experience.
- Informal conversations:
 - UN contractor familiar with the region
 - Members of a family business in Gaziantep (also active in a women's business organization)
- Invited a Turkish professor (Dr. Ezgi Orhan, Çankaya University) to lead a more formal study
- Research coordinated with one year anniversary activities of women's business organization (GAGİKAD)
 - Formal survey of organization members
 - Roundtables with members
 - Separate labor market survey by Dr. Orhan and GAGİKAD members of displaced women's employment experience.



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Gaziantep Survey and Roundtables

- Survey

- N: 35 businesswomen, data collection through e-mailing
- Content:
 - Firm profile
 - Impact of earthquake on firm
 - Recovery expectations



Brief introduction of roundtable workshop

Topics:

- *Damage and losses*
- *Challenges and Needs*
- *Strategies for recovery*
- *Lessons learned*

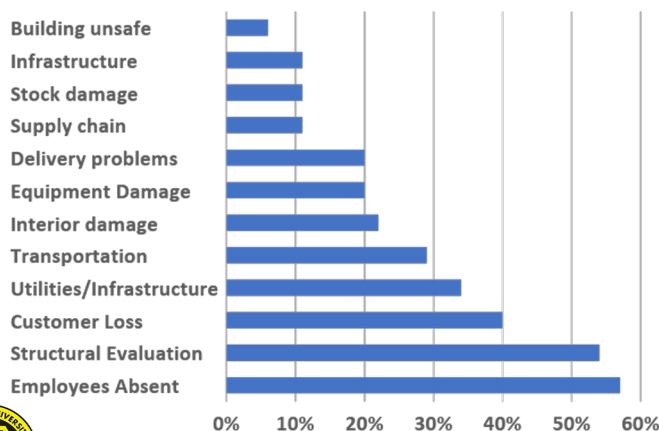
- Roundtable

- N: 23 businesswomen, members of GAGİKAD
- Half-day workshop, focus group style conversation
- Transcripts and translation

What caused business disruption, and what role did building damage play?



Survey responses on why businesses did not operate



What roundtable participants said

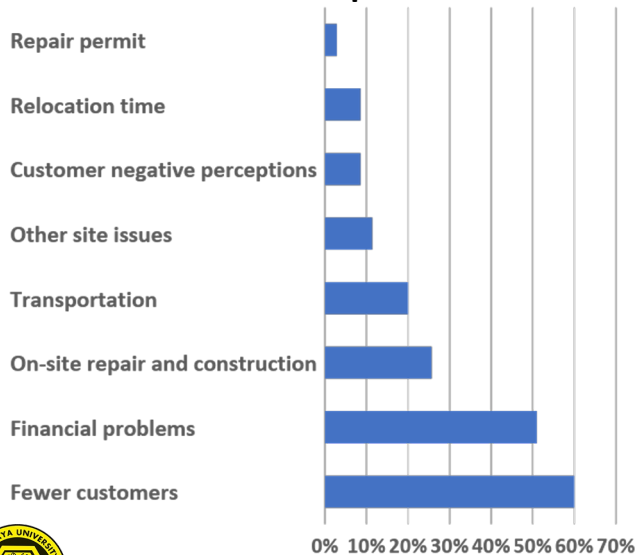
- We couldn't manage much from home because there was **no internet for the first 3-4 days**.
- The **building inspection report** came out as undamaged. However, **electricity, water and natural gas were not provided** for a long time.
- I did not lose any employees, but as a whole industry, we experienced a **loss of patients**.
- ...**disruption continued due to employees**. There are people who come to work from the villages through the Islahiye-Nurdağı road. ... Apart from this, **we were also affected by the major damage in Iskenderun Port**.





Challenges as Businesses Tried to Recover

Survey responses on main problems faced after the earthquake



What roundtable participants said

- ...my factory remained closed for 2 months. Even though I couldn't sell, **banks and other creditors did not postpone payments.**
- I lost my job, ...I had not rehabilitated myself psychologically, I **was also hit financially. Then I was hit by inflation.**
- Employers somehow took care of their employees, paid their salaries, and found a place to stay, but **the employers were not taken care of.**
- As a woman in the business world, after the disaster, I had the **obligation to take care of children** and schools were closed.
- I ...went out to distribute aid to ...Kahramanmaraş, Hatay and Nurdağı regions. I paid for it [gasoline, staff salaries] all myself. **I spent all my savings.**
- Our **customers naturally started to decrease.**
- After the earthquake, most of the flights and tour programs, and **holiday plans were canceled.**



Takeaways for Research Design

- I. Complementary approaches of informal conversation, survey, and workshops
- II. Participatory knowledge production
 - Importance of the participatory process: Learn from the participants and their experiences
 - Narrowing the gap in knowledge caused by a distant setting: collaboration with local researchers and organizations
 - Reciprocal approach: knowledge learned contributes to local response capabilities
- III. Women's perspective on business and disaster



What comes next in characterizing and preparing for the economics of earthquake impacts?

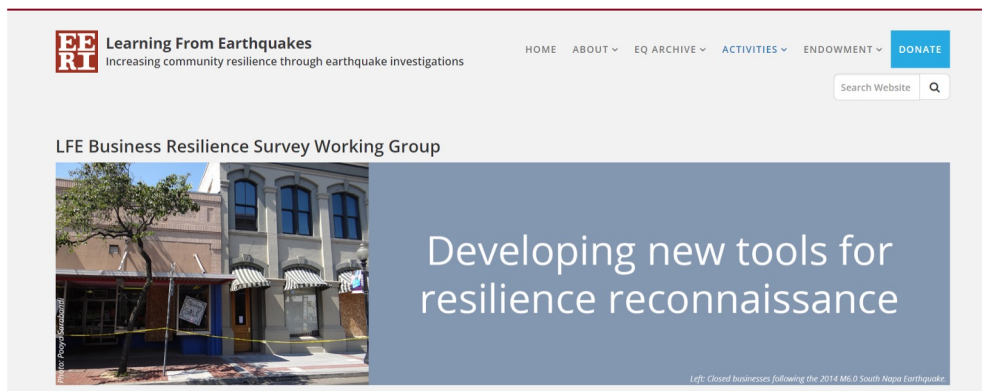
- Work over the past 3 decades has broadened our understanding of the macro and micro economic effects of major earthquakes, but we have more to learn
 - How much do factors other than direct damage determine how a business is affected, or how a region recovers?
 - How can advance preparation and capacity building reduce the risk of displacement of resource-scarce places and people?
- Local, state, regional and national level agencies have become much better prepared to work cooperatively where response is needed, but we know that yesterday's strategies don't always work for tomorrow's event.
- Do we need to expand the definition of what "preparedness" means? Structural improvements? Emergency supplies? Securing records? Relocation plans? Rebuilding plans?
- Lessons from other types of disasters can help educate organizations and individuals on actions for preparedness and community cooperative steps.

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EERI LFE Business Resilience Directions

- Continuing development of collaborative qualitative and quantitative methods
- Preparing to learn from large US earthquake with reciprocity
- Integrating people, businesses, policies into functional recovery



cynthia.a.kroll@gmail.com

Business Resilience Working Group Co-Chairs:
Anne Wein awein@usgs.gov

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Q&A

The recording of today's webinar will be posted within a week at EarthquakeCountry.org/northridge30-webinar7 and SoCal.EERI.org



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Episode 8: Rethinking Communication about Seismic Risk – Linking Knowledge to Action in Innovative Ways Since the 1994 Northridge Earthquake

Moderator: Louise K. Comfort, Visiting Researcher, University of California, Berkeley
Professor Emerita, Graduate School of Public & International Affairs, University of Pittsburgh

Speakers: Ronald T. Eguchi, President and CEO, ImageCat, Inc.
Lucy Jones, Founder and Director, Dr. Lucy Jones Center for Science and Society



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