The Value of Earthquake Scenarios for Emergency Preparedness and Community Resilience

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How Do We Plan for or Think About the Future?
Scenarios – a tool to plan for an uncertain future
Scenario development and applications

- Manhattan project, military planning and war game analyses since WWII
- Land-use and transportation planning
- Business strategy and planning, made famous by Shell Oil’s use to deal with the unpredictability of the Arab oil embargo
- Geopolitical, environmental and civil rights strategies
- Emergency and disaster planning
- Climate and resource planning
Earthquake scenarios in California date back to the 1980s

- Rationale for the scenario event selected
- Potential geologic effects (i.e. ground shaking, surface fault rupture, liquefaction, landsliding)
- Exposure analyses and potential damage descriptions
  - Population
  - Lifeline utilities (i.e. transportation, power, water, wastewater, communications)
  - Critical structures (i.e. hospitals, schools, government facilities)
Example Earthquake Scenarios (post-2000s)

- M9 Cascadia
- M7.9 N San Andreas
- M7 Hayward
- M7.8 S San Andreas
- M7.7 New Madrid

- Detailed hazard modeling
- Use Hazus (FEMA GIS-based loss estimation methodology) or other software to model building damage, casualties, sheltering needs, and utility impacts
- Supplemental engineering analyses – fire following, lifeline utilities
- Social and economic (near- to long-term) analyses
- Policy and planning considerations
M7.9 N San Andreas Earthquake Scenario (2006)

- Fire - Plus 5% - 15%
- Lifelines - Plus 5% - 15%
- Total Loss: $150 billion

<table>
<thead>
<tr>
<th>County</th>
<th>Loss Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alameda</td>
<td>7.4%</td>
</tr>
<tr>
<td>San Francisco</td>
<td>25.9%</td>
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<tr>
<td>San Mateo</td>
<td>24.6%</td>
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<tr>
<td>Santa Clara</td>
<td>11.9%</td>
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<tr>
<td>Other Counties</td>
<td>2.7%</td>
</tr>
<tr>
<td>All 19 Counties</td>
<td>9.0%</td>
</tr>
</tbody>
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Kircher & Associates Consulting Engineers
Earthquake Professional’s “Top Ten Agenda”

● Develop a culture of preparedness
  1. Know your risks
  2. Prepare to be self-sufficient
  3. Care for the most vulnerable
  4. Collaborate for a regional response

● Invest in Reducing Losses
  5. Focus on dangerous buildings
  6. Ensure essential facilities function
  7. Invest in critical infrastructure

● Ensure Resiliency in Recovery
  8. Plan for regional housing
  9. Protect your financial recovery
  10. Plan for regional economic recovery

Task Groups:
- Earthquake and Tsunami Scenario
- Business and Work Force
- Coastal Communities
- Critical Buildings
- Transportation
- Energy
- Information and Communications
- Water and Wastewater
● 4 Impact Zones for M9 EQ Scenario
● Sector-by-sector findings and recommendations
● 4 Overarching Policy Recommendations
  – Undertake comprehensive assessments of the key structures and systems that underpin Oregon’s economy
  – Launch a sustained program of capital investment in Oregon’s public structures
  – Craft a package of incentives to engage Oregon’s private sector in efforts to advance seismic resilience
  – Update Oregon’s public policies
“Oregon Unprepared” documentary (2015)

Governor’s Resilience Task Force on Implementation (2014)
Governor’s Transportation Vision Panel Report (2016)
“Two Weeks Ready” Campaign

Appointment of Oregon Resilience Officer (2016)

Governor’s Resilience 2025 Policy Agenda (2018)

Regional Recovery Framework (2019)
M7.8 Southern San Andreas Earthquake Scenario (2008)

- 1,800 deaths; 53,000 injuries
- Loss of 45,000 buildings (1% region total) from shaking-related effects; 260,000 more (1 in 19 buildings) with repairs in excess of 10% of building replacement costs; 5-10 steel-frame building collapses
- 1,600 fire ignitions igniting fires in areas of dense, wood-frame construction, destroying 200 mn sq feet of building stock (= 133,000 homes)
- 100,000 households impacted/displaced (225,000 households initially in emergency shelters)
- Structures and Contents Damage - $113 billion
- Business Interruption/Traffic Delay - $100 billion
  - $53 billion from water outages
  - $7.3 billion from power outages
MMI Ground Shaking Intensity Comparison:
M\text{w}7.8 Shakeout Scenario vs. M\text{w}6.8 Northridge Earthquake (1994)
2009 ShakeOut Drill
5,300 emergency responders
5.4 mn participants

FEMA Catastrophic EQ Plan (2010)

(2012)

2019 ShakeOut Drill
10.8 mn participants statewide
Over 67 mn participants globally in 10 years

Los Angeles
Earthquake “czar” and Mayoral Seismic Task Force (2014)

Mandatory building retrofit program (2016)

Quake-prone Concrete buildings study (2014)

100 Resilient Cities and CRO (2015)

LA Resilience Plan (2018)

M7 Hayward Fault EQ Scenario (2017 - 2020)

Vol. 1 (2017)
Vol. 2 (2018)
Vol. 3 (2020)
Scenario Best Practices and Lessons Learned

- Scenarios can stimulate the advocacy, adoption and implementation of enhanced earthquake preparedness and risk reduction investments and actions, but it isn’t necessarily immediate. Important to have policy advocacy and action agenda too!
- Barriers to implementation include risk awareness and uncertainty, competing demands, lack of funding sources and political will
- “Windows of opportunities” for overcoming barriers to investments and actions open and close with time which means that there need to be stewardship of the information, ongoing advocacy and cultivation of other advocates and “champions”
- Opportunity windows can be created by an array of triggers (i.e. other hazards/disasters, changes in leadership, related initiatives to link seismic safety to) so its important to be ready to act

Policy and Legislation

- Have Public Policy Proposals Ready When the Time is Ripe
- Learn How “Things Work” in the Legislative or Executive Agency
- Gain Access to Policy Makers Who Will Champion Seismic Safety
- Get a Critical Mass of Policy Makers to Agree about the Problem
- Understand that Policy Making is Largely Political and Economic, Not Technical
- Propose Workable Solutions
- Remember that Not all Policies are Regulatory
- Design Policy to Meet the Legitimate Needs of Likely Opponents
- Policy Enactment Is Just the Beginning
- Remember That Nothing Lasts Forever
Thank you!

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The Really Big One

An earthquake will destroy a sizable portion of the coastal Northwest. The question is when.

Kathryn Schulz, The New Yorker, 2015