

User Benefit Pathways and Perceptions for California's Earthquake Early Warning System

Laurie A. Johnson

Sharyl Rabinovici

Grace S. Kang

Stephen A. Mahin

Pacific Earthquake Engineering Research Center



Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES



Background

- ❑ 2013 State Legislative mandate for California Governor's Office of Emergency Services (Cal OES) to form a public-private partnership
- ❑ 2013 - 2015, CA EEWS Implementation Committee worked to develop a comprehensive system to meet legislative objectives:
 - Public/private partnership model
 - Organizational structure for system management and operations
 - Identification of non-state funding sources
 - Comprehensive plan for education and training
- ❑ Senate Bill 438 (adopted Sept 2016; commenced Jan 2017) authorizes creation of CA EEW Program and Advisory Board
 - February 2018 deadline for project business plan, including 2017 \$10 million state commitment to the \$28 million estimated system cost

Study Purpose

Six-month study led by Pacific Earthquake Engineering Research Center (PEER) in partnership with Cal OES and California Seismic Safety Commission, February – July 2016

Aims:

- ❑ Qualitatively assess the anticipated value of earthquake early warning to California's economy and infrastructure
- ❑ Provide information that can be used to develop a more quantitative benefit-cost analysis



14 Sectors Interviewed

(24 organizations / 69 individual representatives)

- ❑ Electric Utility
- ❑ Telecommunications
- ❑ Mass Transit
- ❑ Transportation
- ❑ Gas Utility
- ❑ Water Utility
- ❑ Public Safety
- ❑ Hospital and EMS
- ❑ Education
- ❑ Business
- ❑ Commercial/Industrial
- ❑ Insurance
- ❑ Financial
- ❑ Information Technology

Represented Sector	Northern California	Southern California	Statewide	Total
Electric Utility	+	+	1	1
Telecommunications			2	2
Mass Transit	1		1	2
Transportation			1	1
Gas Utility	1+			1
Water Utility		1		1
Public Safety			1	1
Hospital and Emergency Medical Services			1	1
Education		1		1
Business		1		1
Commercial/Industrial	+	2	1	3
Insurance			1	1
Financial			1	1
Information Technology	1			1
Grand Total	3	5	10	18

(Note: (+) indicates when the work of the organization fits in additional sectors.)



Study Results

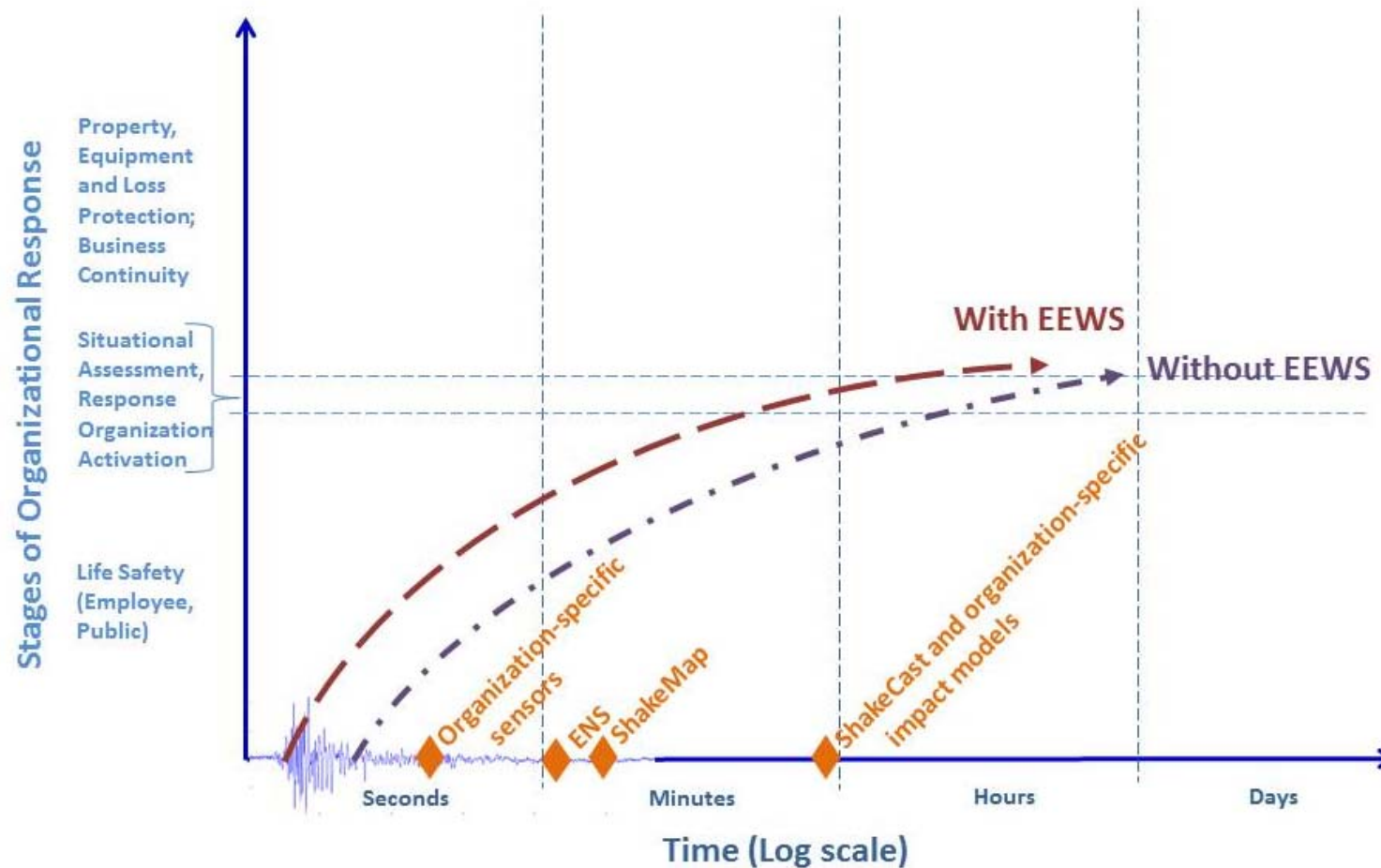
- ❑ Affirmed broad societal value
- ❑ 14 categories of potential uses and benefits of a statewide EEWS
- ❑ Sector-specific findings (e.g., earthquake preparedness and response planning and experiences with warnings to date)
- ❑ Revealed potential implementation issues
- ❑ Clarified research and outreach agendas for assessing benefits of a statewide EEWS

Broader Societal Value

- Sectors unanimously perceive the overall societal benefits as very high; a few seconds to tens of seconds could help thousands to millions of people to take precautionary actions
 - Effort of providing societal access may have major educational benefit
 - Gaining access may have socio-psychological benefits
- Strong consensus that overall societal value can also result from different sectors having access to and making concrete use of a statewide EEWS



Potential Gains through Organizational Use of EEWS are Incremental



Primarily through its potential to reduce injuries and provide early technical data for use in situational assessment and response planning, EEWS has the potential to facilitate faster organizational movement through the stages of response and to implement more targeted response efforts.

Potential Uses and Benefits

- 14 Potential Use Types
- Human-controlled
 - Automated

	Electric Utility	Telecommunications	Mass Transit	Transportation	Gas Utility	Water Utility	Public safety	Hospital/EMS	Education	Financial	Insurance	Business	Commercial/Industrial	Information Technology
Notification for Occupational Safety	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Notification for Public Safety for a Particular Facility		✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
Broadcast Notification for General Public Safety	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓		✓
Activation of Emergency Response Plans and Situational Assessment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Large-Scale Utility Control	✓			✓	✓	✓								
On-Site (Facility) Utility Control	✓			✓	✓		✓	✓	✓		✓	✓	✓	✓
High-Speed Mass Vehicle Control			✓	✓								✓		
Low-Speed Mass- Vehicle Control		✓		✓								✓		
Independent Vehicle Control	✓			✓			✓		✓			✓		
Industrial Equipment, Assets, and Process Control	✓			✓		✓					✓		✓	✓
Industrial Chemical Control				✓		✓					✓		✓	✓
Commercial Equipment, Assets and Process Control	✓			✓		✓				✓	✓	✓	✓	✓
Large-Scale Access Control		✓		✓			✓							
On-Site Access Control	✓	✓	✓	✓		✓	✓		✓			✓	✓	✓



Benefit Readiness & Feasibility

- 14 Potential Use Types
- Human-controlled
 - Automated

	Feasibility for Human Controlled Application of EWS	Willingness for Human Controlled Application of EWS	Feasibility to Automate Application of EWS	Willingness to Automate Application of EWS
Notification for Occupational Safety	Strong	Strong	Mixed	Mixed
Notification for Public Safety in a Particular Facility	Strong	Strong	Mixed	Mixed
Broadcast Notification for General Public Safety	Weak	Weak	Mixed	Strong
Activation of Emergency Response Plans and Situational Assessment	Strong	Strong	Mixed	Mixed
Large-Scale Utility Control	Strong	Weak	Weak	Weak
On-Site (Facility) Utility Control	Mixed	Strong	Mixed	Mixed
High-Speed Mass Vehicle Control	Strong	Strong	Strong	Strong
Low-Speed Mass- Vehicle Control	Strong	Strong	Mixed	Mixed
Independent Vehicle Control	Mixed	Strong	Weak	Weak
Industrial Equipment, Assets, and Process Control	Weak	Strong	Mixed	Mixed
Industrial Chemical Control	Weak	Strong	Mixed	Mixed
Commercial Equipment, Assets, and Process Control	Weak	Strong	Mixed	Mixed
Large-Scale Access Control	Weak	Strong	Weak	Weak
On-Site Access Control	Mixed	Strong	Mixed	Mixed



Direct vs. Indirect Benefits

P – Primary Benefit
S – Secondary Benefit

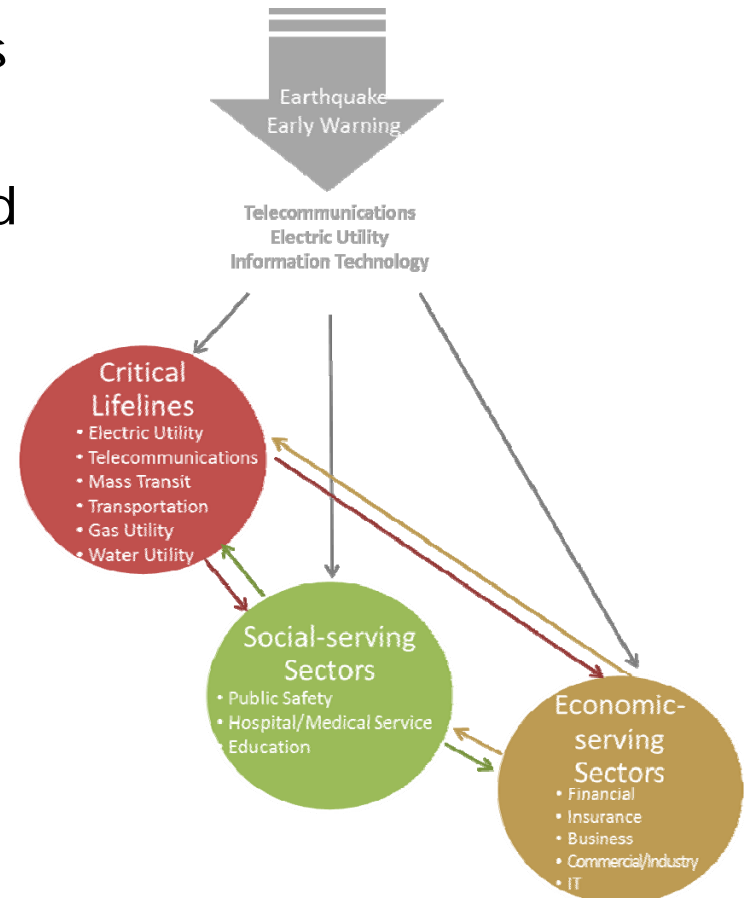
	Public Safety	Employee Safety	Property and Asset Protection	Equipment and Operations Protection	Business Resumption and Continuity	Business Income and Loss Protection
Notification for Occupational Safety	S	P	S	S	S	S
Notification for Public Safety in a Particular Facility	P	P	S	S	S	S
Broadcast Notification for General Public Safety	P	S	S	S	S	S
Activation of Emergency Response Plans and Situational Assessment	S	P	P	P	S	S
Large-Scale Utility Control	S	S	P	P	S	S
On-Site (Facility) Utility Control	S	S	P	P	S	S
High-Speed Mass Vehicle Control	P	P	P	P	S	S
Low-Speed Mass Vehicle Control	P	P	P	P	S	S
Independent Vehicle Control	P	P	P	S	S	S
Industrial Equipment, Assets, and Process Control	S	P	P	P	P	P
Industrial Chemical Control	S	P	P	P	P	P
Commercial Equipment, Assets, and Process Control	S	P	P	P	P	P
Large-Scale Access Control	P	P	S	S	S	S
On-Site Access Control	P	P	S	S	S	S

Key Benefit Pathway Insights

- ❑ Foremost perceived benefit is direct life safety
- ❑ To maximize the potential life safety benefits:
 - More systematic and detailed study is needed of the range of situationally-specific human activities and the set of practical delivery modes and appropriate warning responses in each (e.g., more than DCHO)
- ❑ High-level of (end-to-end) system reliability must be assured in order for sectors to make full use of a statewide EEWS and thus maximize potential societal benefits

Pathway Conditions & Constraints

- ❑ Diverse routes to achieving benefits
- ❑ Benefits vary in importance and complexity across organizations and sectors
 - Telecomm, Electricity, and Information Technology (IT) sectors are central to the operational feasibility and performance of EEWS and thus to all its potential societal benefits
- ❑ Close linkage of EEWS to life safety has political, financial, and equity implications
 - Many participants viewed a statewide EEWS as a social entitlement with responsibility residing with government and its social contract with the public



Potential Implementation Issues

- ❑ Statewide EEWS should be viewed as a major infrastructure development project for the state with a secure and consistent funding source
- ❑ System planning and implementation must be deeply and broadly collaborative (e.g. science/technical/engineering, emergency management, telecom/electric/IT sectors, and experts in occupational behavior, public health, psychology and community engagement)
- ❑ The range of situationally-specific human activities and set of practical delivery modes and appropriate warning responses (e.g. beyond DCHO) in each requires systematic study
- ❑ Adequate knowledge and training is a fundamental prerequisite to life-safety benefit realization
- ❑ Implementation timing needs to account for the timing of partner contributions to system development as well as user requirements
- ❑ Organizations will have significant costs to develop, deploy and train for potential applications of EEWS
- ❑ Liability protection for partners and users will be needed and affects governance arrangements for the system

Further Study Recommendations

- ❑ Develop a robust set of use scenarios for each application and elaborate on user-specific cases
- ❑ Collect quantitative evidence about the different application-use scenarios and their benefits
- ❑ Expand analysis to include more sectors (e.g. military, construction, and pharmaceutical) as well as within-sector variations and readiness
- ❑ Significantly increase engagement with telecom, electric utilities, and IT partners
- ❑ Deeper and broader involvement of secondary beneficiaries



Thank you!

Cal OES/Earthquake, Tsunami, and Volcano Program/ California Earthquake Early Warning Program/Research:

http://www.caloes.ca.gov/EarthquakeTsunamiVolcanoProgramsSite/Documents/CaOES-CSSC1604-PEER201606-CAEWS-Benefits-Study_FINAL_8.31.16.pdf

CSSC (Seismic)/Publications:

http://www.seismic.ca.gov/pub/CSSC_16-04_PEER201606_FINAL_8_1_16.pdf

PEER/Publications/2016 Reports:

http://peer.berkeley.edu/publications/peer_reports/reports_2016/CaOES-CSSC1604-PEER201606-CAEWS-Benefits-Study_FINAL_8.31.16.pdf



Cal OES
GOVERNOR'S OFFICE
OF EMERGENCY SERVICES

