

Maintenance

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Project Title:

ShakeCast, Connecting the DOTs

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ShakeCast, Connecting the DOTs

This Transportation Pooled Fund project will bring participating Departments of Transportation (DOTs) into full ShakeCast operation for post-earthquake assessment of state and local bridge inventories.

WHAT WAS THE NEED?

When an earthquake occurs, the U. S. Geological Survey (USGS) ShakeMap portrays the extent of potentially damaging shaking. In turn, the ShakeCast system, a freely-available, post-earthquake situational awareness application, automatically retrieves earthquake shaking data from USGS ShakeMap, analyzes shaking intensity data against users' facilities (e.g., bridges, buildings, roads), sends notifications of potential impacts, and generates maps and other web-based products for emergency managers and responders. ShakeCast is particularly suitable for earthquake planning and response purposes by DOTs. The California Department of Transportation (Caltrans) has been working with the USGS over the last ten years to develop a robust and operational ShakeCast platform. A long-term goal is to "connect the DOTs" to bring this technology to all states with seismic hazards, as the major earthquakes anticipated to occur in the future will cross state borders. The recently released ShakeCast V3 system includes a full statistical fragility analysis framework for general structural assessment of bridges as part of the near real-time system; significant improvements in the graphical user interface, including a console view for operations centers; and custom, user-defined hazard and loss modules. The new version also includes advancements in estimating the likelihood of shaking-induced secondary hazards to bridges and along roadways due to landslides and liquefaction.

WHAT WAS OUR GOAL?

The primary goals of the project are to: (1) Bring participating DOTs into full ShakeCast operation for post-earthquake assessment of state and local bridge inventories; and (2) Provide a mechanism to actively engage representatives from state DOTs with the common interests in implementing



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and expanding the application of ShakeCast technologies to improve emergency response capabilities.

WHAT DID WE DO?

This collaborative effort brought participating DOTs and Federal Highway Administration (FHWA) into full ShakeCast operation for post-earthquake assessment of state and local bridge inventories. The project provided a mechanism to actively engage representatives from state DOTs with the common interests in implementing and expanding the application of ShakeCast technologies to improve emergency response capabilities.

WHAT WAS THE OUTCOME?

Ten state DOTs and FHWA successfully operate a fully functional ShakeCast system. Figure 1 and 2 shows the distribution of shaking hazards and all partnering DOTs in the TPF. In the event of an earthquake, ShakeCast system automatically retrieve seismic data and analysis ground shaking distribution with facility vulnerabilities (e.g., fragility curves) for the facilities in the impacted area. The earthquake shaking data used by the ShakeCast is in the form of a ShakeMap (i.e., a map that displays earthquake shaking parameters spatially), which is obtained by the ShakeCast system which monitors USGS web products. From the system analysis, ShakeCast generates email event notifications to users with a hierarchical list of potential impacted state and local bridges within the regions of strong shaking. Figure 3 shows schematically the overall ShakeCast system operation model.

DOTs ShakeCast instances were created and with the completion of cloud-based USGS ShakeCast Remote server at the Denver Federal Center with an exact functional backup at the USGS's Sioux Falls data center. The default setup for a ShakeCast instance includes the bridge inventory based on the latest NBI database for the designated State DOT and two notification groups (for actual and scenario earthquakes) that represent the

geographic boundaries of the State. The ShakeCast NBI conversion tool was used to provide mapping between the NBI bridge class and the Hazus bridge model and fragility for the base bridge model further refined with additional NBI parameters based on the HAZUS methodology. The USGS ShakeCast team worked with each DOT to finalize their requirement specifications regarding structure inventory, user groups, products, and notification configuration. A data repository SharePoint site was created for content management to minimize the needs for web access and maximize data accessibility between partnering DOTs. Table 1 shows the outline of State DOTs ShakeCast system and product customization deployment. The focus to develop system features and product enhancements specific to each partnering DOTs and FHWA was achieved under this project.

WHAT IS THE BENEFIT?

The project enabled Caltrans, neighboring State DOTs, and FHWA to respond more effectively to cross-border earthquakes following a major earthquake. The collaborative effort leveraged funds from multiple state DOTs to deliver a product of interest to all State DOTs with seismic hazards.

LEARN MORE

<https://www.usgs.gov/news/featured-story/usgs-shakecast-system>

IMAGES

SHAKECAST TRANSPORTATION POOLED FUND PROJECT (2017, PHASE 1)

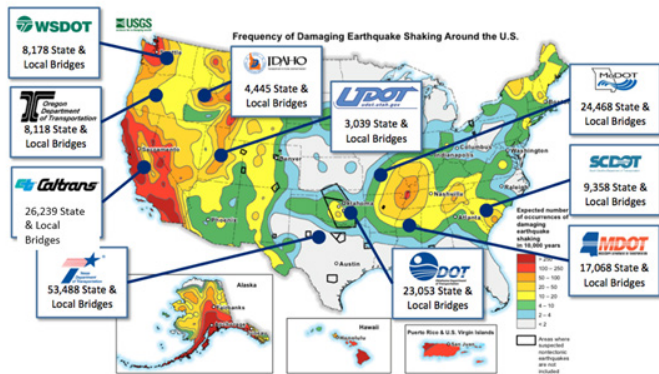


Image 1: Distribution of shaking hazards and state transportation department partners in the TPF (2017). Courtesy of USGS.

SHAKECAST TRANSPORTATION POOLED FUND PROJECT (2021, PHASE 2)

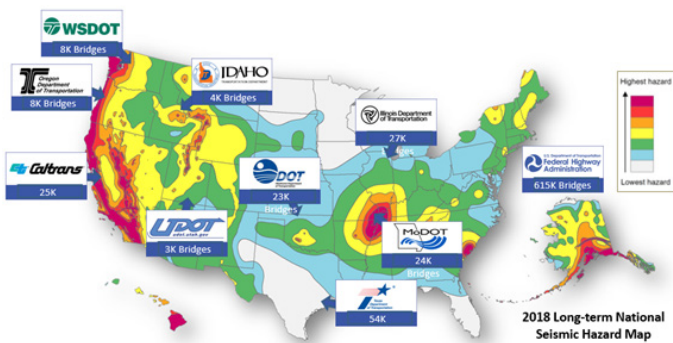


Image 2: Distribution of shaking hazards and state transportation department partners in the TPF (2021). Courtesy of USGS.

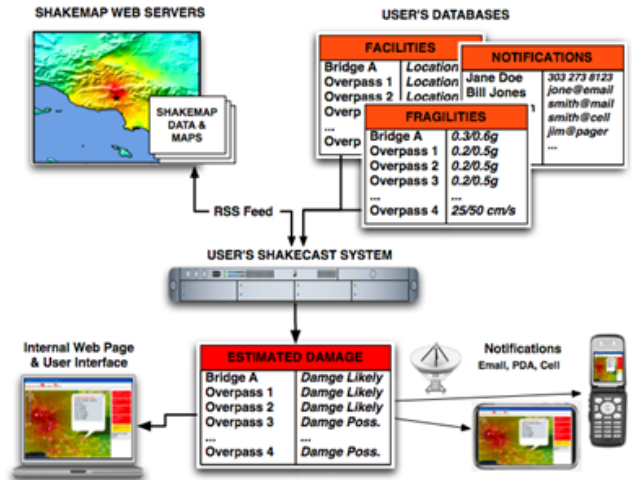


Image 3: ShakeCast system operation model flow chart. Courtesy of USGS.

TABLES

State DOT	In-House ShakeCast System? (2017)	In-House ShakeCast System? (2020)	ShakeCast-Related Research and Development?	Level of Customization
California	Yes	No	Yes	High
Washington	Yes	Yes	No	Default
Utah	Yes (V2)	No	TBD	Moderate
Oregon	No	No	TBD	Moderate
Oklahoma	Yes (AWS)	Yes (AWS)	Yes	High
S. Carolina	No	No	TBD	Default
Idaho	No	No	TBD	Moderate
Mississippi	No	No	TBD	Default
Texas	No	Yes (AWS)	Yes	High
Missouri	No	No	TBD	Moderate
FHWA	No	No	Yes	High
Illinois	No	No	TBD	Default

Table 1: State DOT ShakeCast Initial Deployment.

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