

Appendix 4

Sample interview protocol

The following questions aim to understand the earthquake impacts on building clusters and lifeline systems that support a vital service or function within a community or neighborhood. This stands in contrast with more traditional engineering investigations that focus on individual buildings or sites. Therefore, it is critical to clearly document the scale for the recorded observations (e.g., the service territory for a utility provider or jurisdictional boundary for a city). The intended audience for the questions below include utility operators/regulators and government officials in cities, municipalities, and other agencies.

Opening questions

These questions can be useful to start the interview and identify areas to probe in more detail. They are more qualitative in nature but should get the discussion going.

- What are some of the most significant impacts of the earthquake?
- What have been the most significant challenges in responding to (or, depending on the timing of the interview, recovering from) the earthquake?
 - Where are you in the recovery process?
 - Have you set any recovery goals or milestones?

Pre-event overview

Attempt to document the size and characteristics of the system before the earthquake, including locations of major infrastructure. Ask about organizational structure to identify opportunities to obtain responses to following questions at different scales. These questions only need to be asked during the first reconnaissance trip.

- If lifeline system, how many customers served within the selected region?

- If building cluster:
 - Residential: how many residents, buildings, housing units?
 - Commercial/industrial: how many businesses, workers, buildings, square footage?
 - Education: how many students, teachers, schools?
 - Healthcare: how many patients, nurses, doctors, hospitals, clinics?
 - Cultural: how many visitors?
- Please describe major infrastructure and/or equipment within the selected region and their locations:
 - Electrical: generating stations, major transmission lines, substations
 - Residential: major neighborhoods, community centers, emergency shelters
 - Healthcare: hospitals, clinics
- Please identify and describe any critical interdependencies with other building clusters and lifeline systems
 - Physical: successful system operation depends on material output(s) from another system (e.g., power and water)
 - Cyber: successful system operation depends on availability of information and communication systems
 - Geographic: co-location of systems (e.g., electrical lines and fiber optic cables slung under a bridge)
 - Logical: an interdependence that is not physical, cyber, or geographic (e.g., financial decisions affecting the ability of a power company to supply electricity)
- Please describe any pre-event mitigation, preparedness, or planning activities undertaken (e.g., retrofits, upgrades, replacements, emergency response plans, policies, regulations, etc.)
- For lifeline systems, please describe any redundancies and/or backups within the system (e.g., multiple access roads to a facility or community)
- Please describe any critical system vulnerabilities identified before earthquake (e.g., only one water treatment facility; significant population of URM buildings)
- For lifeline systems, please describe any alternate or competing delivery mechanisms within the selected region (e.g., personal water wells; diesel generators)

Pre-event functionality

Attempt to document the state of the system before the earthquake. These questions only need to be asked during the first reconnaissance trip.

- Please describe the metrics used to monitor or assess system functionality on a daily basis (e.g., gallons of water delivered, vacancy rate, average rent, emergency room wait time, business failure rate, unemployment rate, classroom size, student-teacher ratio, etc.)
- Using the above metrics, please describe the state of the system in the months before the earthquake

Initial damage and functionality

Attempt to document the earthquake impacts and the state of the system immediately after the earthquake. If possible, link these observations to earthquake shaking intensity recorded within the selected region. These questions only need to be asked during the first reconnaissance trip.

- For the infrastructure and equipment identified previously, please describe the damage caused by the earthquake
 - For building clusters, if there are a large number of buildings try estimate the number in each damage category (e.g., red, yellow, green tags; number collapsed; minor, moderate, severe damage); if there are a small number of buildings try to document damage to specific buildings
 - For lifeline systems, try to document failures of major equipment and structures
- For the interdependencies identified previously, please describe if any impacted the functionality of the system
- Using the metrics identified previously, please describe the state of the system immediately after the earthquake, including:
 - For building clusters: the percentage of buildings not usable (due to damage, interdependencies, or both)
 - For lifeline systems, the percentage of service area disrupted and the location(s), if possible

Current functionality

Attempt to document the current state of the system.

- For the interdependencies identified previously, please describe if any are currently impacting the functionality of the system
- Have any new interdependencies emerged since the earthquake?
- Using the metrics identified previously, please describe the current state of the system, including:
 - For building clusters: the percentage of buildings not usable (due to damage, interdependencies, or both)
 - For lifeline systems, the percentage of service area disrupted and the location(s), if possible
- Have any new metrics been developed since the earthquake?
- Please describe any adaptive strategies that have been employed to temporarily restore service levels (e.g., water trucks, portable toilets, moved operations to tents, etc.)

Restoration and recovery

Attempt to document repair and recovery of the system.

- Please describe the current rate at which the system is being restored:
 - Flat: no progress is being made to restore those parts of the system that were damaged
 - Slow: some progress
 - Fast: significant progress
 - N/A: the system is fully restored
- For the damage identified previously, please describe any progress towards either repairing or replacing damaged infrastructure and equipment
- Describe the decision making process or strategy developed for making repairs and restoring system functionality

- Please describe any factors that are impeding or speeding system restoration:
 - Within natural infrastructure: subsidence of land disrupts gravity-fed water distribution systems and/or causes new areas of flooding; frequent rain causes additional landslides that block highways; constant aftershocks cause additional damage
 - Social factors (within the human infrastructure): outmigration leads to shortage of workers and/or customers; emotional and/or psychological stress impacts worker productivity; local population lacks necessary capacity and/or skills for recovery; strong local organizations provide resources for recovery
 - Economic factors (within the human infrastructure): lack of capital or credit for repairs; generous insurance policy speeds repair work
 - Institutional factors (within the human infrastructure): excessive regulations or lack of leadership impedes reconstruction; comprehensive pre-event recovery plan and/or expedited permitting process speeds repair work
- Please describe any transformative changes within the system (i.e., things that might have slowed recovery in the short term but have led to or will lead to a more resilient system in the future), including:
 - Improved enforcement of current building code and/or engineering standards or adoption of improved one (i.e., changes in the regulatory environment)
 - New system configuration with improved redundancy (i.e., significant system configuration changes)
 - New or updated policies, plans, and/or strategies
 - Organizational changes
 - Stockpiling of resources (i.e., preparedness)

Closing questions

These questions are helpful in closing the interview and identifying key takeaways and lessons learned.

- What are the biggest lessons learned from the earthquake?
- Do you have any recommendations for others?