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Keynote 3: Lessons from the National Earthquake Hazards Reduction Program Can be Applied to the National Landslide Hazards Program: A Rational Approach.

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Who are we?

- We are an actuary and a geotechnologist seeking to bridge two very different disciplines to achieve a result of significant benefit to property owners.
- I am the kind of actuary who specializes in all forms of insurance other than life and health. This includes fire, automobile, workers compensation, liability, earthquake, windstorms and so on.
- I was the Chief Property/Casualty Actuary for the California Insurance Department (CID) for 20 years. During that time, I took a special interest in the problems of how to provide insurance for natural disasters.

The Business of Insurance

- Insurance is a special kind of business, in which the costs of the product are not known until AFTER the product is sold. (When Ford sells a car, Ford knows exactly the costs of making that car.)
- In addition, the insurance company holds your money and promises to pay if you have a covered claim. A fiduciary responsibility.
- An insurance company issues far more policies than it has assets, because only a few policies will have claims each year. A leveraged business.

What Do Actuaries Do?

- Actuaries are experts in all aspects of forming and running an insurance company, a very complicated business.
- They determine what rate (dollar premium) to charge for each type and location of house or automobile to be insured.
- They estimate the probability of catastrophic event, such as hurricanes, earthquakes, large brush fires, hail storms, and so on.
- Insurance claims often involve lawsuits, which are not settled for many years. Fire and earthquake claims are usually not settled for many years. An Actuary must estimate the reserves for these claims.

What Do Actuaries Need to Know?

- When State Farm sells homeowners insurance in California, it must know:
 - What rate to charge for each type and location of a house.
 - The rate is based on the past history claims from policyholders.
 - The past history must be adjusted for building cost inflation and changes in building codes.
- When AAA Auto Club sells automobile insurance in California, it must know:
 - What rate to charge for each type of car, by location, by owner's driving record.
 - This results in a very large matrix of combinations to fit the population, all based on history.

Problems in Insuring Natural Disasters

- Historical claims data from past natural disasters can't be used for determining the rates for the insurance.
- Once an earthquake has occurred, the stress has been removed.
- Yet, insurance is now available for earthquakes, hurricanes, hail, and floods.
- Generally, there is no insurance available for landslides or subsidence (sinkholes).
- Earthquakes, landslides and sinkholes are part of the exclusion for "earth movement" in homeowners policies. Earthquake insurance must be purchased separately.
- The demand by property owners for this insurance is low, mainly because the public's perception of risk from most natural hazards is low and that government programs will cover their losses.

Hurricanes and Hail

- What do Hurricanes and Hail have in common?
- Answer: World War II.
- In 1940, there were 377 qualified weather forecasters in the US. Far fewer were professional meteorologists.
- During one year, 1942, the army increased that number by 2,590 through special training programs at MIT, Cal Tech, and NYU.
- After the war, the meteorological profession grew and the public interest in predicting the weather grew.

Weather Modeling after WW II

- After the war, some of the trained weather forecasters continued their interest in meteorology and took jobs in the field.
- One group moved to Hartford and joined the Travelers Insurance Company to develop a windstorm and hurricane model. Travelers insured hurricanes along the East Coast.
- Another weather forecaster, my father, moved to Chicago and founded a bureau, funded by the insurance industry, to model hail patterns for rating hail insurance. Hail only occurs in certain places and under certain conditions. This experience led him to become an actuary like myself.

The growth of natural hazard modeling

- Hurricane modeling is now a big business, not only along the East Coast, but around the world, for rating and catastrophe prediction.
- Hail insurance, which protects mainly corn and tobacco, continues to be modeled for rating purposes.
- Flood insurance is a federal government program, which relies mainly on special flood maps of designated hazard areas.
- Earthquake modeling did not develop until the 1980s, with the development of the modern PC computer. The first model was developed by Karl Steinbrugge, a professor at the University of California, Berkeley.

The Beginning of EQ Modeling

- I had the good fortune to work with Karl in the 1980s.
- After he retired, he was under contract with the California Insurance Department to work with me.
- He developed a Questionnaire which every insurance company in California had to submit each year.
- The insurers supplied the number, type and location of the homes and commercial buildings that they insured for earthquake damage.
- The Questionnaire contained an algorithm to estimate the Probable Maximum Loss (PML) for each EQ zone.

California
was divided
into EQ zones



How was this Questionnaire used?

- Each year, the data from the Questionnaire were compiled and summarized into a published report.
- From this report the CDI could determine the PML for each insurers by location.
- The commercial EQ exposure was greater than the residential exposure, although the residential received the most political attention.
- The CDI could see if an insurer had too much PML (gambling?).
- The Questionnaire did not set rates for EQ insurance.

After an Earthquake

- When an EQ occurred, the Questionnaire was especially useful for identifying insurers that would have the most claims.
- This happened after the 1989 Loma Prieta and the 1994 Northridge EQs. Several insurers were especially hard hit by these events.
- This Questionnaire was useful when insurers submitted an application to start insuring for EQ damage – how much capital would be needed?
- After both these events, the California Legislature considered numerous legislation dealing with EQ insurance.

Growth of EQ Modeling

- With the introduction of the PC computer, two firms were formed to provide EQ modeling in California – RMS and EQE.
- Staffed with seismologists and structural engineers, they could use detailed fault maps from the State Geologist and the USGS, along with ground attenuation knowledge, to estimate the PMLs.
- These models were much more detailed and used much more geological information than the CDI's Questionnaire.
- These models are particularly useful to insurers of commercial buildings and reinsurers.

The need for EQ modeling

- It is very difficult to get a mortgage on a large commercial building without an assessment of the earthquake exposure and PML exposure.
- If the exposure is high enough, earthquake insurance would be required.
- The same type of evaluation of the landslide exposure could be required.
- The commercial exposure includes damage to the building, damage to contents and business interruption (loss of sales and disruption of suppliers).

What do the EQ models need to know?

- The inputs to the EQ models are:
 - The known fault zones
 - The estimated probabilities of events by magnitude and recurrence interval.
 - The regional soil characteristics
 - The expected attenuation, including liquefaction potential
 - The expected damage to building, by type of construction and inventory, called the “vulnerability.”
 - The secondary damage potential, including business interruption
 - The results are highly dependent on the assumptions in the inputs.

The federal program - NEHRP

- The federal National Earthquake Hazards Reduction Program (NEHRP) can be credited with funding the geological, seismological and structural engineering research necessary to the development of the earthquake computer models.
- NEHRP started in 1977 to promote the study of earthquakes, with a view toward promoting mitigation, sound building practices, life safety, and economic recovery.
- NEHRP is the work of four primary agencies: FEMA, NIST, NSF and USGS.

Can Models be Developed for Landslides?

- A landslide model would be more complicated than an EQ model
- Landslides require a “trigger” to cause the earth to slide, such as rainfall or an EQ.
- All of the geophysical and engineering knowledge is available.
- The software would be similar to the EQ modeling software.
- What is lacking is the interest from insurers. Hardly any insurers offer landslide insurance, because of the unknown risk.
- However, a credible model would help change this.

Landslides 101

- According to the USGS National Landslide Information Center, landslides are a serious geologic hazard common to almost every State in the United States.
- It is estimated that in the United States, they cause in excess of \$1 billion in damages and from about 25 to 50 deaths each year.
- Globally, landslides cause billions of dollars in damages and thousands of deaths and injuries each year, particularly in underdeveloped countries.
- Source: USGS website, <http://landslides.usgs.gov> “Landslides 101”

The Focus of USGS on Landslides

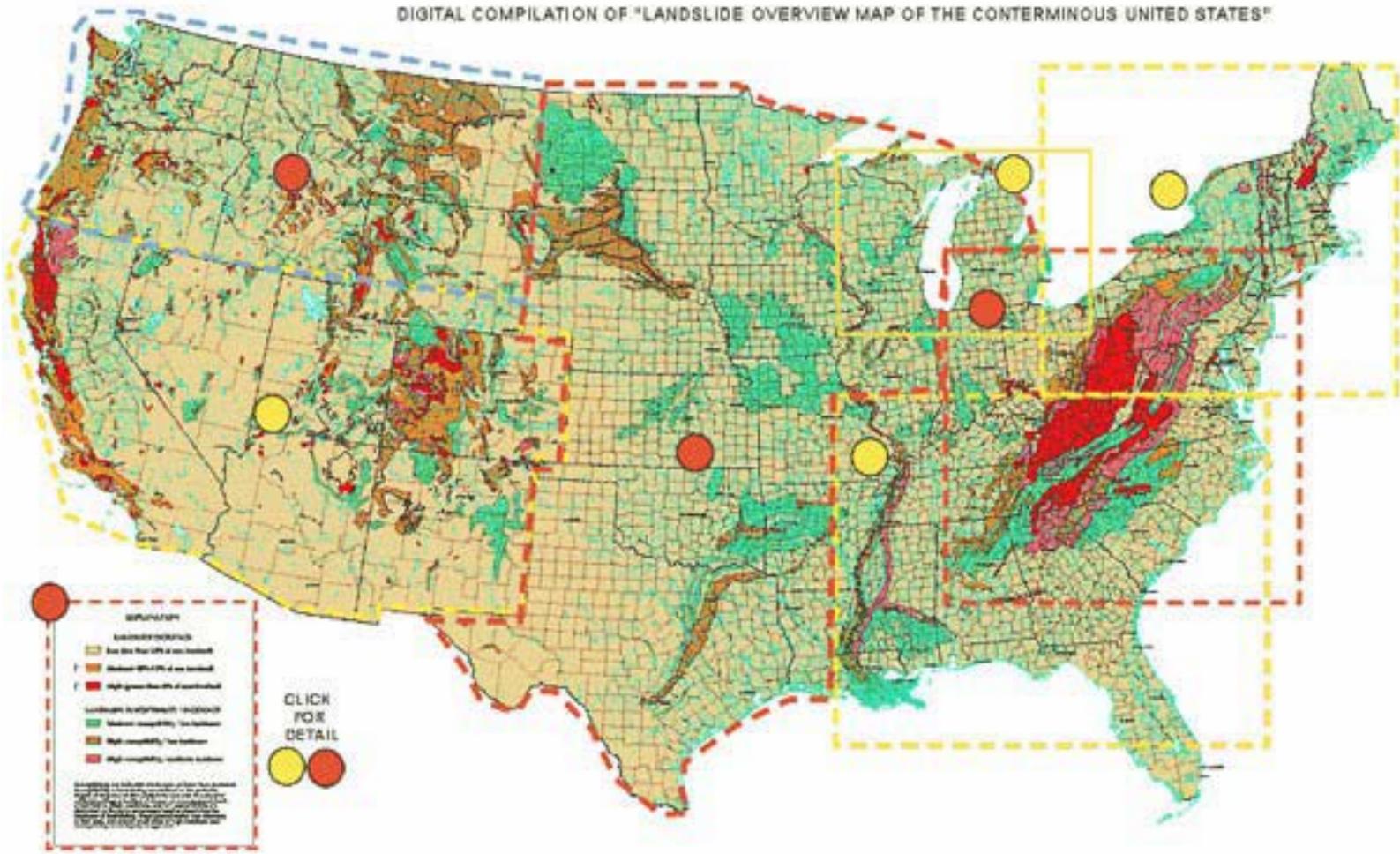
- Advancing public safety
- Investigating past landslides
- Monitoring current sites
- Undertaking research to make accurate landslide hazard maps, and
- Making forecasts of landslide occurrences.

USGS Landslide Hazards Research Program

The results of this research will be particularly useful to insurance companies. This research seeks to answer the major questions:

- 1. When and where will landslides occur?
- 2. How big will they be?
- 3. How fast and how far will they move?
- 4. What areas will the landslides affect or damage?
- 5. How frequently do landslides occur in a given locality?

DIGITAL COMPILATION OF "LANDSLIDE OVERVIEW MAP OF THE CONTERMINOUS UNITED STATES"



Current Landslide Modeling Efforts

- USGS also has a well-established program focusing on landslides, with a section on landslides on its website: landslides.usgs.gov.
- This is the USGS Landslide Hazards Program.
- USGS is developing software for landslide assessments and modeling, with names like Seismic LANDslide Movement Modeled using Earthquake Records - “SLAMMMER,” and
- TRIGRS which is a program relating slope stability to rainfall infiltration.

Homeowners Insurance

- The common Homeowners insurance policy excludes damage due to “earth movement.”
- The primary coverages in an Homeowners policy are fire, burglary and personal liability, all of which can be priced and happen infrequently at any particular home, but often enough that the aggregate future losses can be predicted by actuaries based on past loss statistics.
- With landslide coverage included, the Homeowners policy would be almost a true “all-risk” policy. To have complete insurance coverage for “earth movement,” the policy would have to include earthquake liquefaction and sinkholes as well.

Public Awareness

- In California, when a house is sold, the buyer must be informed if the house is near a known active fault zone.
- With improved landslide hazard maps, the same requirement could be made for designated landslide zones.
- Landslide loss models would also be of great benefit to regional and local governments, for emergency response planning, for land use planning and for maintenance programs responsible for utility water leaks that could contribute to triggering landslide movements.