ONTOLOGY-BASED ENVIRONMENT FOR EARTHQUAKE ANALYSIS AND DESIGN

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The Problem

- Scattered earthquake data sources
- Multiple earthquake data types
- Multiple user types
- Need to access multiple data sources & types
- No single point of access to all data
Damage Example

Severe Damage Suffered by Church in Oaxaca during the M 7.1 Puebla, Mexico Earthquake of September 19, 2017
# Earthquake Data Sources and Data Types

## Organizations (Data Sources)

- USGS
- FEMA
- NIST
- EERI
- CREED Center
- Purdue Univ.
- NICEE
- India
- EPICENTER
- UCL/EEFIT
- UK
- UNISDR
- UNESCO
- GEM
- UNITAR
- WORLD BANK

## Data Types

- EQ Ground Motions/Shaking Intensity Maps/PAGER Data
- Heritage Inventory and Management System, ARCHES etc.
- Observed Earthquake Damage Image Data/Maps
- Survey and Reconnaissance Data/Remote Sensing/GIS etc. Losses
- Post Earthquake Damage/Needs Assessment PDNA
- Disaster Risk, Vulnerability, Risk Assessment, Resilience, Economic Losses Lessons/ and Guidelines

## Earthquake Events

- 2010 Haiti Earthquake
- 2010 Chile Earthquake
- 2015 Nepal Earthquake
- 2016 Philippines Earthquake
Role of Technology

- Remote Sensing / Satellites Imagery/ Aerial photography / Photogrammetry / GIS/ Drones – capture earthquake damage data
- Database systems track and save damage data
- Web-based systems offer access and sharing of data
- Ontologies offer a common representation of knowledge and reasoning capabilities
- Intelligent Agents provide mechanisms to analyze data and provide insights
Approach

➤ Integration of Earthquake data sources
  ◦ Data extraction layer
  ◦ Tools for cleansing, validation & cataloging

➤ Earthquake information model (Ontology)
  ◦ Multiple perspectives
  ◦ Tools for intelligent analysis (Agents)

➤ Data access layer
  ◦ Transparent access to all data
  ◦ Multiple scenarios and configurations

➤ Service-oriented architecture
  ◦ Web-based access
System Architecture

- Identification and Integration of data sources
- Unified model of building information and risk information
- Intelligent analysis tools
- Access to the unified model
- Data Consumers

Data Sources → USGS → EERI → NIST → CREED → GEM → UNITAR → Data Extraction Layer

Integrated Data/Information Model Layer

Intelligent Analysis Tools (Agents)

Data Access Layer

Scenario

Data Consumer 1 → Data Consumer 2 → Data Consumer 3 → Data Consumer 4
System Users

- Researchers
- Planners, Building Officials, Policy Makers
- Government Agencies and Organizations
- Integrated Data Sources
- Designers: Architects, Engineers
- Private Companies, Contractors
- Insurance Companies
Benefits

- Single point of access to many earthquake-related data sources
- Integrated data provide context for better interpretation
- Unified model (ontology) provides a medium for intelligent analysis
- Data access tools for validation, cleansing, scenario development.
- Bigger Picture, Lessons for mitigation against future events, guidelines for repair & retrofit
Conclusion

- Need for integrated data access
- Need for easier view of relevant information
- Proposed system brings together research and practice
- Tools for continuous update and data collection
- Intelligent analysis tools (reasoning)
- Extraction of lessons learned from Knowledge Base of Observed damage and experimental results.
Thank You – Please Come see my Poster!

Today Poster Session:

- **Time**: 5:15 – 7:00 pm
- **Room**: Pasadena (Exhibit Hall)
- **Poster location**: Number 095
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