CENTER FOR HAZARDS RESEARCH AND POLICY DEVELOPMENT
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Improving Risk Assessment Methodology: The University of Louisville and the Disaster Resistant University (DRU) Program

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Abstract

While State and Local governments are required to complete a Hazard Mitigation Plan under the dictates of the Disaster Mitigation Act of 2000 (DMA 2000), Universities are not required by that law to perform similar planning and mitigation activity. FEMA's Disaster Resistant University (DRU) program was intended to encourage and promote mitigation among institutions of higher learning. The University of Louisville received a DRU grant under the second and what was to be the last round of grants of the program, as it was phased out as a designated set-aside of planning and mitigation funding for Universities.

This paper describes the University of Louisville approach to creating a University Hazard Mitigation Plan, and the unique elements of creating a risk assessment and vulnerability analysis for the campus that mirrors similar efforts in state and local hazards planning. The project has been a collaborative effort on the part of the practitioner unit on campus responsible for day-to-day emergency preparedness and safety (the Department of Environmental and Health Safety) and one of the University's research units, the Center for Hazards Research and Policy Development (CHR), a highly active research unit performing theoretical and applied hazards research projects at the local regional and national level.

The project has been successful in creating a method of risk assessment, and classifying the exposure of structures and population. Key challenges have been access to data from various sources within the university, and the ability to assess structural integrity from existing building inventory data. This paper concludes by identifying needs for meaningful risk assessments and robust exposure models, and suggesting research needs that would improve University resilience.

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Introduction

While State and Local governments are required to complete a Hazard Mitigation Plan under the dictates of the Disaster Mitigation Act of 2000 (DMA 2000), Universities are not required by that law to perform similar planning and mitigation activity. FEMA's Disaster Resistant University (DRU) program was intended to encourage and promote mitigation among institutions of higher learning. The University of Louisville received a DRU grant under the second and what was to be the last round of grants of the program, as it was phased out as a designated set-aside of planning and mitigation funding.

This paper describes the University of Louisville approach to creating a University Hazard Mitigation Plan, and the unique elements of creating a risk assessment and vulnerability analysis for the campus that mirrors similar efforts in state and local hazards planning. The project has been a collaborative effort on the part of the practitioner unit on campus responsible for day-to-day emergency preparedness and safety (the Department of Environment5al and Health Safety) and one of the University's research units, the Center for Hazards Research and Policy Development (CHR), a highly active research unit performing theoretical and applied hazards research projects at the local regional and national level.

The DRU Program

The Disaster Resistant University (DRU) initiative was funded by the Federal Emergency Management Agency (FEMA) to encourage institutions of higher learning to reduce the risks of losses from natural hazards. In round one, six universities participated in the national pilot

Disaster Resistant University grant program: Tulane, University of North Carolina, Wilmington, University of Miami, Florida, University of Washington, Seattle, University of Alaska, Fairbanks, and the University of California, Berkeley. In round two of funding, FEMA awarded over $3.4 million for pre-disaster mitigation planning activities and projects to over 20 universities on a competitive basis, which included the University of Louisville.

The University of Louisville's DRU project has the primary goal of increased university preparedness, accomplished through these six objectives:

1. Create a University level DRU Committee. The committee consists of personnel appointed by the President from the Department of Environmental Health and Safety (DEHS), Physical Plant, Public Safety (University Police), the University Fire Marshall, Provost's Office, Office of Communication & Marketing, Vice Provost for Diversity, Center for Hazards Research and Policy Development, as well as members from the community: Louisville Metro Emergency Management Agency and the Area 6 Coordinator of the State Emergency Management Agency.

2. Complete a Risk Assessment and Vulnerability Analysis. A risk profile will be created for each anticipated hazard and a building by building risk assessment plan will be generated. The vulnerability analysis will look into potential losses for various hazards.

3. Database architecture design and implementation. A digital database will be created to include all the data collected on each building. This database will contain attribute data with geo-spatial and hazard profile data.

4. Faculty/Staff/Student Survey. An online survey will be conducted to assess the understanding of risks posed by natural hazards on the university and mitigation efforts.

5. Tabletop Exercise. The University will conduct two tabletop exercises to ensure that mid and upper management know about the University's disaster management plans and can implement them efficiently.

6. Communication to the University Community. Communication in the form of brochures and web pages will be made for effective communication to the university community about mitigation plans and efforts.

The University of Louisville is located in Kentucky's largest metropolitan area, and has two main campuses. The 274-acre Belknap (main) Campus is three miles from downtown Louisville. The Health Science Center is in downtown Louisville and houses the university's health related programs and the University of Louisville Hospital. Due to Louisville's geology, climate, and geographical setting, the metro area is vulnerable to a wide array of natural hazards.

The UofL Approach - Risk Assessment & Vulnerability Analysis

A risk assessment is the crucial component for reducing risk and making resource allocation decisions that will improve the safety of the university and reduce losses should an event occur. An assessment involves identifying the hazards to which the campus is prone, evaluating the full extent of those risks, taking into account whatever precautions have already been taken, and the implementation of mitigation and control measures.

As traditionally performed in other planning processes, the process of risk assessment includes four steps: 1) identify potential hazards; 2) profile hazard events; 3) inventory all assets (on campus); and 4) estimate potential losses.

Identify potential hazards: The Center for Hazards Research and Policy Development identified local hazards by using definition in the city's (Louisville Metro) All-Hazard mitigation plan. That plan identified 12 natural hazards, which included: Earthquake, Dam Failure, Flood, Sinkhole and Karst, Tornado, Wildfire, Winter Storm, Landslide, Severe Storm, Hail, Drought, and Extreme Heat.

Profile hazard events: Once hazards are identified, the next step is to investigate the local history of natural hazards. The University of Louisville has been impacted by Tornadoes in 1974, flooding in 1937, 1993 and 1997, and an ice storm in 1994 that closed the University for a week. A review of the Louisville Metro Local Hazard Mitigation Plan showed Presidential Declared Disasters as a result of Tornadoes, Severe Storms, Flooding, Blizzards, and Landslides.

Inventory all assets on campus: To complete an inventory of assets, a digital database needed to be built for every building on the two campuses. The database was developed in a GIS format (Shapefile) for use within ArcGIS 9. The database contains the official building name, building number, construction year, building elevation, original cost of construction, estimated replacement cost, renovation cost and year, area covered by each building, number of floors, number of basements, number of elevators, and the current building condition. Using this attribute set, a campus base map has been developed using ArcGIS. The base map and the use of GIS allow the ability to create various hazard and loss estimate scenarios. Using the base map and the digital database, CHR determined the vulnerability of each building on campus. Those variables are described here.

Population: The University Planning, Design and Construction Center (UPDC) sent data that indicated by-room allocation of students/staff, and square footage of buildings. Cumulative

totals were determined for the building. For buildings that did not identify population, the estimate of *1 person per 120 square feet* served as a proxy measure.

Cost: Total cost is the total replacement cost, which is the sum of the insured value of the building structure and the insured contents in the building.

Laboratories: The University's Lab Safety Coordinator provided data regarding refrigerators, freezers, autoclaves, Bio Safety Cabinets, lasers and X- rays in each of the labs on campus. Additionally, data was included on radioactive carcinogens and other harmful chemicals being used on campus. The basis of the ranking for the buildings is directly related to the presence or absence of hazardous chemicals.

Construction Type: UPDC had performed a building survey in 1996 that described the construction types for many of the buildings on campus. These are based on the Kentucky Building Code Section 215: 1 – Fireproof; 2 – Non Combustible; 3 – External Masonry Wall; 4 – Frame; 5 – Heavy Timber.

Current Building Conditions: UPDC provided CHR with data on current building conditions. The data was developed by using the National Center for Higher Education Management System (NCHEMS) building condition codes:

1. Satisfactory: Suitable for continued use with normal maintenance. Any single item of major maintenance or capital renewal is not greater that $40,000. (Catastrophic failures expected)
2. Remodeling – A: Requires restoration and/or replacement of some building system components in order to meet acceptable standards without major room use changes, alternations, or modernizations. The approximate cost of "Remodeling A" is not greater than 25 percent of the estimated replacement cost of the building.
3. Remodeling – B: Requires major updating and/or modernization of the building. The approximate cost of "Remodeling B" is greater than 25 percent, but not greater than 50 percent of the estimated replacement cost of the building.

4. Remodeling – C: Requires major remodeling and total replacement of the major building system components. The approximate cost of "Remodeling C" is greater that 50% of the replacement cost of the building.
5. Demolition: Should be demolished or abandoned because the building is unsafe or structurally unsound, irrespective of the need for the space or the availability of funds for replacement. This category takes precedence over categories 1, 2, 3, and 4. If a building is scheduled for demolition, its condition is recorded as "demolition," regardless of its condition.
6. Termination: Planned termination or relinquishment of occupancy of the building for reasons other than unsafeness or structural unsoundness, such as abandonment of temporary units or vacation of leased space. This category takes precedence over categories 1, 2, 3, and 4. If a building is scheduled for termination, its condition re recorded as "termination," regardless of its condition.

Critical Buildings: "Critical buildings" were identified as the campus police, fire, and emergency operations buildings along with the campus's major power supply buildings.

The above variables allowed a ranking of each building for each variable, providing a vulnerability ranking. Each variable was broken down into five categories using the Jenks classification method in ArcGIS. (See Map 1 for an example)

Loss Estimation: The final step of the risk assessment computes loss estimates. The University has low exposure to flood zones, landslide prone areas, or major karst areas, eliminating the true loss estimation step in the risk assessment process. A different approach was required. Even without a true loss estimation scenario, the vulnerability variables can be assessed to determine which buildings would incur the most losses during a crisis or disaster event.

Results

The project experience has indicated the need for collecting and managing University data in one common database. For this project, GIS was the appropriate database architecture. Prior to this project, the University had never compiled this type of data in this format. The experience is thought to be similarly true in many other Universities. The methodology allowed

users to examine individual vulnerability scenarios, or the ability to view total vulnerability. The information can improve decision making, by increasing functional capability on a response basis, or by reallocating staff and resources to reduce identified risks.

The final results being compiled in a GIS architecture allow the data to be housed in a powerful database management system and provides the data to be displayed in a visual map. The base map provided the base layer for the hazard identification process. CHR discovered that the University was not threatened by any hazard that could be mapped in a boundary condition (e.g., floods, landslides, and karst-- See Map 2 for Flood Map), but it could still get flooded due to excessive rains -- as in 1937-- even though it is not in a floodplain. Sections of the university could also be impacted by an earthquake. In 1977, an earthquake along the Wabash Valley Fault in Southeastern Illinois was felt in much of the Midwest and caused at least one chimney to fall in Louisville. Most seismic activity in Kentucky has occurred in the western portion of the State near the New Madrid seismic zone, and with the exception of the 1811-1812 New Madrid earthquakes, no other earthquakes have caused significant damage in Louisville.

The GIS architecture also facilitated the inventory of assets. There are distinct advantages in the ability to visualize on a map which building is more vulnerable to a fire via the "Construction Type" variable and which building has the most equipment via the "Cost" variable. Lastly, the GIS architecture allows for a model to calculate building-by-building vulnerabilities via the digital database created for the vulnerability assessment.

Areas of Improvement and Future Research

The lack of good population was an area of concern for this study. This was an area where it was assumed there would be accurate data, but this was not the case. In the future a more accurate count of population would be beneficial as well as knowing the population

changes throughout the day. Another area of improvement is the missing data for some buildings that was discovered in many of the variables. In the future these data gaps would need to be filled to prepare a better campus wide vulnerability model.

The next steps for the DRU process at UofL include taking the risk assessment section and writing the Hazard Mitigation Plan. The risk assessment will provide the stakeholders a basis to complete and prioritize mitigation actions for the University. Through the stakeholder meeting process there have already been discussion of alternative power supplies and the need for satellite phones for first responders. Following the completed Hazard Mitigation Plan, an online survey will be conducted to evaluate the knowledge level of natural hazard risks among staff and students. As a final component, two tabletop exercises will be carried out to ensure that the university community understands the process and the issues in the disaster management plans.

One particular research need is a systematic evaluation of the state of Universities on a preparedness continuum. Universities have a duty to students, faculty and staff, and it is clear that there are few standards of preparedness, and fewer guides, that would assist institutions of higher learning to advance their academic community's preparedness and resilience.

Conclusions

The DRU project has provided UofL with the first step in becoming a safer and more prepared campus. In order to protect the lives and property supported by the University, it is crucial that a clear picture of threats and vulnerabilities is available. A completed risk and vulnerability analysis also provides a multi-layered central database that can be used for many other activities. One need step in the near future will be to integrate the centralized GIS effort with facility management efforts, which would allow more efficient use of resources, while simultaneously increasing the resiliency of the campus community.

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