Local Resilience of Community Water Systems and Severe Weather Patterns

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Roadmap of Discussion

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Abstract

Natural disasters and changing patterns of severe weather events are presenting mounting challenges for communities who need to define and agree upon a resilience plan.

To respond to this need, an on-line decision support system tool for deliberative risk ranking was tested on the Community Water Systems of two coastal communities in the US. This tool, by breaking down the risk ranking process into phases, reconciles local experiences with recorded hazard scenarios.

Water system risks defined and prioritized qualitatively in a first phase, are recursively compared to the effects that past local hazards had on the local community. The process enables communities to prepare for climatologically induced changes and to prioritize the actions they can take locally to protect valuable systems and resources.
Acknowledgements

• Vulnerability Assessment Support System:
  – Brent Yarnal, Penn State University
  – Peter Howe, QCNR-Utah State University

• Semantic Vulnerability Upper Model:
  – Chunn-kit Ngan, Penn State
  – Antonio De Nicola, ENEA – Italy

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  – NOAA ‘s Climate Program Office
  – SM Resources
  – Syneren Technologies Corp
Outline

- Focus Group Methodology
- Vulnerability Assessment Experiment
- Process Model Quality Parameters (complete, transferrable, verifiable)
- CWS Risks in Relation to Weather and Climate
- Vulnerability Assessment Collaborative Environment: Key features of fact based decision making
Focus Group Methodology

Phase 1: Issue definition
- Recruit participants from system stakeholders

Phase 2: Risk identification and ranking
- Individuals list and define risks
- Individuals rank risk severities and probabilities
- Group compiles consensus risk list
- Group ranks risk severities and probabilities
- Individuals assign vulnerability dimensions to risks
- Group assigns vulnerability dimensions to risks

Phase 3: Visualizing results
- Display risk ranks in vulnerability scoping diagram

Web-based Risk Analysis System (WRAS) from SYNEREN
Focus Group Output

Risks are prioritized according to:
- Probability
- Severity

Risks are categorized by vulnerability dimensions:
- Exposure
- Sensitivity
- Adaptive Capacity

Probability and Severity provide transferrable information on local experiences.

Vulnerability dimensions facilitate the compilation of a complete list of risks by the focus group and describe how risks are perceived.
Scoping Diagram (P-VSD)
Risks in Relation to Severe Weather

Weather accounts for 2/3 of the vulnerabilities to community water systems

Total Risk Factors 66

<table>
<thead>
<tr>
<th>Risk Type</th>
<th># of Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiple Causes</td>
<td>25</td>
</tr>
<tr>
<td>Drought</td>
<td>6</td>
</tr>
<tr>
<td>Flood</td>
<td>3</td>
</tr>
<tr>
<td>Indirect</td>
<td>5</td>
</tr>
<tr>
<td>Not Related</td>
<td>17</td>
</tr>
</tbody>
</table>

February 5th, 2014
Data Output Visualization

Dates, Events, Severity, Damages

Local Station Historical Records (temp, Precipitation)

Hazards by Frequency and Damage Values ($)

Vulnerability Assessment Support System

History of Local Hazards

Monthly Maximum Temperatures

SYNEREN
Delivering High Performance

February 5th, 2014
Semantic Web Service
### Fact Finding for Planning

#### Example of Risk Scenario: flood water enters drink water system

<table>
<thead>
<tr>
<th>Vulnerability Type</th>
<th>Definition and Use Case Scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensitivity</strong></td>
<td>Design requirements fail under unfavorable conditions (e.g. Water contamination exceed filtration ability, Flood level tops water source barriers)</td>
</tr>
<tr>
<td><strong>Exposure</strong></td>
<td>Identify points of entry into system (e.g. Flood water enters one or more of the system intakes)</td>
</tr>
<tr>
<td><strong>Adaptive capacity</strong></td>
<td>Sensitivity and exposure define range of available actions (e.g. Access alternate water system, Boil water)</td>
</tr>
</tbody>
</table>
Summary

• Vulnerability assessment protocols can be adapted to web-based tools
• Web-based Vulnerability Assessments can be complete and transferrable
• Critical to define verification methods are needed to reconcile viewpoints of multiple stakeholders (expert knowledge, planners, users)
• Semantic Web and Recommendation Algorithms Provide Viable Solutions to Verification and Planning
“Even in a world too complex to fully describe, rules that express learnable regularities can be acquired”

(Leslie Valiant “PAC: Nature’s Algorithms for Learning and Prospering in a Complex World”)