Establishing Trust Management in an Open Source Collaborative Information Repository: An Emergency Response Information System Case Study

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Outline

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The Problem

• Emergency response often requires collaboration among professionals, volunteers, and untrained observers who have never worked together before

  – Challenges:
    • Information provided by various participants is of varying accuracy
    • Rapid processing of incomplete and sometimes contradictory information
    • Allocating critical resources to the most important response needs
Study Objectives

• Automatic and transparent mechanism able to estimate trustworthiness of collaboratively generated emergency response information
• Identify risks properly and communicate them effectively
• **Research Question:** How to enable trust management in an open source collaborative information repository for an emergency response situation while still maintaining the ease and efficiency of user contributions?
Why Open Source?

- It is argued that open source is not suitable to Emergency Response projects [1,2]. But,
  - Cost: The system is free to obtain and low cost to maintain
  - Adaptability: Allows quick set up and adoption [3]
  - The success of SAHANA, an open source emergency response information system developed in Sri Lanka immediately after the Indian Ocean Tsunami

Adopted Version of Drupal

Event

Submitted by admin on Sun, 04/13/2009 - 16:21.

This is an Event page. This page can be used to describe the overall event. Individual incidents that are caused by the event can be added by selecting the Add child page option at the bottom left-hand part of the page.

If you want to add content to the overall Event description, please select the Add new comment option at the bottom right-hand part of the page.

- Current Status
- Haz Mat - Gas Spill
- Sample: Broken Gas Main

Current Status

Event - Olive Incident

Submitted by admin on Wed, 04/22/2009 - 08:18.

admin

This is a mass casualty drill for the Olive Incident.

A vehicle has struck a building.

Monrovia City EOC has been activated

Login or register to post comments
Adopted Version of Drupal

Three Main Parts of the System
Adopted Version of Drupal
Why is Trust an Issue?

• Trust builds reliance and cohesion within a community which promotes open, substantive, and influential information exchange [4].

• Trust has become an important interdisciplinary research area [5]
  – Sociology: Social structure
  – Psychology: Personal trait
  – Economy: Mechanism of economic choice and risk management


Characteristics of Trust

- **Trust is Subjective**: Every individual makes his or her decision to trust or not [6].
- **Trust is Context Dependent**: Trust in one environment does not transfer directly to another environment [7].
- **Trust is a Composite Property**: Composition of different factors depending on the environment [8].
- **Trust is Dynamic**: Influenced by factors, events, or changes in context [9].
- **Trust is Measurable**: The level of trust can be represented by a continuous real number [9].


Proposed Trust Model

- Based on trust\risk framework called SECURE
- 3 Important Components
  - Trust Calculator
  - Risk Evaluator
  - Evidence Store
Proposed Trust Model-Trust Calculator

- **Trust Calculator**: Uses 2 factors
  - Author Trustworthiness: The individual who provided the information (Professional, Certified volunteer, or untrained observer)
  - Information Timeliness: A piece of information may lose its validity over the course of minutes based on the dynamic nature of a particular situation.

- **Output**: A Continuous real number trust value representing confidence in information content.
The degree of trust implies a certain amount of risk an entity may or may not accept.

<table>
<thead>
<tr>
<th></th>
<th>Low Trust</th>
<th>High Trust</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Risk</strong></td>
<td>Response depends on available resources If there is good availability then full response for that type of incident If there is poor availability then limited response for that type of incident</td>
<td>Full or greater response</td>
</tr>
<tr>
<td><strong>Low Risk</strong></td>
<td>Send one fire engine to investigate</td>
<td>Full response for that type of incident</td>
</tr>
</tbody>
</table>
Proposed Trust Model-Evidence Store

• **Evidence Store:** Contains
  - Trust factors and their weights in the relevant context
  - Knowledge acquired from similar prior incidents
  - City Zoning Guidelines
Proposed Trust Model
Evaluation of the Model

- Case study based on a mass casualty drill and small city Emergency Operations Center (EOC) activation. EOC activation included:
  - City of Monrovia: Fire Department, Police Department, and all departments as part of the EOC
  - Monrovia Unified School District
  - Schafer Ambulance
  - American Red Cross: Disaster Coordinator
  - Arcadia Methodist Hospital
Evaluation of the Model

• **Usage:** Decision support tool for all agencies participating the drill

• **Desired Output:** Timely action plans for specific types of incidents based on level of trust and risk
  – **Requirement:** Pre-loading evidence store with response policies, rules, and pre-action plans

• **Expected Benefit:** Reduce response times
Evaluation of the Model

• Trust Issues:
  – Main Issue: Information inaccuracy
  – Communication Difficulties: Lower trust

• Suggestions:
  – Establishing checkpoints within certain time intervals to verify information accuracy and provide corroboration
  – Establishing a common terminology among drill participants [10,11]


Evaluation of the Model

• Risk Assessment
  – **Purpose:** Meaningful risk based guidance to help emergency responders decide best course of action
  – **Issue:** Based on field experience that may not be a part of training activity
  – **Suggestion:** Transforming tacit knowledge into explicit knowledge and storing explicit knowledge in a repository
Evaluation of the Model

• Study Limitations
  – The proposed model is more appropriate to larger incidents because small incidents are cleared before the application or resources could be deployed
  – The proposed model may not be applicable to other situations because trust is context dependent
Conclusion

• Trust is difficult to understand
• Information is volatile in an emergency environment due to rapid changes in conditions
• Trust calculator and risk evaluator mechanisms together with corroborative evidence might assist emergency responders with resource allocation decisions
Comments & Questions

Thanks for your attention!