



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

HICSS-42

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Outline

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- Study Objectives
- Why Open Source?
 - Adopted Version of Drupal
- Why is Trust an Issue?
 - Characteristics of Trust
- Proposed Trust Model
- Evaluation of the Model
- Conclusion
- Comments & Questions



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


[1] P. Currion, C.D. Silva, and B.V.D. Walle “Open source software for disaster management”, Communications of the ACM Special Section: Emergency response information systems: Emerging trends and technologies, 50(3), 2007, pp.61-65.

[2] P. di Maio, “An Open Ontology for Open Source Emergency Response System,” Retrieved on June 5th 2008 from MIT Web site: http://opensource.mit.edu/online_papers.php?lim=1000


[3] P. Currion, C. de Silva, and B. Van de Walle, “Open Source Software for Disaster Management,” *Communications of the ACM*, vol. 50, pp. 61-65, 2007.

Adopted Version of Drupal



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Communication System

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THIS is a mass casualty drill for the Olive Incident

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Three Main
Parts of the
System



Adopted Version of Drupal



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Event - Olive Incident

Submitted by admin on Wed, 04/23/2008 - 08:39.
admin

THIS is a mass casualty drill for the Olive Incident

A vehicle has struck a building.

Monrovia City EOC has been activated

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Incident Name

Source of Information

Actions Needed

Time Stamp

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

[4] S.L. Jarvenpaa, K. Knoll, and D.E. Leidner, "Is anybody out there? Antecedents of Trust in GlobalVirtual Teams," *JMIS* vol. 14, pp. 29-64, 1998.

[5] Yan, Z. and S. Holtmanns, "Trust Modeling and Management: from Social Trust to Digital Trust," Book chapter of *Computer Security, Privacy and Politics: Current Issues, Challenges and Solutions*, IGI Global, 2007.

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].

[6] R. C. Mayer, J. H. Davis, and F. D. Schoorman, "An Integrative Model of Organizational Trust", *The Academy of Management Review* (20)3, 1995, pp. 709-734.

[7] A. Josang, E. Gray, and M. Kinateder "Simplification and Analysis of Transitive Trust Networks. *Web Intelligence and Agent System*". 4(2), 2006

[8] T. Grandison and M. Sloman "A Survey of trust in internet applications", *IEEE Communications and Survey*, 3(4), 2000, pp. 2-16.

[9] Y. Sun, W. Yu, Z. Han, and K.J.R. Liu, "Information Theoretic Framework of Trust Modeling and Evaluation for Ad Hoc Networks," *IEEE Journal on Selected Area in Communications*, vol. 24, pp. 305-317, 2006.

Proposed Trust Model



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



- **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.

Proposed Trust Model-Risk Evaluator



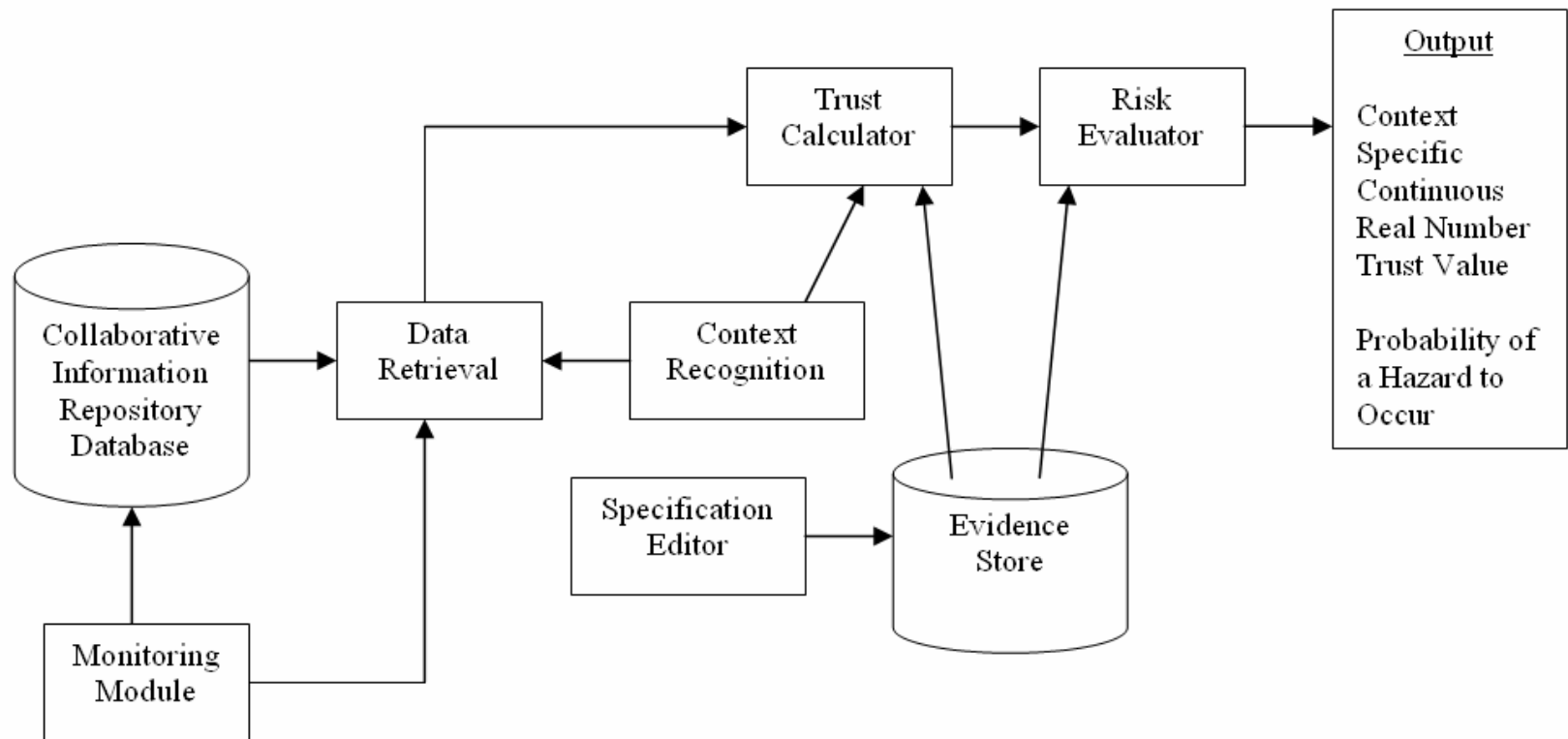
- The degree of trust implies a certain amount of risk an entity may or may not accept.

	Low Trust	High Trust
High Risk	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	Full or greater response
Low Risk	Send one fire engine to investigate	Full response for that type of incident



- **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]

[10] Z. O. Toups and A. Kerne, "Implicit Coordination in Firefighting Practice: Design Implications for Teaching Fire Emergency Responders," Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, San Jose, California, 2007.

[11] G. A. Bigley and K. H. Roberts. "The Incident Command System: High-Reliability Organizing For Complex and Volatile Task Environments," *Academy of Management Journal*, vol. 44, pp. 1281-1300, 200



- 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



- 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!