Decision-Support in the Wild: A Qualitative Study on How First Responders Use Technology for Rapidly Identifying Toxic Chemicals

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Abstract

Although many decision-support applications have been developed for assisting first responders to rapidly identify toxic chemicals during emergencies, little is understood about the contexts in which such tools are used. We therefore conducted semi-structured interviews with 20 first responders across two US states in an effort to understand their task contexts during a chemical incident and their use of decision-support tools. The results revealed three intersecting themes: the plurality of roles played by first responders, the combination of assorted tools used, and the multiplicity of conditions triggering the need for technology-assisted decision-support. These themes help to describe the complex information flow involved, in addition to providing design implications for future tools that can support more effectively complex decision-making in emergency situations.

Introduction

First responders use a wide range of decision-support tools to rapidly and accurately identify toxic chemicals in emergency situations such as terrorist attacks and chemical plant incidents. However, little is understood about the combination of tasks such tools support, and the contexts in which they are used. Here we describe preliminary findings from semi-structured interviews with 20 first-responders recruited from fire departments, emergency management teams in hospitals, and chemical plants across two US states.

Method and Results

Because it is practically difficult to directly observe a toxic chemical incident, we conducted semi-structured interviews with first responders. We used a snowball method to identify interview participants starting with an initial sample of first responders, who then helped us identify additional participants to recruit. The participants were asked to describe their role as first responders, and the context, tasks, and tools they used during a chemical incident which was potentially hazardous to humans. The interviews were audio-recorded and transcribed, and subsequently analyzed using the grounded theory approach.[1] To comprehend the complex flow of information during a toxic chemical incident, we used a directed bipartite network consisting of nodes representing the environment, actors, or tools, and directed edges between the nodes representing information flow (Figure 1). The interpretation of the results was verified by an expert first responder (CW).

Preliminary analyses of the transcripts helped to identify three intersecting themes. (1) The **plurality of roles** that most first responders play during emergency response. For example, a hazmat technician stated that he played three roles during an incident including scene response, chemical assessment, and hazmat training, out of a total of 11 different roles identified across all participants. (2) The **combination of assorted tools** used during most chemical incidents. For example, Figure 1 shows the use of a combustible gas indicator, a pH meter, and tools in a lab to assist human judgment in determining the nature of a liquid in an abandoned truck. (3) A **multiplicity of triggers** for using decision-support tools for toxic chemical identification such as WISER.[2] The first responders reported 7 possible triggers for using a decision-support tool including the absence of a sample or Hazmat id, and suspected errors or lack of reading from meters. These results help to define the space of possible combinations of roles, tools, and triggers, which could guide the design of future decision-support tools.[2] In our future research, we will use this emergent framework to develop interfaces that are adaptable to the different roles, and are capable of integrating information from multiple chemical-detecting devices.

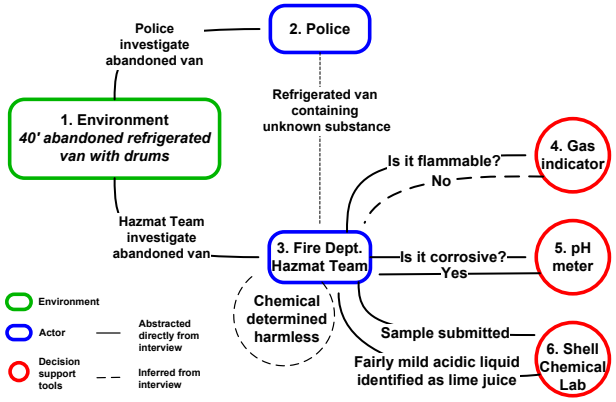

Figure 1. A directed network showing how information flowed between the environment, actors, and decision-support tools during a chemical incident of a suspicious liquid in an abandoned truck.

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References

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