

Visualize to Realize: Improving Safety of First Responders

Vikas Sahu, Ann L. Fruhling, PhD

Introduction

The goal of this study is to improve the safety of first responders during an emergency hazardous material (hazmat) incident.

- A first responder (FR) is an individual who arrives first during a hazmat incident and takes the initiative to act in order to minimize the risk to public health and property from such incidents. Often first responders are firefighters.
- The reports of National Fire Protection Association recorded a national average of more than 30,000 firefighter injuries between 2010-16 (National Fire Protection Association, 2017).
- According to the US Fire Administration, an average fatality of 120 firefighters were recorded between 2010-16 throughout the nation. In 2017, a total number of 81 fatalities were recorded. (FEMA, Department of Homeland Security, 2017).
- In order to ensure FRs' safety, the IC at the incident command and control center monitors critical information about first responders and local environment.
- In the state of Nebraska, the IC uses a dated system with two displays with different information required to monitor the scenario. The user interface of these displays often have slow response times. (Shearer & Bernard, 2017).

Purpose of Research

The purpose of this experimental study is to develop and evaluate the usability of a new dashboard integrating critical information about first responders' health and safety for an incident commander to monitor and make decisions.

At this stage, the dashboard will be generally defined as a visualization tool that will help to reduce cognitive load for the incident commander during emergency situations and improve decision making capability regarding safety of first responders.

Problems

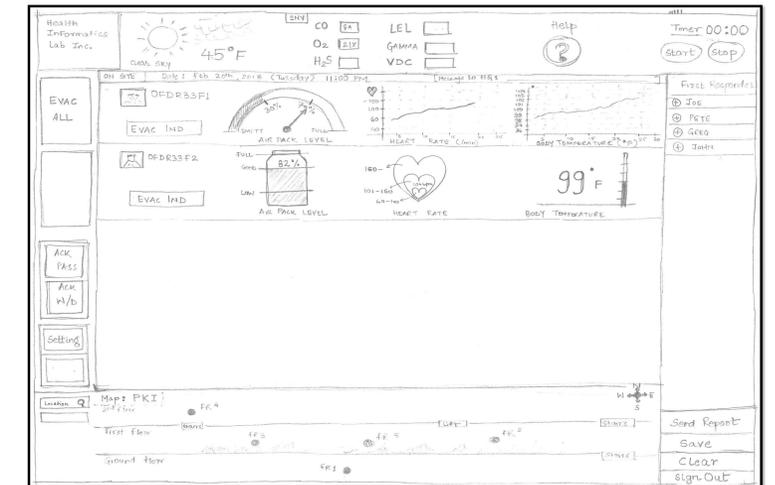
- Data integration problems** – The critical data about FRs and incident environment are displayed on **two different** screens because each system has its own user interface, which makes it difficult to make effective decision during emergencies.
- Current technology is dated** – The user interface works on a Windows XP platform with limited processing capabilities that gets updated in a time interval of 45 seconds. This implies that the data available to IC about FRs is often not available until after 20 steps have been taken and thus potential exposure to hazardous materials may have already occurred before the FR is aware.
- Incident commander experiences cognitive overload** – There is a constant exchange of critical data between FRs and IC during emergencies. The visualization of so much data on separate displays leads to cognitive overload for IC.
- System user interface usability issues** – The dated user interfaces for the current systems have several problems such as: not well organized, do not match the emergency management work, poor navigation, etc.

Problem: Too much information to absorb

Problem: Captures information only about Air Pack level: Not Sufficient



Prototype Design Sketch



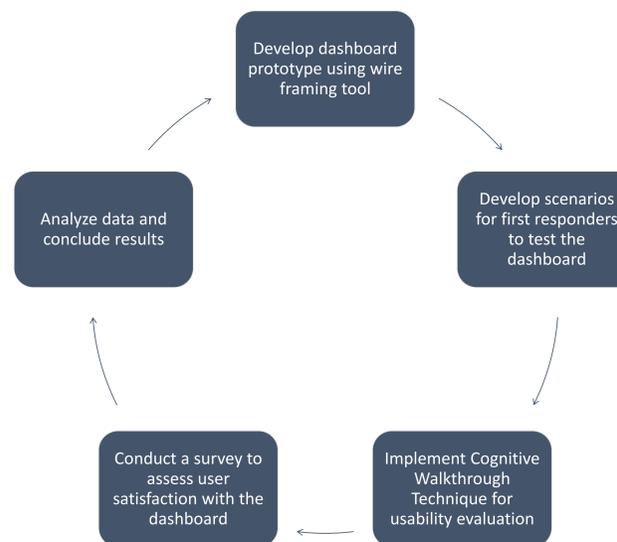
Current Work Flow



Research Question

What are the most critical dashboard display design features that will optimize the performance and decision making of an incident commander during a hazmat response situation?

Research Design



Projected Contributions from this Research

Several contributions from this study are anticipated such as:

- Integrated user-interface of dashboard will reduce the cognitive load of Incident Commander (IC) during emergencies.
- Visualization of critical data (for FR's and incident environment) on a single screen will allow IC to make efficient decision for first responders.
- Integration of critical data into a single screen will improve the usability of the dashboard.
- Overall, we hope the new dashboard will help in improving the safety of first responders during hazardous incident responses.

Future Work

The future work for this study includes the following steps:

- Transformation of final screen sketches into dashboard prototype using a suitable wire framing software package.
- Usability evaluation of the dashboard prototype in a simulated scenario-based test environment using Cognitive Walkthrough Technique. Cognitive Walkthrough technique is used to determine the ease with which a new user will learn to interact with a computer-based information system.

This research is being conducted in collaboration with the Special Operations Team, Omaha Fire Department, who are responsible to contain hazmat incidents in the Omaha Metropolitan Area.

Acknowledgement

Funding for this research is supported through a US Department of Transportation, University Transportation Center (UTC) Competition 2016 award.

References

- National Fire Protection Association. (2017, June). Firefighter activities, injuries, and deaths. Retrieved from National Fire Protection Association: <https://www.nfpa.org/News-and-Research/Fire-statistics-and-reports/Fire-statistics/The-fire-service/Fatalities-and-injuries/Firefighter-activities-injuries-and-deaths>
- Shearer, S., & Bernard, W. (2017, Nov 10). Safety and Information Technology Division. (A. Fruhling, & V. Sahu, Interviewers)