Extracting Episodes as a Trace of Resilient Performance of Multi-Agency Incident Management Systems

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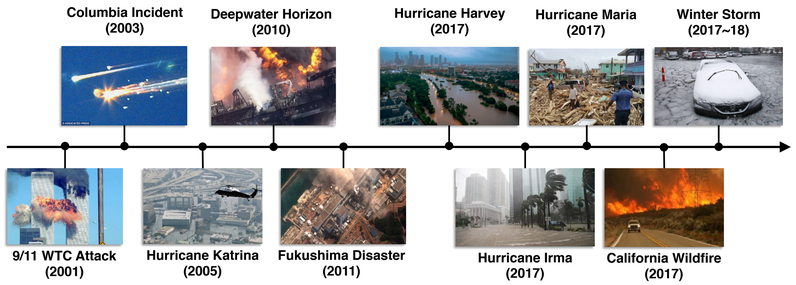
APPLIED COGNITIVE ERGONOMICS LAB
RIHM Research on the Interactions between Humans and Machines

1. Introduction

Limitations in Managing Risks from Disasters ➡
- Civil
- Technical
- Natural

'Prevention' is the best policy but often societies have to 'manage' the disasters once they occur.



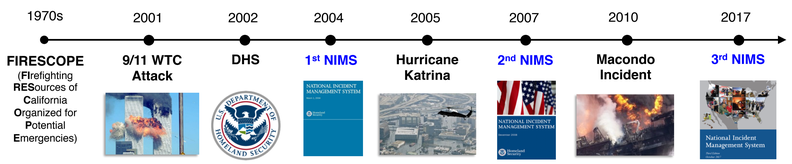
2. Background

Multi-Agency Incident Management System (MAIMS)

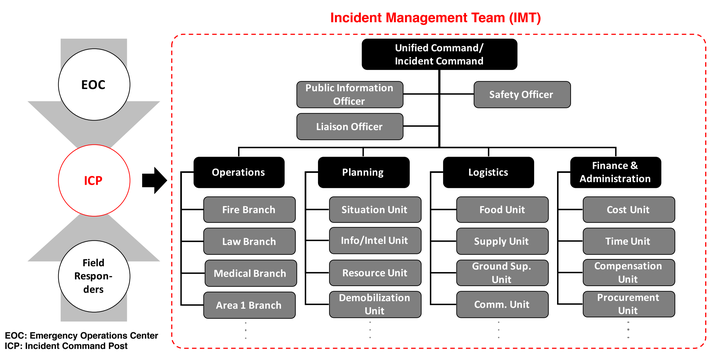
An overarching term for an IMS with the following features:

- ***Multi-Agency***: multiple **agents/agencies, jurisdictions, organizations, and disciplines**.
- ***Incident***: a general term for an event that needs to be controlled (i.e., **emergency, disaster, crisis and planned event**).
- ***Management***: all IM phases including **prevention, protection, mitigation, response, and recovery** (PPMRR).

The U.S. National Incident Management System (NIMS) (DHS, 2017) is a MAIMS.

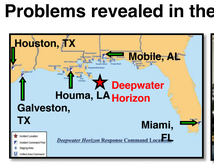


NIMS Generic Structure (DHS, 2017)



EOC: Emergency Operations Center
ICP: Incident Command Post

Problems revealed in the Management of Macondo Incident (U.S. Coast Guard, 2011)



Source: The National Response Team, 2011

Source: C-SPAN (https://youtu.be/_ctvFT_Sq7w)

- **Lengthy information delivery** across levels of emergency response organizations
- **Persistent information request** (**backlog**)
- Difficulty of establishing and running **information handling units (e.g., Situation Unit)**
- **Lack of accuracy and currency** of information

3. Resilience Engineering

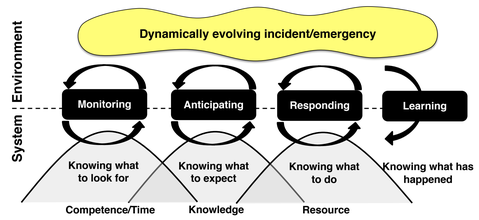
What is Resilience?

A Definition
(Hollnagel, 2011, p. xxxvi)

"The intrinsic ability of a system to **adjust its functioning** prior to, during, or following **changes** and **disturbances**, so that it can **sustain required operations** under both the **expected** and **unexpected conditions**."

***'MARLing'* of Resilience**
(Hollnagel, 2011)

Four processes of a resilient system
- **M**onitoring
- **A**nticipating
- **R**esponding
- **L**earning



Research Questions

- **How is resilience manifested in an incident/emergency context?**
  - ✓ In other words, identifying resilient performance of the MAIMS.
- **What are patterns of the resilient performance?**
  - ✓ **Interactions**: human-human and human-technology
  - ✓ **Technologies**: relationship between technology and performance
  - ✓ **Challenges**: barriers to resilient performance

4. Method – Data Collection

Data Collection Methods

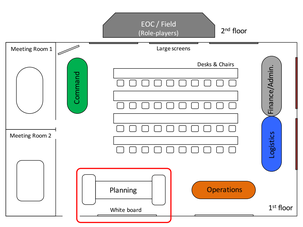
- **Individual Shadowing:**
  - **Five Observers**
  - **Tool used: "Dynamic Event Logging and Time Analysis (DELTA)" developed by Dr. Sasangohar**
- **Audio Recording: 12~20 Voice recorders attached to participants**
- **Video Recording: 2~4 camcorders and 9~12 computer screen capture**

DELTA

Research Facility: TEEX Emergency Operations Training Center (EOTC)

Simulated High-Fidelity Incident Command Exercises

Source: https://teex.org/Pages/services/emes.aspx



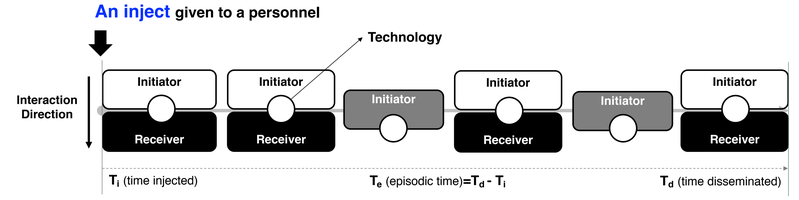
1st /2nd Data Collection Overview

- **Period: (1st) June 13 ~ 15, 2017 / (2nd) August 8 ~ 10, 2017**
- **Place: Emergency Operations Training Center, TEEX**
- **Participants**
  - **Disciplines:** Law enforcement, firefighting, medical services, public work, etc.
  - **Number of Consented:** (1st) **39 out of 44** (88.6%) / (2nd) **32 out of 46** (69.6%)
- **Instructors**
  - **Full-time instructors (2) and adjunct instructors (16)**
  - **Number of Consented: 18 out of 18** (100%) for both sessions
- **Scenarios practiced**
  - **June 13, PM / August 8, PM:** Columbia State University (CSU) – **Mass shooting**
  - **June 14, AM / August 9, AM:** El Diablo – **Sports event**
  - **June 14, PM / August 9, PM:** Needland – **Natural disaster (Hurricane)**
  - **June 15, AM & PM:** Rook – **Natural disaster (Earthquake)**
  - **August 10, AM & PM:** Needland **Civil Disturbance**

4. Method – Data Analysis

Episode Analysis

An inject given to a personnel

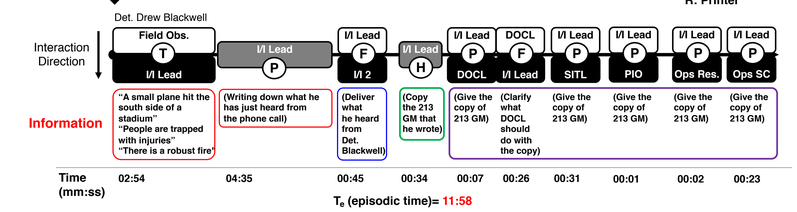


5. Preliminary Results

Episode 1

Inject: El Diablo 13-1a

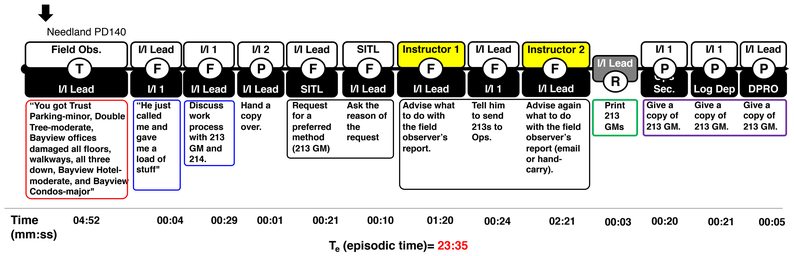
T: Telephone
P: Paper
F: Face-to-face
H: Photocopy
R: Printer



T_e (episodic time)= 11:58

Episode 2

Inject: Needland Tornado 13-1b



T_e (episodic time)= 23:35

Major Findings

- **There was a common performance pattern:**

Receiving data incoming (e.g., field observation) → Understanding data (e.g., taking note) → Verbal exchange of information → Copying document (e.g., hard copies) → Sharing information with other roles

- **Confusion about communication method (e.g., email or hand-carry) may cause longer episodic time.**

6. Discussion & Future Work

Episode Analysis

- To **gather more episodes** and identify **patterns of communication/information diffusion after injects.**
- To understand **the use of different technologies** in these patterns.
- To investigate difference between **low-demand** and **high-demand** injects.

Knowledge Elicitation/Validation

- To perform **interviews with responders of Hurricanes Harvey and Irma**.
- To **validate observations from EOTC** (simulation) against experts' experience and knowledge.
- To support the rationales for the proposed research with real-world inputs.

References

- Department of Homeland Security. (2017). National Incident Management System. 3rd Revision. Washington D.C.
- U.S. Coast Guard. (2011b). On Scene Coordinator Report: Deepwater Horizon Oil Spill. September, 2011.
- Hollnagel, E. (2011). Prologue: the scope of resilience engineering. Resilience engineering in practice: A guidebook.

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