



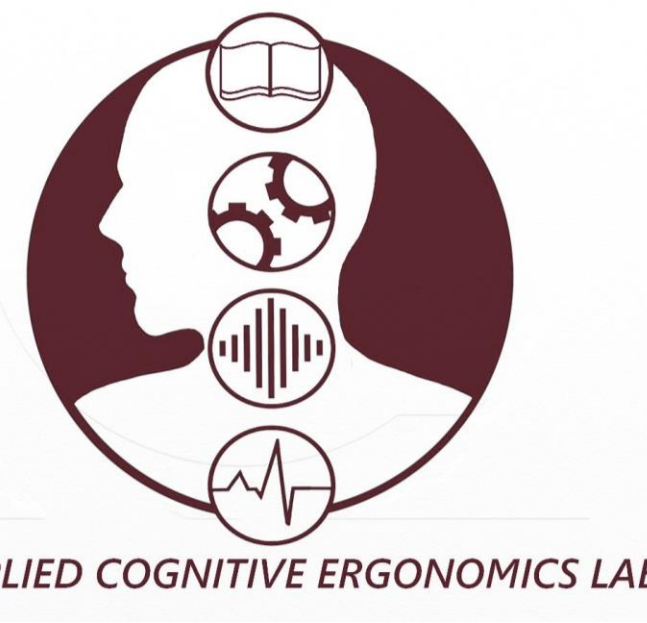
TEXAS A&M UNIVERSITY

MARY KAY O'CONNOR PROCESS SAFETY CENTER TEXAS A&M ENGINEERING EXPERIMENT STATION

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

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APPLIED COGNITIVE ERGONOMICS LAB



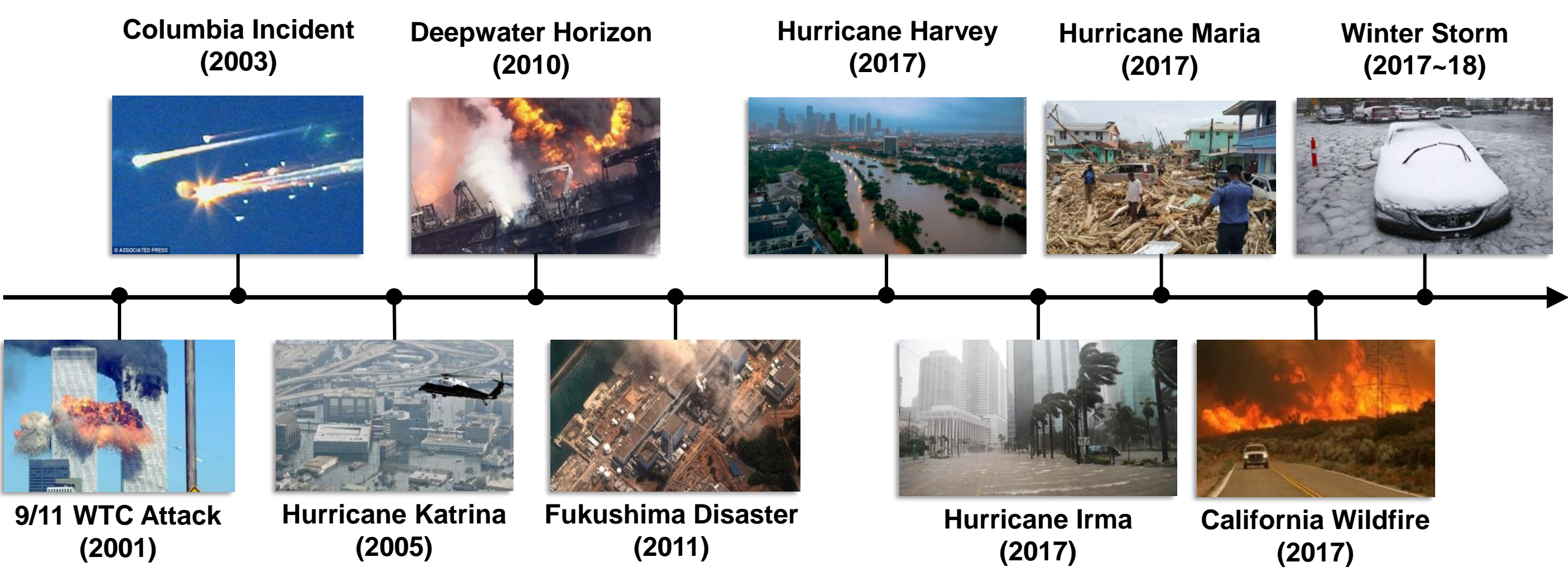
Research on the Interactions between Humans and Machines

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.



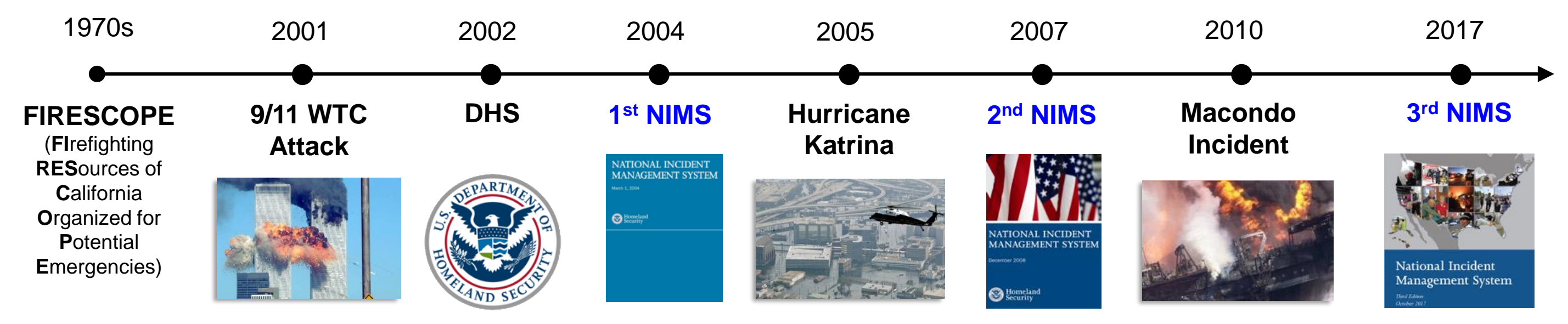
2. BACKGROUND

Multi-Agency Incident Management System (MAIMS)

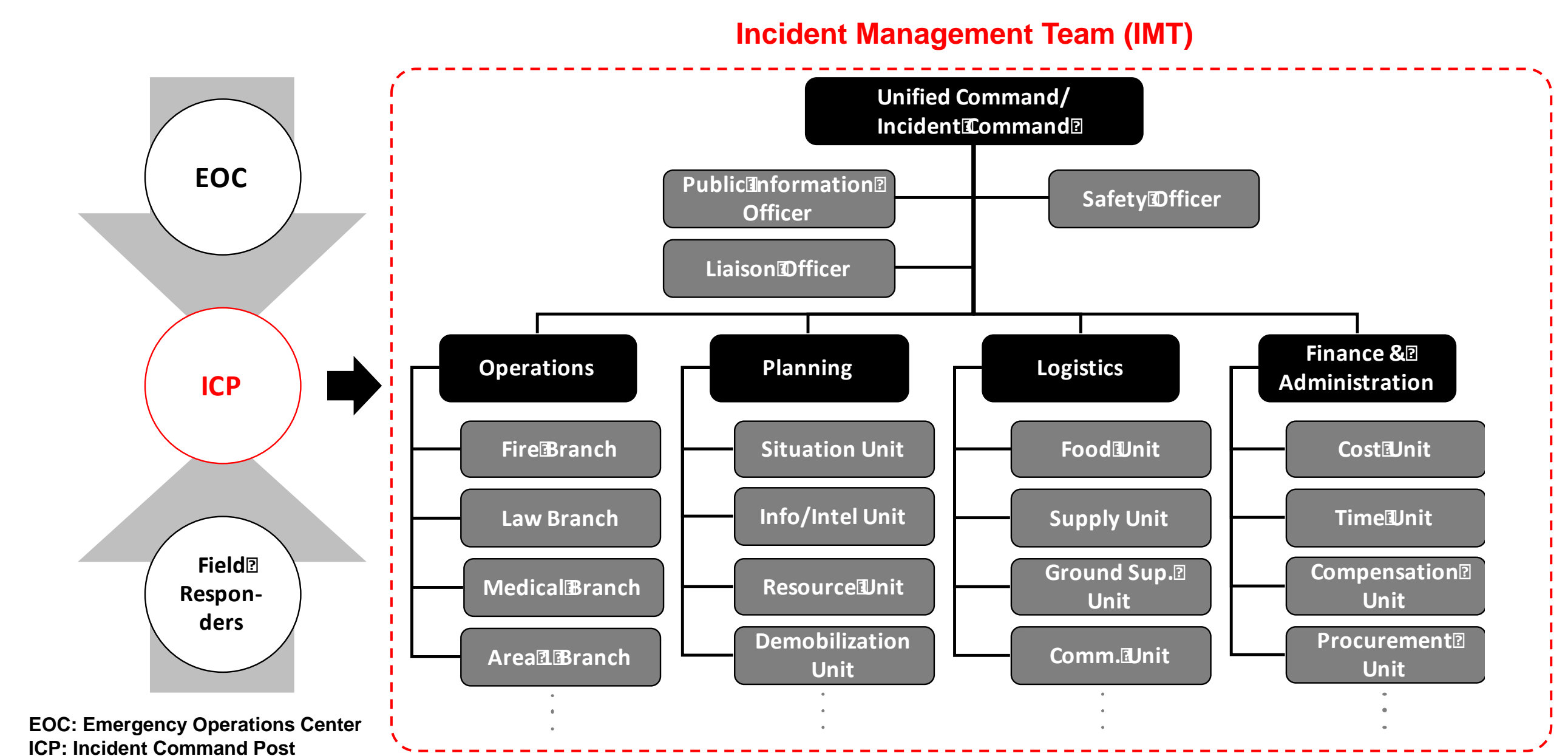
An overarching term for an IMS with the following features:

- **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)



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



- 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?

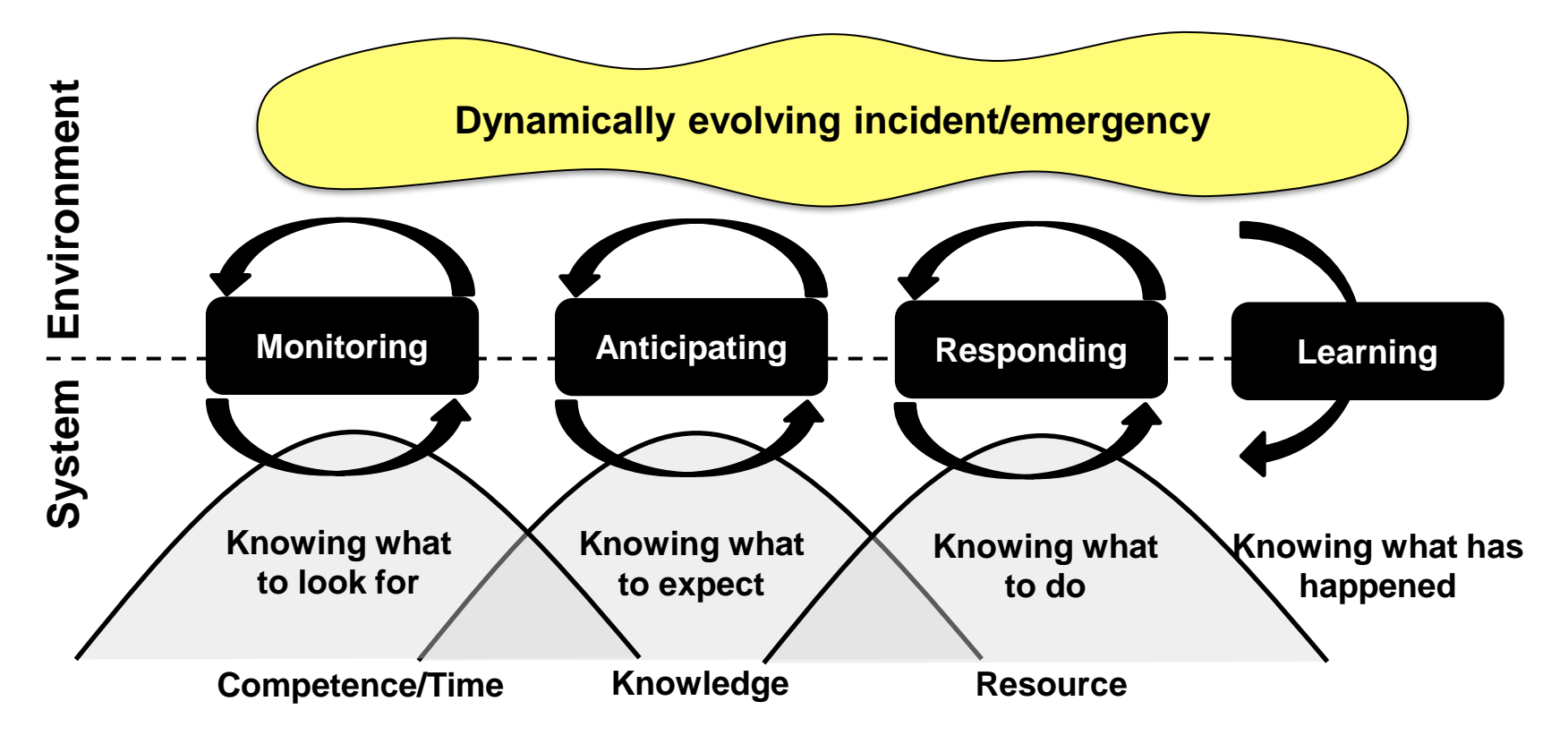
A Definition (Hollnagel, 2011, p. xxxvi)

"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

- Monitoring
- Anticipating
- Responding
- Learning



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

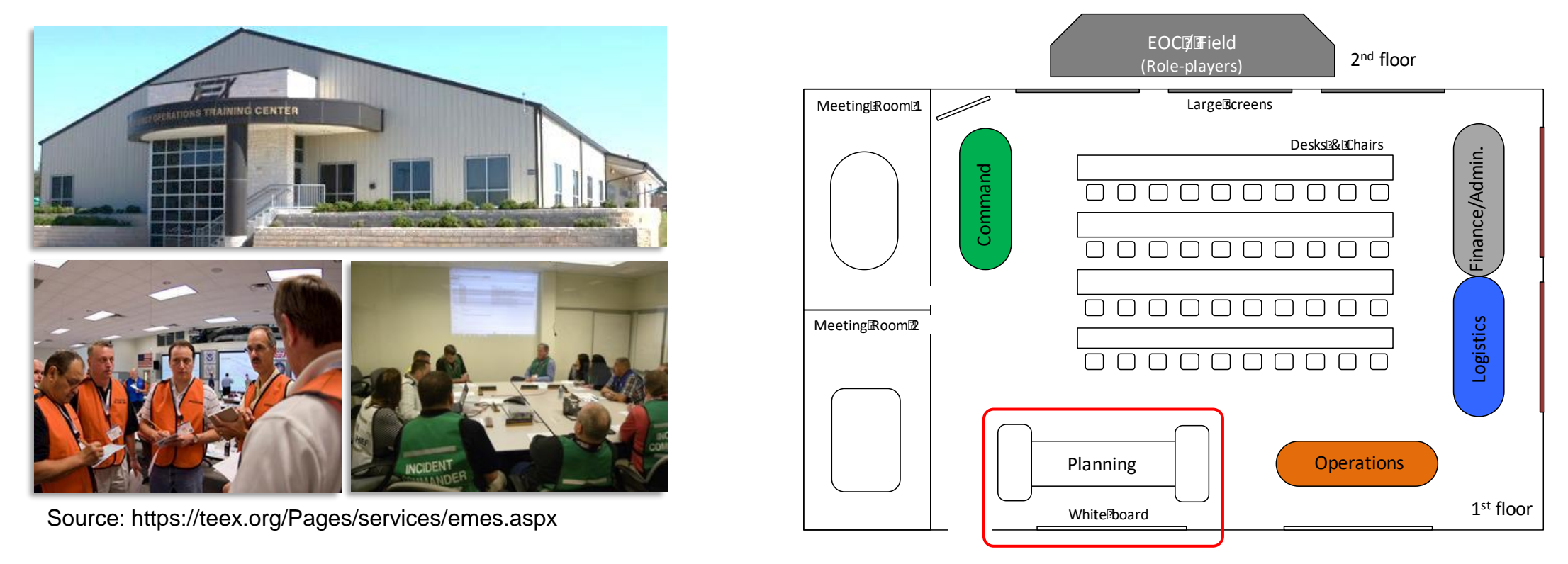
4. METHOD - DATA COLLECTION

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



Research Facility: TEEEX Emergency Operations Training Center (EOTC) Simulated High-Fidelity Incident Command Exercises

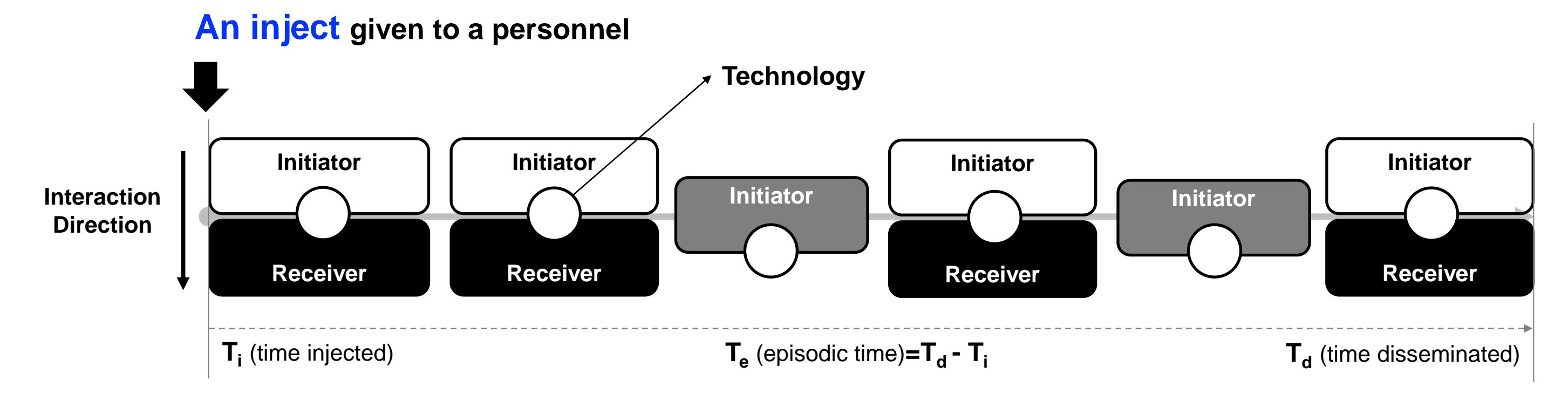


1st /2nd Data Collection Overview

- **Period:** (1st) June 13 ~ 15, 2017 / (2nd) August 8 ~ 10, 2017
- **Place:** Emergency Operations Training Center, TEEEX
- **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

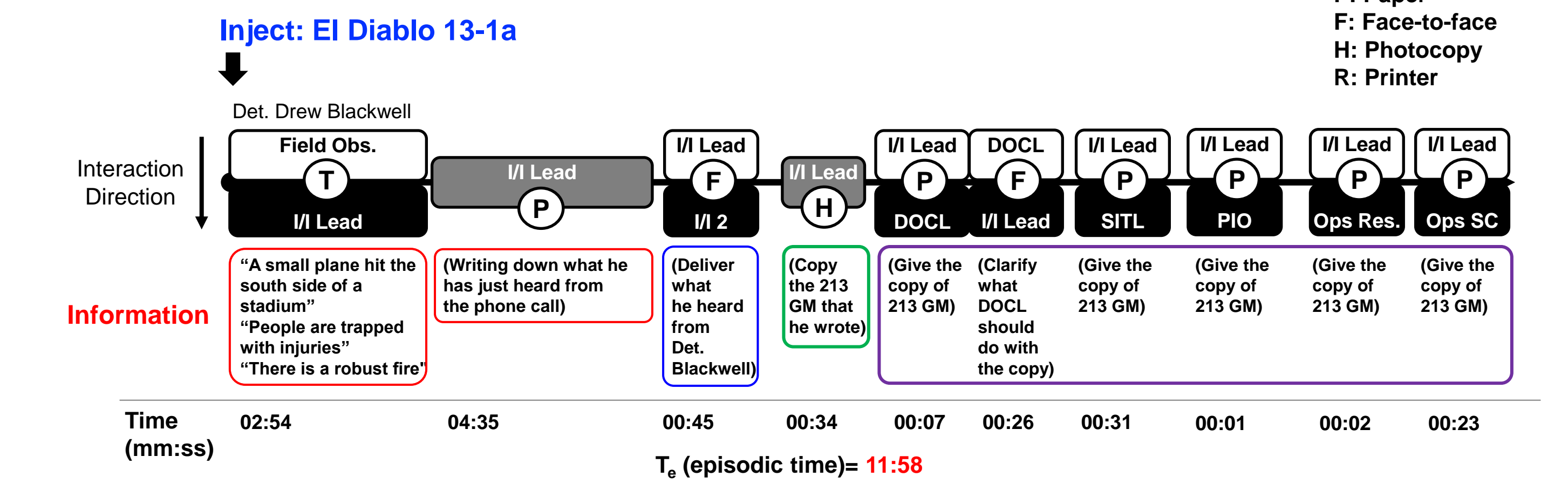
4. METHOD - DATA ANALYSIS

Episode Analysis

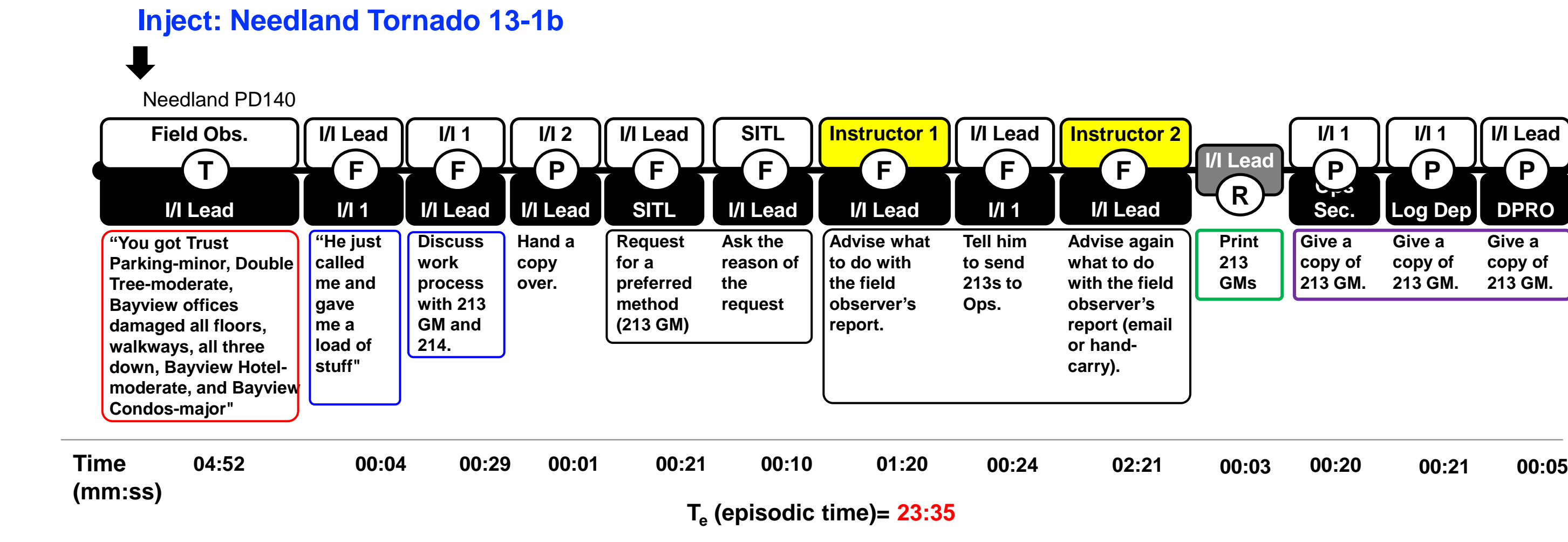


5. PRELIMINARY RESULTS

Episode 1



Episode 2



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.