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Evaluation of work-as-done in information management of multidisciplinary incident management teams via Interaction Episode Analysis

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ABSTRACT

Multidisciplinary incident management teams (IMTs) are required to operate in resilient ways as emergency situations unfold unexpectedly. Although resilience in emergency management has been widely studied in many emergency contexts, the development of a new method to investigate actual resilient performance of the IMTs under realistic settings has been limited. To address such gap, this paper first introduces Interaction Episode Analysis (IEA), a novel approach to capture and describe emergent team performance. As an exploratory observation study, we apply the IEA to an information management aspect of the IMTs in two emergency exercises carried out in a high-fidelity environment. As a result, the IEA provides comparable sets of episodes as instances of work-as-done, rendering opportunities to further analyze essential elements of interactions between team members as well as information management activities. Moreover, the IEA enables comparisons between the observations and identification of challenges faced by the team in managing incident information and adaptive behaviors used to address the challenges. By gathering more evidences as well as addressing limitations identified in this study, the IEA is expected to serve as a method that facilitates the analysis of work-as-done of complex team work and the reconciliation between work-as-done and work-as-imagined to promote resilience in emergency management.

1. Introduction

Economic losses incurred by disasters have gradually increased since 1990, reaching an annual average of $250 billion to $300 billion globally (UNISDR, 2015) and nearly $100 billion in the U.S. (USGCRP, 2018). Despite the growing threat, responding to disasters remains challenging due to a large amount of uncertainty, unexpectedness of events, finite resources, and inadequacy of emergency plans and procedures. Moreover, information necessary to make sense of evolving situations to inform decisions is often inaccurate and outdated (Perry, 2007; Perry and Lindell, 2003). Therefore, a key to effective responses to disasters is the capacity to flexibly adjust performance to changing conditions and to quickly recover from disturbances, a property of social systems defined as *resilience* (Boin et al., 2010; Woods and Hollnagel, 2006b).

One such social system's key component to disaster response is an incident management team (IMT) that is designated to provide on-scene support during a disaster. An IMT includes emergency responders and managers with various expertise and from multiple disciplines such as firefighting, law enforcement, and medical service (Federal Emergency Management Agency, 2017) who work collaboratively to achieve common goals (Boin and McConnell, 2007) usually in a collocated facility (Bigley and Roberts, 2001; Smith and Dowell, 2000). Diverse and multidisciplinary IMTs' ability to adapt its performance to unpredictable conditions has been considered a key factor to success or failure of emergency operations (Kendra and Wachtendorf, 2003; Weick, 1993).

Previous research to understand resilient performance of multidisciplinary IMTs has generally focused on comparing 'work-as-done (WAD)' with 'work-as-imagined (WAI)' to investigate adaptations and improvisations exhibited by IMT members during response. Two main

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approaches have been used to operationalize such comparison: narratives and resilience modeling. First, *narratives* have been used to describe how the IMTs are operated in the real-world or high-fidelity simulated emergency situations (i.e., WAD). Such narratives include accounts and patterns of adapted behaviors found in emergency operations in different types of incidents such as terrorist attack (Kendra and Wachtendorf, 2003; Mendonça, 2007), nuclear incident (Costa et al., 2008; Furniss et al., 2011; Gomes et al., 2014), major sports event (de Carvalho et al., 2015; Filho et al., 2014), search and rescue (Lundberg and Rankin, 2014; Rankin et al., 2013), or firefighting (de Carvalho et al., 2018; Weick, 1993; Woltjer et al., 2006). A common goal pursued in these studies was to provide a practical understanding of resilience under various emergency contexts. Second, there have also been a few attempts to *model* resilience of the IMTs. For example, Aguilera et al. (2016) modeled an emergency command center's response to an oil spill using Functional Resonance Analysis Method (FRAM); a method that represents variability of everyday practices and analyzes how such variability leads to desired or unwanted outcomes (Hollnagel, 2017). This analysis facilitated understanding of how human operators adjusted their activities for key functions such as oil spill assessment, as well as strategic planning and execution. Lundberg et al. (2012) proposed the Resilient Sensemaking and Variety Control Model (RESCOM) for an emergency response which explains how the emergency response team manages disturbances through a cyclic process of monitoring adverse events, implementing control actions, and adjusting the actions based on monitored feedback.

While the literature on resilience narratives and models has contributed to improved theoretical understanding of resilience in various emergency management contexts, only a few plausible proposals for measurement and operationalization of resilience in emergency management exist (Righi et al., 2015). One such effort is Hollnagel (2011)'s Resilience Analysis Grid (RAG) that enables the investigation of essential resilience functions of monitoring, anticipating, responding, and learning. Similarly, Woods (2006) sets forth resilience factors such as buffering capacity (how a system absorbs disruptions), margin (how a system operates near performance boundaries), tolerance (how a system gracefully degrades), flexibility (how a system restructures itself), and cross-scale interaction (how local and management levels influence each other). Later, these factors were used to assess resilience in response to the September 11 disaster (Mendonça, 2016). Although these frameworks provide a rich descriptive understanding of resilience in complex emergency response scenarios, methods utilized to inform such frameworks rely heavily on self-reported data and may fall short in describing complex interactions as WAD among system components (e.g., members and technologies of the IMT) in team environments.

Based on the premise that resilience is a property of a system that emerges through *interactions* among human operators and technical tools to address given demands (Woods and Hollnagel, 2006a), previous research has focused on interactions among the system components. In the context of emergency response, Gomes et al. (2014) attempted to capture interaction patterns between members of an emergency coordination center so as to identify how distributed members engage in information flow and to detect communication overload and bottlenecks. Similarly, Aguilera et al. (2016) studied interactions between human operators, operating procedures, and equipment to investigate how an emergency response team adjusts its performance given potential inadequacy of procedures for some unexpected events and limitations of resources. This is in line with some team researchers who use interactions between team members to understand team resilience or adaptability (Burke et al., 2006; Salas et al., 2005). Given the growing recognition of interactions as an essential lens through which resilient performance of social systems can be analyzed, adequate methods are needed to facilitate the analyses. Nonetheless, such methods are largely absent in the resilience literature (Hosseini et al., 2016; Patriarca et al., 2018).

To address this gap, we propose a novel approach called Interaction Episode Analysis (IEA), which enables documentation and analysis of emergent performance, and challenges and resilient behaviors, using analytical units called *episodes* that represent complex temporal interaction patterns in large multidisciplinary teams. In order to analyze multiple facets of an interaction in the IMTs, we propose to investigate 3C's of interactions: *Context* in which an interaction occur (e.g., initiator, receiver, and technical mediator), *Characteristics* (e.g., frequency and duration of the interaction), and *Content* of the interaction (e.g., spoken words or actions) (Sasangohar et al., 2014; Son et al., 2018).

The particular focus of this study is on the IMT's information management activities which have been shown to be one of the key areas of multidisciplinary emergency operations (Comfort, 2007). In what follows, we first provide some background on organization and information management in the IMTs. We then introduce the IEA methodology and document a study of emergency response teams in a high-fidelity simulation to show the efficacy of the IEA in investigating the IMT's resilient performance.

2. Background

2.1. Organization of the IMT

Once the demands of an incident exceed one jurisdiction's capabilities, multiple organizations are required to coordinate and collaborate in order to work as a single IMT. One of the issues in forming the IMT is difficulty of harmonizing different incident management principles developed and adopted for a specific region or a discipline (e.g., fire service, police) (Perry, 2003; Waugh, 2009). To address this issue, also observed in response to September 11 attack, the U.S. Government developed and launched a common framework called National Incident Management System (NIMS) that is applicable to the IMTs at all levels of government and for all types of incidents as a national template. Among many protocols incorporated into the NIMS, Incident Command System (ICS) provides guidelines for reorganizing various resources such as personnel and equipment, and establishing incident action plans (IAPs) for continuing operations (Federal Emergency Management Agency, 2017).

Following the ICS, an IMT is composed of five major functional sections: Command, Planning, Operations, Logistics, and Finance & Administration (F&A). The Command Section directs the overall operations and consists of incident commanders (e.g., fire chief, police chief) and other command staff: Public Information Officer (PIO) who interfaces with the public and media; Safety Officer who oversees the health and safety of emergency personnel; and Liaison Officer who facilitates coordination between agencies. The Planning Section gathers, evaluates and shares information related to the incident and the IMT's operations. Based on this information, the Planning Section prepares IAPs for operational periods to come. As the main focus of the present study is the information management of the IMT, the layout and descriptions of roles in the Planning Section are provided in Fig. 1. The Operations Section implements tactical activities specified in the IAPs in concert with field responders. Thus, the Operations Section usually owns different tactical branches such as fire, search and rescue, medical, and law enforcement. The Logistics Section supplies resources and services needed for or requested by the Operations Section. Lastly, the F&A Section manages financial matters of the emergency operations such as budget and expenditure (Federal Emergency Management Agency, 2017).

2.2. Information management in the IMT

With the five functional sections in place, the IMT is operated largely for three interdependent areas of incident management: resource management, command and coordination, and information management (Federal Emergency Management Agency, 2017). Among these, managing information under a multidisciplinary environment has been

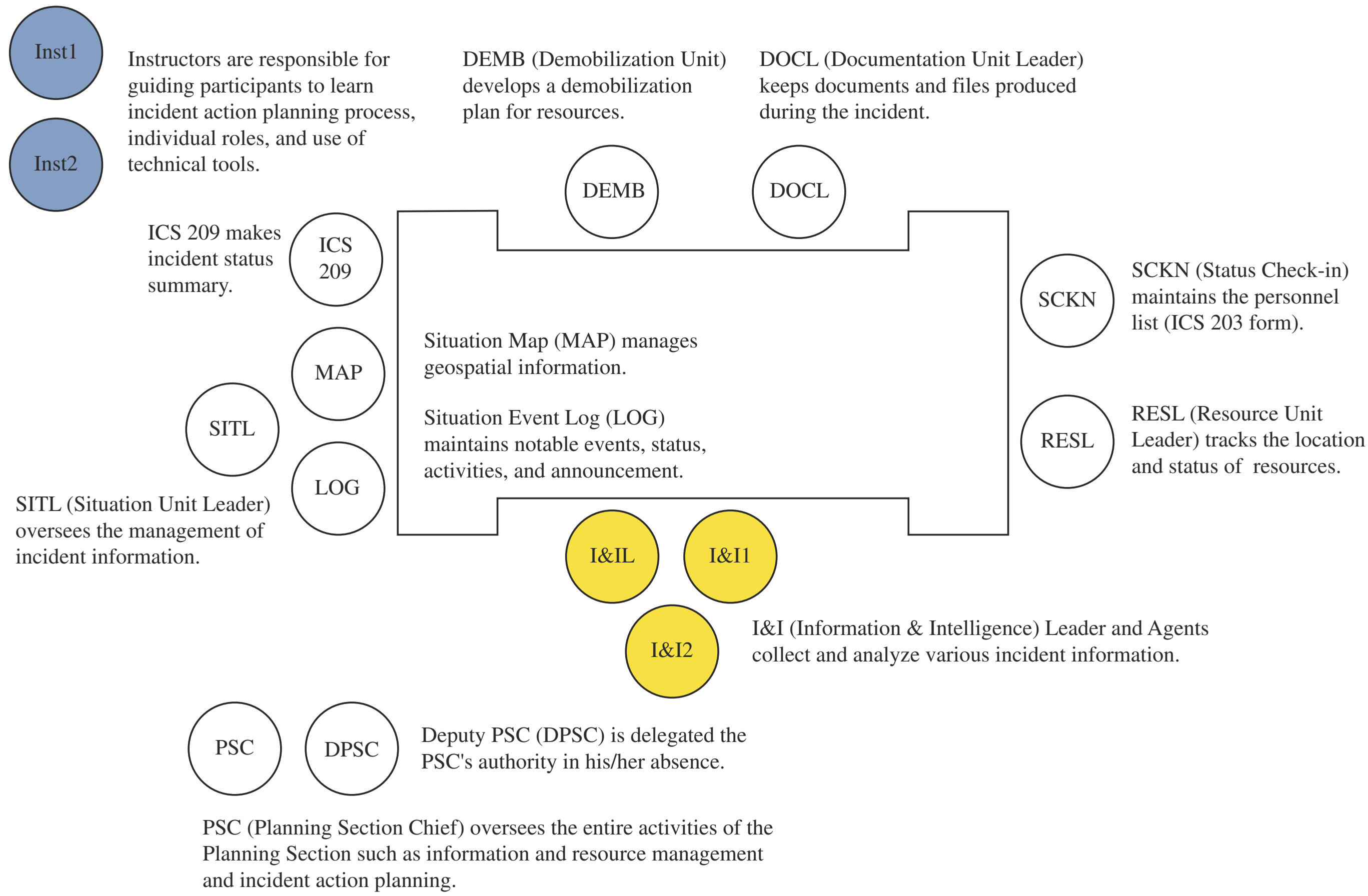


Fig. 1. Layout and roles of the Planning Section. The Section consists of different functional units and each unit is comprised of multiple roles, often involving the leader of the unit. The layout of the roles is based on the research setting described in Section 3.1.

problematic and thus considered critical to effective emergency operations (Militello et al., 2007; Salmon et al., 2011). In particular, the overall incident management is likely to fail without members adequately recognizing evolving threats and communicating such information and resultant decisions with relevant parties (Paton and Flin, 1999). Well-managed information system facilitates learning from the past, monitoring current situations and anticipating what actions need to be taken so that the IMT can remain resilient, especially under fluid and unpredictable circumstances during an emergency (Burke et al., 2006; Comfort et al., 2004).

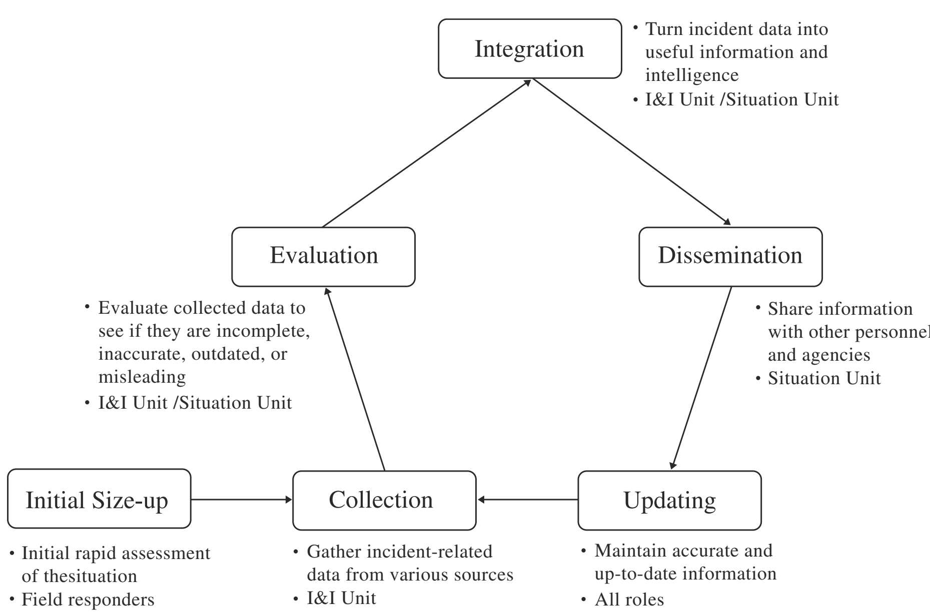


Fig. 2. General information management phases in the IMT. Incident information develops through a cyclic process largely driven by the Planning Section.

Information management in the IMT is expected to take a series of steps. As shown in Fig. 2, the information management begins with the initial assessment of the situation, followed by continuous cycles of collection, evaluation, integration, dissemination, and updating of incident-related data (Son et al., 2018). Although the entire Planning Section is primarily responsible for the information management, Information & Intelligence Unit (I&I) and Situation Unit play a major role in the flow of incident information (Federal Emergency Management Agency, 2017). Based on government documents (e.g., NIMS) and knowledge provided by subject matter experts, the following steps are considered what is expected to occur and thus considered as WAI of information management in our study.

2.3. Interaction Episode Analysis (IEA)

2.3.1. Conception of IEA

An episode refers to a sequence of actions and conversations among multiple agents bound towards a certain topic or subject over a specific period of time (Annabi et al., 2008; Korolija and Linell, 1996). Indeed, episodes have been used as the unit of analysis to report an account of resilient performance of an IMT. As an initial attempt, Aminoff et al. (2007) reported topical episodes from a forest fire exercise such as establishing a staging area and searching a missing child, based on the text messages exchanged between team members. In addition to the narrative accounts, Trnka and Johansson (2009) provided some metrics for interactions, for instance, the number of text messages sent and received between roles and criticality of the roles based on the relative communication frequency. With more emphasis on constituent elements of resilience, Furniss et al. (2011) provided some episodes that narratively describe markers, strategies, and enabling conditions for resilience during nuclear emergency scenarios. Gomes et al. (2014) analyzed emergency planning activities by laying out different roles and their actions on a timeline. Rankin et al. (2013) illustrated how sub-episodes temporally progress in parallel within a main episode regarding a wildfire. More recently, researchers began to use episodes to represent WAD of emergency operations. As an example, de Carvalho et al. (2018) described an emergency response exercise carried out in the field (as an instance of WAD) and compared with standard operating procedures (SOPs) used (as an instance of WAI). While these studies show promise in modeling WAD during an emergency response, methods are limited in capturing the complex interactions between human and technical agents and their relations to resilient performance.

To address this gap, we developed an Interaction Episode Analysis (IEA) (Son et al., 2018), which provides details on *Context*, *Content* and *Characteristics* (Three C's) of interactions (Fig. 3). The IEA documents the *Context* of an interaction, namely, which roles are involved in an interaction and the technology used in the interaction. Regarding the *Characteristics*, the IEA provides a timeline of interaction events which can be used to analyze the frequency and duration of specific interactions. The *Content* of the interaction such as conversation and action is also available in the IEA as an essential component to describe the episode.

On one hand, the IEA is similar to topical episode analysis (TEA) developed by Korolija and Linell (1996) in that both methods can cover multiparty conversation and trace the evolution of a certain topic over time. On the other hand, the IEA provides additional advantages of capturing human-technology interactions and quantifiable temporal aspects of the interactions, which is an important basis for measuring adaptive team performance (Gorman et al., 2010). In addition, the IEA generates a visual representation of the episode, facilitating viewers' understanding of the episodic progress that otherwise requires more efforts to comprehend compared to text-based narratives (e.g., Furniss et al., 2011).

Since major endeavors assumed by the IMT include the management of incident-related information, an episode in the IEA is defined as a series of interactions between members that emerge in the course of coping with information demands given to the team. As shown in Fig. 3, the initiation of the episode may be triggered by external or internal events in a simulated environment. External events–also called 'injects'–are information provided by role-playing staff to the team. The inject generally contains several pieces of information that require further actions to be taken (e.g., identifying an updated number of injuries). The episode may also commence internally as team members recognize the needs to handle particular information based on the instructions from instructors or incident objectives specified in the current IAP. Once triggered either externally or internally, ensuing interactions are manually searched and selectively chosen by analysts if the interactions include terms or data associated with the given or identified demand for the information (e.g., 'fatalities' or '2 dead people' for injury information). The episode concludes when no such terms or data are identified.

2.3.2. An example of IEA

Fig. 5 is presented as an example of how the IEA is applied to team interaction data to generate an episode. First, identifying episodes requires analysts to pre-survey transcripts or video to capture potential topics that need further analysis (Korolija and Linell, 1996). The binding topic of this example is Joint Information Center (JIC), a designated facility that oversees public information activities. The beginning of the episode is determined when the term, 'Joint Information Center' or 'JIC' appears for the first time. By tracing this initial context (e.g., roles interacting, types of information sought), the episode is being developed by involving associated interactions that ensue. For instance, the first four interactions between MAP and Command Section personnel result

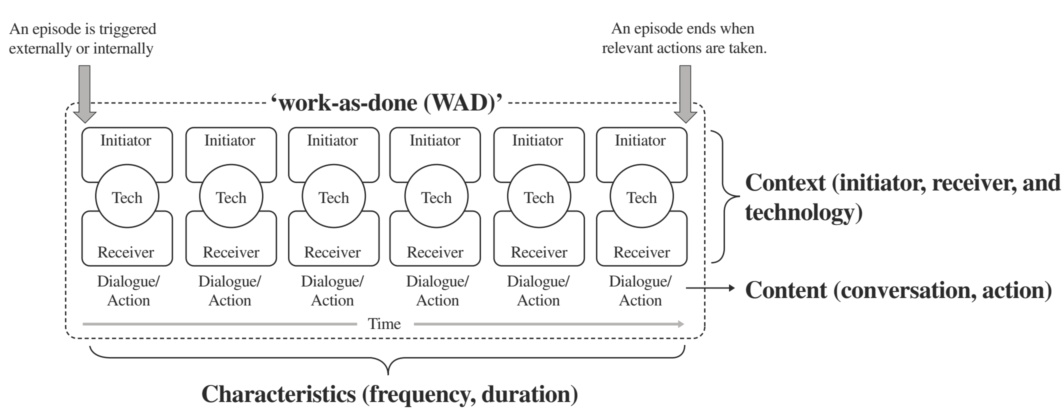


Fig. 3. A schematic of Interaction Episode Analysis. Three C's (Context, Content, and Characteristics) of an interaction are sequentially represented on a time dimension from left to right. The initiator and receiver are filled with a respective color for the section that the role belongs to (See Fig. 4 for color code and labels for section and technologies).

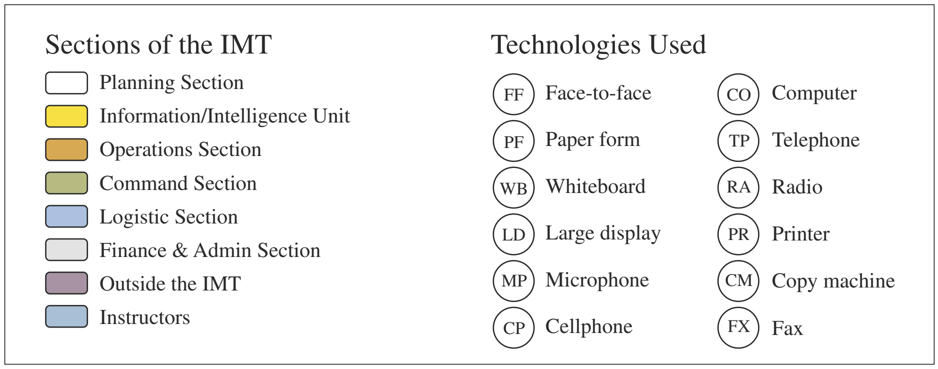


Fig. 4. Color code for sections and labels for technologies. This legend will be used throughout the paper. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

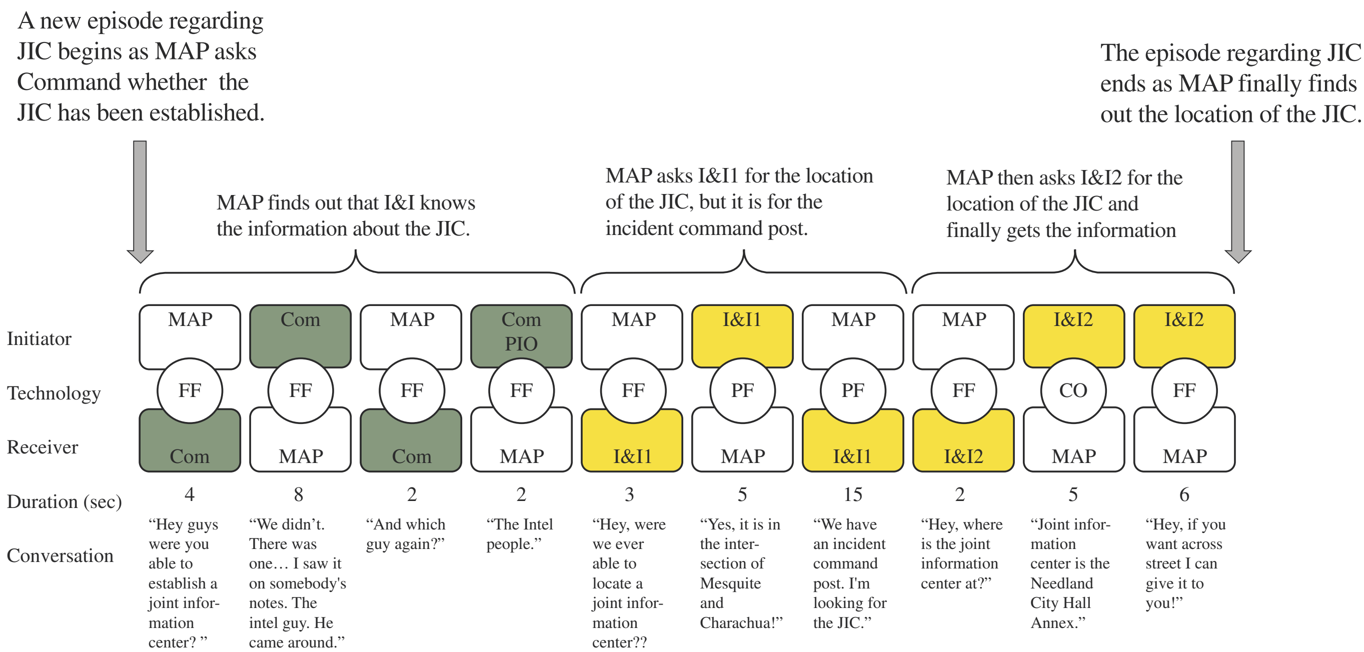


Fig. 5. An episode regarding Joint Information Center (JIC). The episode consists of three sub-episodes regarding the location of the JIC between different roles in the IMT.

in the fact that I&I Unit has the information about the JIC. By searching and inspecting MAP's subsequent interactions with I&I1 and I&I2, the episode regarding the JIC is further established, finally leading to the point where the location of the JIC is obtained. The episode is considered to be ended when the analysts do not find addition terms or interactions related to the binding topic (Aminoff et al., 2007; Korolija and Linell, 1996).

In what follows, we document two naturalistic observational studies conducted in a high-fidelity emergency training facility to describe the IEA further and to illustrate the IEA's efficacy and utility in assessing emergent resilient performance of a representative IMT.

3. Methods

3.1. *Research setting*

The work presented in this paper is part of a larger research project that aims to investigate complex interaction patterns among members of a multidisciplinary team through naturalistic observations. The observations and collection of associated data were carried out in the Emergency Operations Training Center (EOTC) at Texas A&M Engineering Extension Service (TEEX). The EOTC is regarded as a high-fidelity emergency training facility thanks to its similarity in term of physical and functional characteristics to the actual operational circumstances (Feinstein and Cannon, 2002). For instance, the layout of the EOTC is configured as a common facility established during an emergency (e.g., an incident command post (ICP), or an emergency operations center (EOC)) as shown in Fig. 6. Also, a variety of real-world tools in addition to face-to-face communication are used to mediate interactions: ICS paper forms, computers, whiteboards, large screen-projected displays, microphones, landline phones, personal cellphones, printers, copy machines, and radios. A training course typically accommodates 40 to 45 trainees to form a realistic IMT and takes 3–4 days. To replicate the functions of the IMT, more than 200 injects that stimulate trainees' response behavior are given per exercise in an *ad hoc* manner. The goal of the training courses available in the EOTC is to provide incident managers, supervisors, and jurisdiction's officials with skills necessary to respond to and recover from large-scale incidents. The training was designed to practice core incident management protocols in the U.S. such as the ICS and the NIMS through realistic incident scenarios. Data for the project were collected from two separate training courses in 2017. Out of four emergency exercises given in each course, only the

Fig. 6. Simulated emergency response training facility. Trainees perform a specific role for an IMT and wear a vest corresponding to the section and the role.

third exercise was included in the current analysis due to high degree of realism (e.g., support from instructors, stress, time pressure) as indicated by skilled instructors in the EOTC. The two exercises were carried out using the same incident scenario designed for a response to a tornado that hit a virtual city named ‘Needland’. Each of the two exercises is called 1st and 2nd observation in the remainder of this paper.

3.2. Participants

Participants were recruited on the first day of each training course in the EOTC. Most of participants had moderate to high levels of incident management expertise as the course required ICS certificates prior to registration. In two training courses, 39 out of 44 participants (the 1st course) and 32 out of 46 (the 2nd course) agreed to participate in the study. Instructors also consented to participate. Participants’ area of expertise was diverse in terms of discipline (e.g., firefighting, police, medical service) and location (e.g., different states and municipalities). For a retrospective analysis of verbal conversations, audio recordings were obtained from key roles involved in information management of the IMT (Table 1). This research was approved by the authors’ Institutional Review Board (IRB No.: 2016-0489D).

3.3. Data collection and processing

Five members of our research team, trained in human factors engineering, conducted direct observations of the two training courses to understand incident scenarios and interactions between participants. To facilitate real-time coding, observers used the Dynamic Event Logging and Time Analysis (DELTA) tool (Sasangohar, 2015) on Apple iPad Mini 3rd Series devices. Portable voice recorders were attached to each participant’s vest to record team verbal communications. Three camcorders were used to record the video of physical interactions from different angles (one at the left front, another at the right front, and the other near the Planning Section). Audio and video recordings were obtained for the duration of each exercise, which lasted about 2 h and 20 min. The audio and video files were then synchronized using Premiere Pro CC (Adobe Systems Inc., 2017). Researchers then used synchronized recordings to transcribe the verbal communication between the IMT members and code associated metadata to understand *Context*, *Content*, and *Characteristics* of interactions. The metadata coded were: roles of the persons who initiated and received an interaction; a technical tool used in the interaction; start- and end-times of the interaction; and actions or conversations that appear in the interaction. Inter-coder agreement was 72% and 74% for the metadata of the 1st and 2nd observation, respectively. The transcripts and metadata were documented in a spreadsheet (e.g., Excel) to facilitate the searching and filtering of interactions for an episode. Duplicate metadata (e.g., an interaction captured by multiple voice recorders) were excluded. In addition, since a computer was a major tool that the participants used, computer screens were also recorded using Camtasia® (TechSmith, 2017) to see how they used computer software including electronic forms and proprietary simulation software called ‘Emergency Management*Exercise System (EM*ES)’ (TEEX, 2014).

Based on the initial survey of the transcripts and metadata, the elicitation of episodes was carried out by manually and iteratively searching recurrent topical terms and selecting specific interactional conditions, for example, filtering MAP as an initiator and a receiver for the *Joint Information Center* episode. Metadata for roles, technologies, and timestamps were used to assess contextual and temporal characteristic measures. To capture challenges and resilient behaviors from the episodes, themes reported in the literature were referenced such as barriers to team resilience (Militello et al., 2007; Rankin et al., 2013) and types of behavioral improvisations including the use of tools for a different purpose, alterations to task protocols, or extending an individual’s role (Mendonça et al., 2014; Webb, 2004).

Once preliminary representations of the episodes were generated, several meetings between our research team members and experts (e.g., managers and instructors in EOTC) were held to further confirm and adjust the analysis results and to discuss possible rationales behind differences between episodes. In the discussion, multiple aspects of interactions such as sequence of interacting roles and technical tools, time spent on the interactions, and conversations and actions associated with the topic of the episodes were used to speculate why the development of the episodes varied with the same topic.

Table 1
Key roles for information management and audio-recordings obtained.

Key roles in the Planning Section for information management	Audio-recorded?	
	1st observation	2nd observation
Planning Section Chief (PSC)		✓
Deputy Planning Section Chief (DPSC)	✓	✓
Situation Unit Leader (SITL)	✓	✓
Situation Unit Event Log (LOG)*	✓	✓
Situation Unit Map (MAP)	✓	✓
Incident Command System 209 (ICS209)		✓
Information & Intelligence (I&I) Unit Leader (I&IL)	✓	✓
Information & Intelligence Agent 1 (I&I1)		
Information & Intelligence Agent 2 (I&I2)		✓
Planning Section Instructor 1 (Inst1)	✓	✓
Planning Section Instructor 2 (Inst2)	✓	

Note) * assumed by SITL in the exercises included in the current research. Empty cells indicate that the role incumbent did not consent for participation.

4. Results

Findings related to several important utilities of the IEA to facilitate the understanding and analysis of complex human-human, human-technology team interactions are discussed below. First, descriptions of individual episodes are presented to showcase the utilities of the IEA, which are to describe WAD and to highlight distinct emergent information management activities of the IMTs. In addition to the descriptive accounts of the episodes, we present the utility of the IEA to conduct a comparative analysis using several measures related to *Context* and *Characteristics* of interactions. Second, we present examples of how the IEA facilitates the identification of information management phases in the episodes. Third, we illustrate how the IEA’s utilization of *Content* of the interactions along the information flow, enables the elicitation of several challenges that the IMT members encountered and adaptive behaviors to cope with the challenges. Finally, we demonstrate the visualization features of the IEA that help illustrate the overall duration of an episode, sections/roles and technologies involved in the episode, and different interaction patterns of the episode.

4.1. Overall description of episodes

Eight episodes pertaining to the information management of the IMT were identified using the IEA method (Table 2). Each episode represents how the IMT deals with a specific incident information demand during an emergency: initial assessment, updated injury and damage, name and location of emergency medical centers, financial expenditure rate, ingress and egress points of a secured perimeter, joint information center, location of mass evacuation facility or shelter, and response to leaked gas. Half of the episodes were triggered by an inject that the role-playing staff put into the team.

As shown in Table 2, six of the episodes emerged in both observations while two episodes (*Financial Burn Rate*, *Ingress/egress Points*) were identified in either of two observations. The IEA was used to compare the *Content* of the six common episodes between the two observations and thus to identify variations in behaviors or interactions to achieve the same goal. While the comparative analysis is beyond the scope of this introductory study, it yielded interesting findings regarding the variability in response. For instance, the episode of *Initial Field Report* began when a field observer (FOB), role-played by a skilled instructor, reporting to I&IL an initial assessment such as the size of impacted area and the moving direction of the tornado. After collecting data regarding a field assessment report from FOB, I&IL shared the reported information with other personnel in the IMT. In the 1st observation (Fig. 7 (a)), I&IL confirmed with I&I2 if the information had been validated by PSC and asked I&I2 to share the information with other sections and roles. In the 2nd observation (Fig. 7 (b)), I&IL directly shared the reported information with SITL so that SITL disseminated the information. In other words, the field report was conveyed to SITL more quickly but distributed less widely in the 2nd observation than in the 1st observation.

Table 2
A list of episodes identified from two exercises using the IEA.

Episode Name	Description	Triggered by	Identified from	
			1st obs.	2nd obs.
Initial Field Report	A field observer reports his/her initial size-up including initial injuries and damages incurred by a tornado.	Inject	✓	✓
Emergency Medical Center	Two emergency medical centers were established and the Planning Section seeks to find out their names and locations.	Non-inject	✓	✓
Injury/damage Update	Injury/damage status such as casualties, those trapped, and damaged building and equipment is updated throughout the operations.	Inject	✓	✓
Financial Burn Rate	The Planning Section monitors the cap and the 'burn rate' of the funds as the IMT deploys personnel and other resources.	Non-inject		✓
Ingress/egress Points	To secure safe perimeter, ingress and egress points are established and the locations need to identified and shared.	Non-inject	✓	
Joint Information Center (JIC)	JIC is established to coordinate media release. The Planning Section needs to know whether the JIC has been established and where.	Inject	✓	✓
Mass Evacuation Point	As the tornado caused mass evacuation, the Planning Section needs to know where the mass evacuation point or shelter has been established.	Non-inject	✓	✓
Potential Gas Leak	A possible gas leak is reported by a field observer. The Planning Section needs to notify this to Fire Branch and verify it.	Inject	✓	✓

4.2. Evaluating team interactions via IEA

In addition to the detailed narrative analysis of the episodes' *Content*, another important utility of the IEA is to analyze and compare measures of the emergent team performance related to *Context* and *Characteristics* of interactions between members and technical tools. As shown in Table 3, five such measures were used to compare the six common episodes across two observations. *Frequency of interaction* refers to the number of overall interactions between the IMT members in an episode. This measure may indicate more coordinated efforts in coping with the same demand given to the team. Depending on the context, a large number of interactions may indicate difficulties in assessing the situation or missing information. Except for *Initial Field Report*, there were large differences in the frequency of interactions between two episodes. To take *Emergency Medical Center* as an example, 32 interactions were identified in the 1st observation whereas 195 in the 2nd observation. A large number of interactions (55 out of 195) occurred in the 2nd observation to find additional information to inform the assessment (in this episode, finding out specific names of two medical centers).

Temporal characteristics of interactions may provide valuable insight on team's collective performance and resilient behaviors. For example, relatively long duration of episodes (or sub-episodes) may indicate difficulties in information management and communication. Two measures were used to capture the temporal characteristics of the episodes. First, *Episode Length* (EL) measures how long the overall episode took. This can be operationalized as $EL = T_e - T_s$, where T_e and T_S represent end-time and start-time of an episode, respectively. Second, *Sum of Individual Interactions' Length* (SIIL) is the measure of how much time the IMT members collectively spend on interactions with other members to address a specific work demand operationalized as $SIIL = \sum_{i=1}^{n} L_i$, where L_i represents the length of ith individual interactions and n is the total count of interactions in an episode. In some episodes, a large difference between the two duration measures was identified. In *Joint Information Center (JIC)* for example, the episode in the 1st observation took 10 interactions with 52s of SIIL and 255s of EL while that in the 2nd observation was composed of 26 interactions taking 215s of SIIL and 5715s of EL. A greater difference in EL than in SIIL largely results from interactions between Command PIO and I&IL regarding the confusion about the location of JIC that appeared at the later part of the exercise, which add only a few additional counts of interactions but make the end-time of the episode significantly longer.

With regard to the *Context* of interactions, an analysis was performed to identify key roles (the roles who were involved in most interactions) and key mediators (the technologies that were used most frequently to mediate the interactions). For the purposes of this exploratory study, three most involved roles and mediators were identified for each episode (Table 3). An aggregate analysis of episodes across two observations shows that the most frequently interacted roles were I&I2 (15%), I&IL (15%), SITL (12%), MAP (12%), and DPSC (7%). As for the mediator of the interactions, paper form (38%), face-to-face (37%), and computer (19%) were mostly used across the common episodes. A comparative analysis suggests some different patterns of interactions between two observations. With respect to roles, I&IL (21%), I&I2 (14%), and DPSC (13%) were three most frequently interacted roles in the 1st observation whereas MAP (19%), I&I2 (17%), and SITL (12%) were the roles with the most interactions in the 2nd observation. In terms of technologies involved in the interactions, three most used were face-to-face (55%),

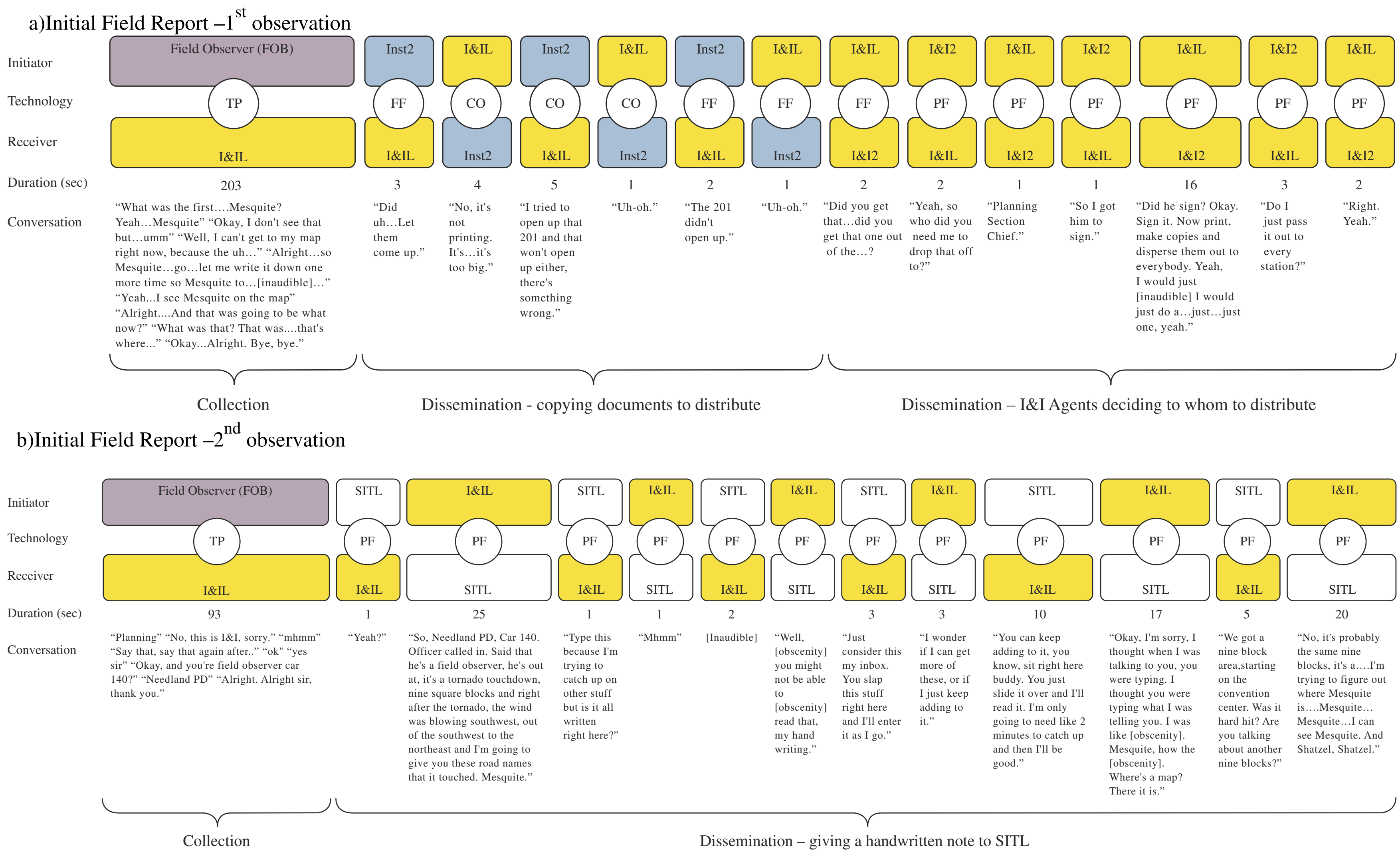


Fig. 7. Graphical representations of Initial Field Report episodes.

Table 3
Sample measures of Context and Characteristics of interactions in the episodes.

Episode Name	Measure	1st obs.	2nd obs.
Initial Field Report	Frequency of interactions (count)	14	13
	Episode length (sec)	261	208
	Sum of individual interactions' length (sec)	246	192
	Three most involved roles (as initiator or receiver) (%)	I&IL (50%)	I&IL (50%)
		I&I2 (25%)	SITL (46%)
		Inst2(21%)	FOB (4%)
	Three most used technologies (%)	Paper form (43%)	Paper form (69%)
		Face-to-face (29%)	Face-to-face (23%)
		Computer (21%)	Telephone (8%)
Emergency Medical Center	Frequency of interactions (count)	32	195
	Episode length (sec)	4418	6574
	Sum of individual interactions' length (sec)	342	866
	Three most involved roles (as initiator and receiver) (%)	MAP (34%)	I&I2 (30%)
		DPSC (19%)	MAP (20%)
		Inst2 (11%)	SITL (10%)
	Three most used technologies (%)	Face-to-face (44%)	Paper form (58%)
		Computer (28%)	Computer (22%)
		Paper form (19%)	Face-to-face (17%)
Injury/damage Update	Frequency of interactions (count)	222	198
	Episode length (sec)	5613	6527
	Sum of individual interactions' length (sec)	2210	1277
	Three most involved roles (as initiator and receiver) (%)	I&IL (25%)	ICS209 (16%)
		I&I2 (16%)	SITL (15%)
		SITL (17%)	I&I1 (14%)
	Three most used technologies (%)	Face-to-face (52%)	Paper form (44%)
		Paper form (39%)	Face-to-face (35%)
		Computer (5%)	Computer (14%)
Joint Information Center	Frequency of interactions (count)	10	26
	Episode length (sec)	255	5715
	Sum of individual interactions' length (sec)	52	215
	Three most involved roles (as initiator and receiver) (%)	MAP (50%)	I&IL (26%)
		I&I1 (15%)	MAP (18%)
		I&I2 (15%)	Com PIO (14%)
	Three most used technologies (%)	Face-to-face (70%)	Face-to-face (50%)
		Paper form (20%)	Paper form (23%)
		Computer (10%)	Computer (19%)
Mass Evacuation Point	Frequency of interactions (count)	71	104
	Episode length (sec)	933	3627
	Sum of individual interactions' length (sec)	534	502
	Three most involved roles (as initiator and receiver) (%)	Inst2 (33%)	MAP (43%)
		DPSC (25%)	Inst2 (14%)
		I&IL (6%)	ICS209 (10%)
	Three most used technologies (%)	Face-to-face (76%)	Computer (65%)
		Computer (15%)	Paper form (19%)
		Whiteboard (8%)	Face-to-face (15%)
Potential Gas Leak	Frequency of interactions (count)	19	50
	Episode length (sec)	569	485
	Sum of individual interactions' length (sec)	243	280
	Three most involved roles (as initiator and receiver) (%)	I&IL (32%)	I&IL (33%)
		SITL (26%)	SITL (16%)
		Inst1 (21%)	I&I2 (10%)
	Three most used technologies (%)	Paper form (53%)	Paper form (44%)
		Face-to-face (37%)	Face-to-face (36%)
		Computer (5%)	Whiteboard (10%)

paper form (30%), and computer (10%) in the 1st observation while paper form (44%), face-to-face (26%), and computer (25%) were the top three ones in the 2nd observation.

4.3. Evaluating information management phases in episodes

In addition to the focused analysis of, and comparison between episodes, the IEA also enables the evaluation of how information has been handled within an episode and facilitates comparison among similar contexts. For example, the episode of *Potential Gas Leak* describes how the same inject of a potential gas leakage is dealt with differently in two different teams. In the 1st observation, an FOB provided a field report of a potential gas leakage in the incident area and advised to check this with a Fire Branch in the Operations Section. While the same inject was given, ensuing interactions differed in two observations. In the 1st observation (Fig. 8 (a)), the information management phases that occurred were: initial size-up – collection – dissemination – updating. For example, FOB reported the potential gas leak to I&IL. Then, I&IL passed the information about the potential gas leak to SITL and then SITL discussed with an instructor whether sharing of the information is necessary. Once the information regarding the potential gas leak was disseminated via event log, SITL checked for any update to be shared in an upcoming meeting.

In the 2nd observation (Fig. 8 (b)), more evaluation-related interactions took place, following initial size-up – collection – evaluation – dissemination phases. To give more details, after receiving an initial report of the potential gas leak from FOB, I&IL attempted to confirm the potential gas leak with Operations Fire Branch. Then, I&IL passed that information to SITL but SITL wanted to wait for the potential gas leak to be confirmed by the Operations. After the Operations had confirmed the gas leak, I&I2 passed it to SITL and SITL posted it to the event log.

Differences observed in the information management phases, may

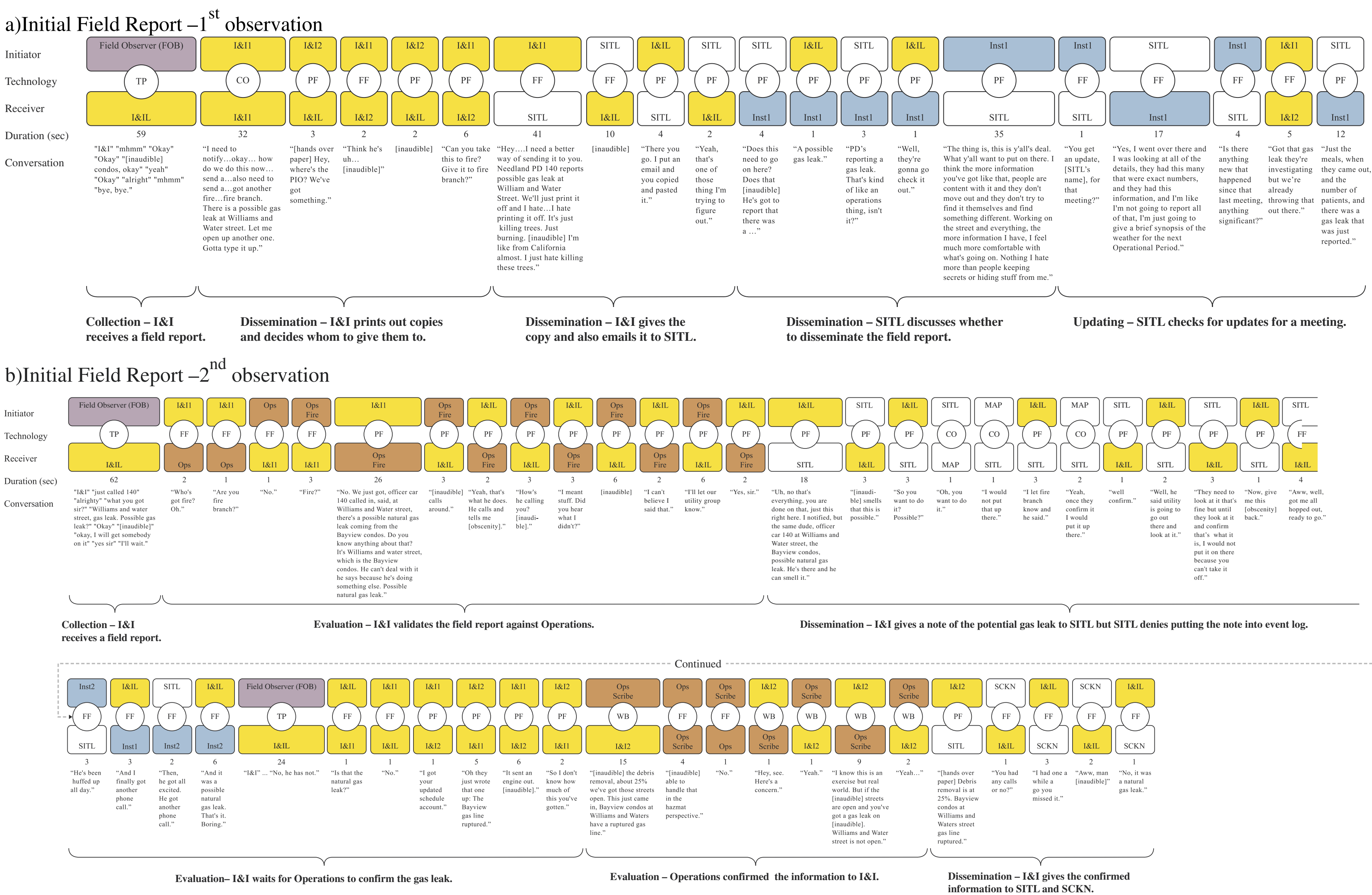
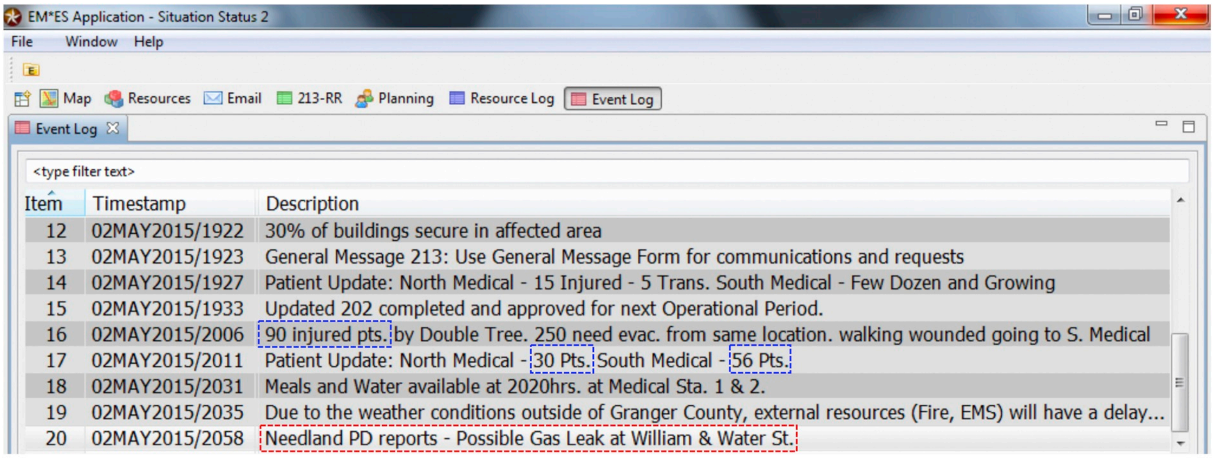
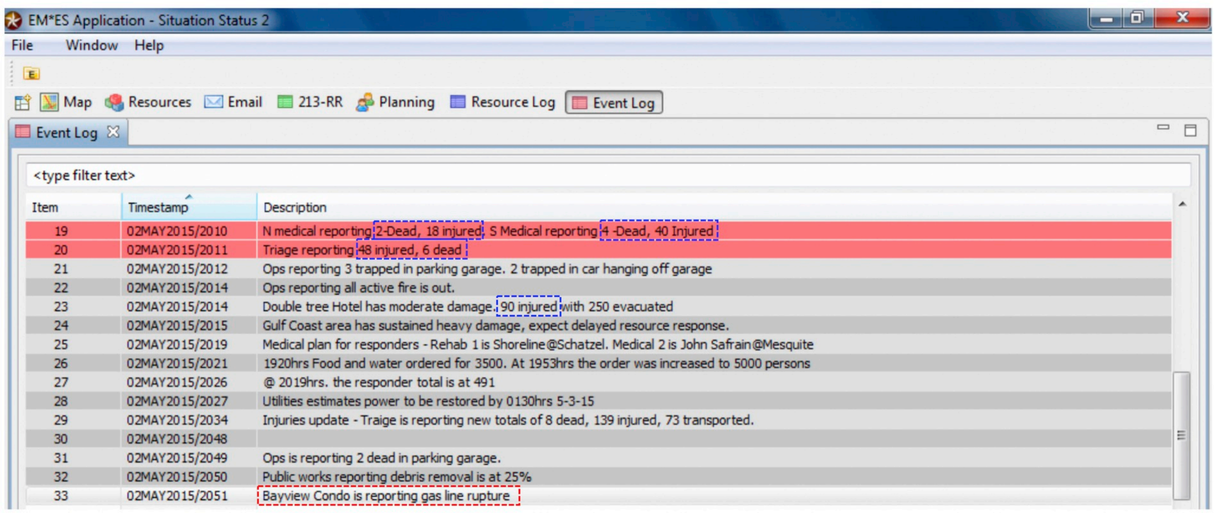


Fig. 8. Graphical representations of Potential Gas Leak episodes.



(a) 1st observation. Item 20 shows the information regarding potential gas leak.



(b) 2nd observation. Item 33 shows the information regarding potential gas leak.

Fig. 9. Screens captured from EM*ES Event Log for Potential Gas Leak. The information disseminated for the gas leak is highlighted in red-dotted boxes and numbers of casualties in blue-dotted boxes. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

explain differences in the quality of the disseminated information in the *Potential Gas Leak* episode. Although the information about the gas leakage was disseminated in both observations, more specific information was provided in the 2nd observation. For example, while only street names, "William & Water St.", were offered in the 1st observation (Fig. 9 (a), the red-dotted box), the specific name of the building, “Bayview Condo”, and the cause of the gas leak, “gas line rupture”, were disseminated in the 2nd observation (Fig. 9 (b), the red-dotted box). Considering the frequency (1st: count = 19 vs. 2nd: count = 50) and durations (1st: EL = 569s, SIIL = 243s vs. 2nd: EL = 485s, SIIL = 280s) taken for this episode (Table 3), the IMT in the 2nd observation exhibited more coordinated efforts (e.g., a higher interaction count) for a similar time period (e.g., EL and SIIL) and produced the information of better quality.

4.4. Evaluating challenges and resilient behaviors via IEA

IEA enables the identification of WAD in IMTs, which facilitates the investigation of challenges and resilient behaviors to address such challenges. By placing more emphasis on analyzing the *Content* of the episodes, 40 sub-episodic instances (i.e., part of interactions bounded for a sub-topic within an episode) regarding challenges that the IMT had faced or resilient behaviors exerted by the IMT members (or lack thereof) were identified. Among them, four most frequent categories of such instances are presented below:

(i) *Difficulty of integrating multiple incident data* (17 instances): The most frequently observed challenge in the IMT's information management was associated with integrating and classifying multiple pieces of incident data as the situation evolved. Especially, key roles for information management (e.g., SITL, I&Is, MAP) which were primarily responsible for evaluating and integrating incident data had confusions about number of casualties. From the *Injury/damage Update* episode in the 1st observation, for example, SITL found out from the event log a discrepancy between numbers of injuries such as “90 [patients] by Double Tree” vs. “30” plus “56" in “North” and “South Medical” centers (Fig. 9 (a), the blue-dotted boxes). To clarify the discrepancy, SITL, I&IL, and I&I2 had over 90 interactions spending additional 287s of SIIL. A similar challenge was also identified in the 2nd observation (Fig. 9 (b)). SITL and MAP discussed inconsistencies among numbers, for example, “18 injured” in “N[orth] Medical”, “40 injured" in “S[outh] Medical”, “Triage reporting 48 injured”, and “90 injured” in “Double tree Hotel”. Although the discussion regarding these discrepancies took relative fewer interactions and shorter durations than in the 1st observation, findings in two observations indicate that the members of the IMTs had difficulties integrating multiple pieces of incident information.

(ii) *Confusing and inconsistent information* (9 instances): Although collocated in one facility, the IMT members had confusion over specific terms or event-specific information communicated from different sources. In the *Mass Evacuation Point* episode from the 2nd observation, ICS209 and MAP sought to find correct street names of the shelter between "Angelo" or "Antelope", and between "Westpoint" or "West Point". As a result of the confusion, the members experienced difficulties in locating and labeling the shelter on the incident mapping tool. A similar confusion occurred in naming the *Emergency Medical Center* in the 2nd observation. For example, I&I2 asked MAP, "Are these centers or stations?" and MAP answered that they are "medical groups". The confusion over words and inconsistent terms caused 11 more interactions spending additional 46s of SIIL among associated members whereas no such confusion was found in the 1st observation.

Several instances of ambiguity about event-specific information were identified. In particular, the IMT members took efforts in identifying names of specific facilities to ensure proper event logging. To give an example, as illustrated in Fig. 10, SITL and I&I2 were looking for specific names of the two medical centers so that they could display the names on the incident mapping tool. They asked different roles such as Operations personnel and Command Liaison Officer. After they realized that the medical centers could be broadly categorized as "north" and "south", they began to use "N medical" and "S medical". This instance shows that an attempt to increase the thoroughness of information (e.g., identifying the exact names of the medical centers) came at a trade-off of reduced efficiency, resulting in 55 more interactions and 200s of SIIL (23% of the episode's SIIL).

(iii) *Adaptive behavior to excess information* (4 instances): Our analysis showed an excess amount of incident data was fed to Situation Unit (5.5 min and 3.3 min per new incident input in the 1st and 2nd observation). With the higher incoming rate of incident data, recipients may have had to adapt by improvising their own ways. During the *Initial Field Report* episode in the 2nd observation, SITL exhibited such improvisation when he grabbed a small plastic box near him and placed the box next to his computer stating to I&IL, "Just consider this my inbox. You slap this stuff [e.g., a field assessment report] right here and I'll enter it as I go." By putting an inbox as a buffer for the influx of incident data, SITL was able to enter information into the event log at his own pace. Actual interactions that happened between SITL and I&IL are presented in Fig. 11.

(iv) *Addressing inadequacy of interaction mediators* (4 instances): To follow incident management protocols such as ICS, the IMT members were expected to use designated paper forms (e.g., ICS 213 general message). However, users of the paper forms often expressed their complaints regarding readability of handwritten notes and additional efforts for typing the handwritten notes and printing copies of typed documents. In the *Injury/damage Update* episode of the 1st observation, I&IL after taking a note of a field report stated, "Okay, [a field observer] just gave me a bunch of [expletive] and [SITL] can never read my handwriting". In the *Potential Gas Leak* episode of the 1st observation, I&IL also expressed a nuisance of printing copies for conveying a field report to others saying, "Hey, I need a better way of sending it to you. Needland PD 140 reports possible gas leak at William and Water street. We'll just print it off and I hate, I hate printing it off." To that end, I&IL quickly changed his communication method to an email to address the issues associated with the paper forms.

5. Discussion

Investigating resilient behaviors in the IMTs has proven to be

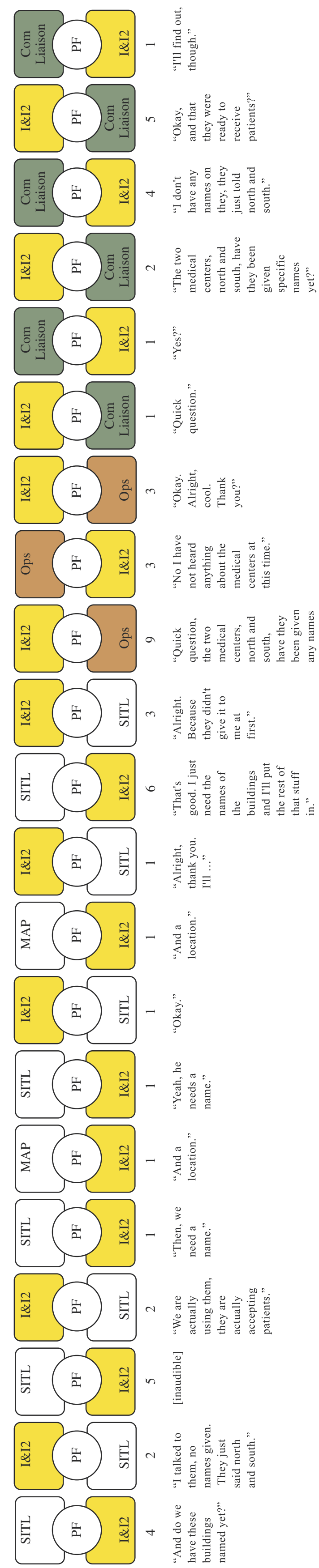


Fig. 10. An excerpt from Emergency Medical Center from 2nd observation regarding the names of two medical centers.

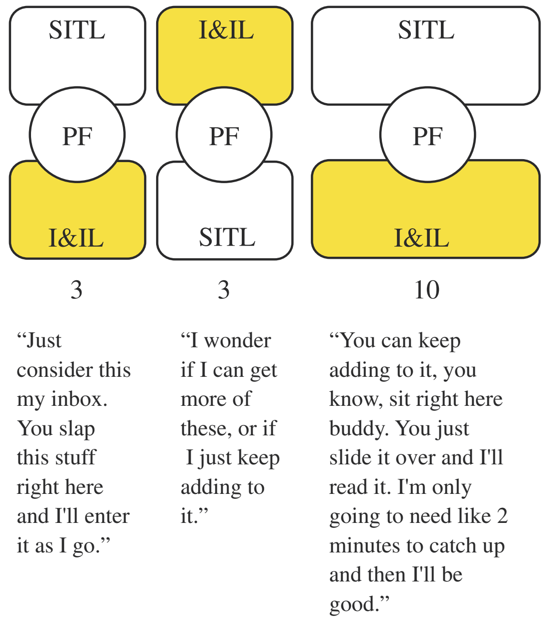


Fig. 11. An excerpt from Initial Field Report in the 2nd observation.

challenging. While Resilience Engineering (RE) literature provides several important frameworks, operationalization of these frameworks to understand resilience in the IMT requires context-dependent metrics as well as methods for focused evaluation of complex team interactions. While comparison between WAD and WAI shows promise in identifying important resilient behaviors in this domain, a rigorous approach to describe WAD remains a major gap (Patriarca et al., 2018). To fill such research gap, the present study introduced the Interaction Episode Analysis (IEA); a novel method to facilitate detailed investigations of WAD through modeling the three C's of interactions among IMT members. To better describe the IEA and illustrate its efficacy in the field of practice, two naturalistic observations of the IMTs were conducted. By utilizing data obtained from high-fidelity emergency exercises, we extracted multiple episodes as instances of WAD and provided some measures that characterize the episodes (e.g., frequency, duration, frequently interacted roles, and mediating technologies). Moreover, the IEA enabled the identification of the information management processes, challenges experienced in such processes and adaptive behaviors exhibited to address the challenges. The IEA's utilities and limitations as well opportunities for future research are discussed below.

5.1. IEA as a descriptive method for WAD in complex team environments

This paper provides some preliminary evidence suggesting that the IEA can be used as a descriptive method to delineate a multidisciplinary team's WAD of coping with given demands (i.e., injects). In particular, using *episodes* as the unit of analysis shows promise in providing convenient boundaries to such complex phenomenon and facilitates focused analysis of abstract constructs such as resilience. While the construct of episode has been advocated for in the research methods literature (Annett et al., 2000; Miles and Huberman, 1994; Polkinghorne, 1995), operationalization of episodes as a methodical way has been limited (Annabi et al., 2008).

By applying the IEA to the data collected from two observational studies of representative IMTs, multiple common episodes were obtained. The representative episodes identified in this studies, were used to assess primary incident-related information needed and information management phases of collection, evaluation, and dissemination. While previous approaches to model WAD have been interpretive in that they relied on analysts' observations and knowledge to explain the team activities in the field (Furniss et al., 2011; Kendra and Wachtendorf, 2003; Mendonça, 2007), the interaction-based approach taken in the current study shows its utility to describe a team's actual emergent performance focusing on three crucial elements, namely, *Context*, *Characteristics*, and *Content* of an interaction between team members. While content analysis has shown promise in qualitative research to describe team actions or communications, the analysis of context and characteristics of interactions provides a fuller picture that enables the investigation of what roles and technologies in the team are more coordinated to handle a particular demand on a temporal dimension. Given the prevalence of complex interactions among human system elements and the vital role such interactions play for the system to adapt to given demands (Woods and Hollnagel, 2006a), the IEA serves a need for reliable, generalizable, and operationalizable interaction analysis and modeling methods.

5.2. IEA as a comparative analysis method

In addition to its utility to enable the focused investigation of episodes by depicting WAD in complex teamwork scenarios, the IEA can be used to compare WAD in similar scenarios. While previous studies that employed episodes illustrated a simple temporal progression of the episodes (Gomes et al., 2014; Rankin et al., 2013), the studies rarely utilized evaluation criteria that allowed comparisons between similar contexts. In this paper, several evaluation metrics were introduced to demonstrate the efficacy of the IEA to enable comparisons between the episodes with similar demands. For instance, the *Emergency Medical Center* episode shows a large difference in *frequency of interactions* and *sum of individual interactions' length (SIIL)* between the two observations (1st obs.: 32 interactions for 342s of SIIL vs. 2nd obs.: 195 interactions for 866s of SIIL). In addition, the *most involved roles* and *most used technologies* were different (MAP (34%) and face-to-face (44%) in the 1st observation and I&I2 (30%) and paper form (58%) in the 2nd observation) (Table 3). Such differences may trigger additional inquiries to investigate deviations from known WAIs (e.g., expected interactions between specific roles mediated by certain technologies).

In addition, this paper shows that the IEA can be used to evaluate if expected phases of information management in the IMTs (i.e., WAI) are realized in the episodes as instances of WAD. Despite promise shown in the current study, defining context-dependent WAI remains an important challenge. For example, while general phases of initial size-up, collection, evaluation, dissemination, and updating were expected in our study, our findings suggest that not all phases of information management were present and that different interaction patterns existed under each phase. Previous research has used SOPs to operationalize WAI with their implementation investigated as WAD (de Carvalho et al., 2018). Nevertheless, making SOPs that cover all the possible incident scenarios is an onerous undertaking, especially in the disaster management domain. Therefore, future work is needed to examine how WAI can be established in different incident contexts to facilitate the comparison between WAI and WAD.

Furthermore, the IEA advocates the utility to capture and interpret particular instances of interest from field practices. We presented four narrative categories of the challenges and associated resilient actions of IMTs as achieved in the literature (Furniss et al., 2011; Militello et al., 2007; Patterson et al., 2020; Rankin et al., 2013). In line with recent WAD visualization methods (Walter et al., 2019) the IEA makes it possible to further describe how often such instances occur, what roles are primarily involved, and how a technical tool mediates interactions between roles. It should be noted that the findings regarding challenges and resilient behaviors were mostly derived from a particular section or unit (e.g., Situation Unit or I&I Unit) of the IMT. Thus, future research is needed to examine how the IMT at a system level can exhibit resilient strategies (e.g., avoiding an anticipated hazard) depending on essential resilience functions (e.g., monitoring and anticipating) (Hollnagel, 2011; Lundberg and Johansson, 2015) in dealing with a specific hazardous scenario.

Lastly, the IEA provides a visual representation of episodes that can further facilitate the understanding of WAD emerging from complex work settings. As shown in the graphical illustration of episodes, the IEA first supports viewers of episodes in readily perceiving its relative length generally determined by the number of interactions involved in the episode. While the temporal progression of episodes was depicted as a single bar in a previous study (Rankin et al., 2013), the episodes illustrated in this paper provide much richer visual features such as graphical symbols for roles, technologies, and colors for different sections (Fig. 4). Taking advantages of these features, viewers can easily recognize which sections are involved and how the involvement changes over time. Such visual features also enable viewers to quickly recognize cross-sectional interactions, that is, a mixture of role symbols of different colors. For instance, three cross-sectional interactions (I&I Unit – Situation Unit, I&I Unit – Operations, and I&I Unit – Command) and their relative lengths can be easily conceived from Fig. 12. Also, the graphical representation readily reveals that a paper form is a dominant mediator of the interactions.

5.3. Limitations and future work

Several limitations should be addressed in future work. There were some limitations related to the observational context. First, it is to be noted that our study was conducted in a simulated environment. Thus, some features induced from a real incident such as stress or fatigue may have not been rendered well. However, given that opportunities to observe a real emergency are rare and the risks involved in doing so, the EOTC is considered a reasonable alternative as it serves the gold standard in emergency management high-fidelity simulation by replicating the functional and physical settings of an incident command facility and providing realistic incident scenarios. An additional limitation is that not all IMT trainees participated in the study. Therefore, these roles were excluded from audio-recording. Due to such missing data, some episodes were analyzed only in one of the two exercises, not both. Having an identical set of roles in a future study would enable a comparison between two episodes under more homogeneous conditions. One of the challenges in naturalistic studies including ours that involve audio-recording is the presence of noise. The noise recorded in the audio often prevented our research group from accurately transcribing and extracting metadata, sometimes resulting in '[inaudible]' in the transcripts. While audio-recorders were attached to participants' vests for convenience and unobtrusiveness, future studies may utilize headsets for improved audio quality. Another important challenge for the data collection was the large size of the IMT (about 45 members). This resulted in difficulties in identifying certain roles for real-time and retrospective coding, particularly, when a role incumbent of the Planning Section was interacting with another from other Sections (e.g., Operations, Command).

Second, there exists a limitation that arises from different compositions of the IMTs between the two observations. Variability in the IMT members' level of expertise and area of specialization (e.g., law enforcement vs. firefighting) may have affected the team task performance such as information management. Hence, a future study needs to reduce the variability by balancing such individual characteristics of IMT members. Furthermore, a relationship between the layout of the simulation facility and interaction patterns may exist. As indicated in Table 3, interactions frequently took place between adjacent units such as Situation and I&I Units. While the influence of proximity on communication between members has been studied (Roberts et al., 2019), future research is necessary to examine how spatial configurations and layout affect interaction patterns in the IMT setting.

Third, the IEA facilitates the analysis of *how* episodes developed differently in coping with the same information input (e.g., locating Emergency Medical Center) and the speculation of *why* such difference might have occurred (e.g., confusing names of the Center). Nonetheless, the IEA requires further methodological rigor to better support analysts

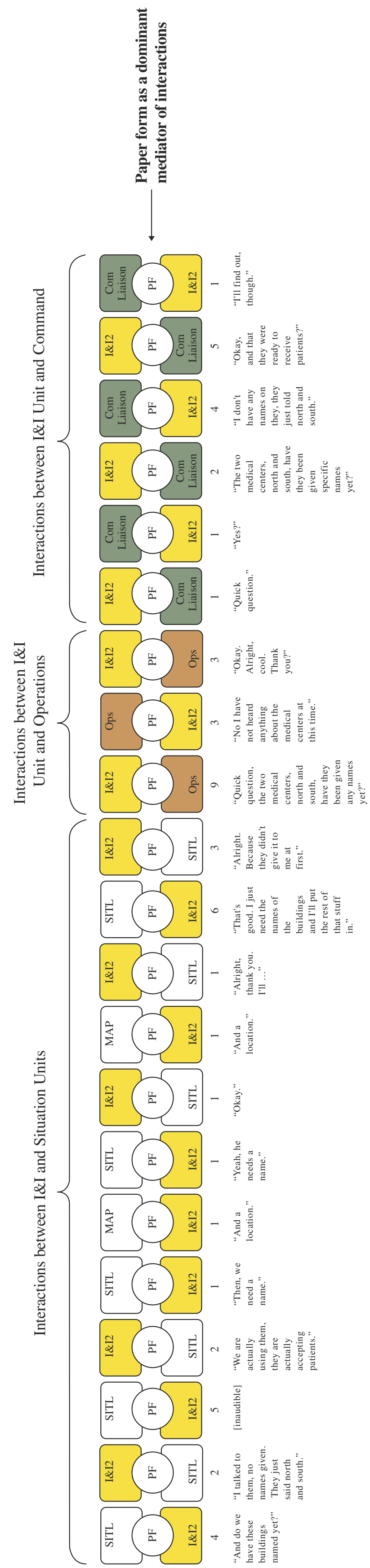


Fig. 12. Three blocks of cross-sectional interactions in the episode of Emergency Medical Center in the 2nd observation.

in unraveling the underlying reasons why the IMT members exhibit different behaviors, for instance, through debriefing sessions where participants can revisit their situational awareness, decision-making, and actions taken during the episodes.

Finally, while the IEA shows promise as an analytical method to investigate complex team interactions, the utility of the method to capture complex multi-tasking scenarios should be further investigated. To alleviate the substantial amount of efforts and expert knowledge required for the application of the IEA, a computerized software tool that eases the entry, analysis, and display of the interaction data is worth being developed. In addition, while representing interactions on a temporal dimension is a strength of the IEA, such presentation is sequential. To address the weakness, social network approaches that provide relational structure established over a certain period (e.g., Stanton and Roberts, 2019) may be adopted. Some interactions in a complex team environment may take place in parallel whereas the IEA represents serial dyadic interactions in its current form. In our study, we observed that interactions among more than two roles often occurred. For example, the first part of interactions in Fig. 12 took place among I&I2, MAP, and SITL. Although the overall interactions appeared to be polyadic (i.e., involving more than two actors), such multiparty interactions were largely composed of multiple dyadic interactions, which were captured by the IEA in line with the original development of episode approach (Korolija and Linell, 1996).

6. Conclusion

This study introduced a novel approach called Interaction Episode Analysis (IEA) to extract and describe WAD in complex team work, and applied the IEA to naturalistic emergency operations exercises to demonstrate its efficacy. Based on interactions between members of a multidisciplinary team, the IEA shows promise to enable the analysis of the IMT's emergent information management performance. Given previous studies' reliance on narrative accounts of actual team activities, the IEA provides an alternative method to investigate complex team work. By providing a rich descriptive representation of WAD, as well as comparative and evaluative utilities, the IEA may help understanding emergent interactive team performance and the impact of mediating tools in coping with either expected or unexpected demands, often referred to as resilience. While several limitations need to be addressed, the IEA shows potential to serve as an analytical method to understand WAD in a wide range of collaborative domains, facilitating the comparison with known WAIs to create more resilient team performance.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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