Managerial Challenges in Early Disaster Response: The Case of the 2014 Oso/SR530 Landslide Disaster

Hans Jochen Scholl
University of Washington
jscholl@uw.edu

Sarah L. Carnes
University of Washington
slc12@uw.edu

ABSTRACT

The larger the scale, scope, and duration of a disaster, the higher is the number of response units. However, with more units involved in the response also the heterogeneity of responder units drastically increases in terms of capabilities, experiences, practices, techniques, tactics, and procedures. As a result, the coordination and overall management of the response becomes an increasingly challenging endeavor. In the response to the 2014 Oso/SR530 landslide disaster in Washington State over one hundred agencies were involved, which presented a huge coordination task for the incident command. This empirical study is exploratory and focuses on the activities and interactions of professional responders, particularly, in the early phases of the response. It amends and complements previous studies on the subject by identifying and describing in detail various challenges in the early response. It also discusses recommendations on how to tackle and potentially mitigate the challenges identified in future responses.

Keywords

Incident Command System (ICS), National Incident Management System (NIMS), coordination challenges, resource challenges, training and preparedness challenges, collaboration, communication and information sharing.

INTRODUCTION

The most massive landslide (not attributable to volcanic activity) in the history of the United States occurred near Oso, Washington in the morning of Saturday, March 22, 2014 at about 1037 hours. Forty-three people lost their lives along with an unaccounted number of animals. Within a minute over fifty residential structures vanished from the face of the earth, and the Washington State Route 530 (SR530) was engulfed by mud and debris at a length of more than one mile (Lombardo, et al., 2014).

The enormity of the incident was only slowly understood, so it took the Governor ten days to request the declaration of national disaster from the President. The response and early recovery effort extended for almost three months, and the SR530 only opened to the public in late September that same year, after the mud and debris cover had been removed and the highway had been partly rebuilt. Even two years after the slide, the debris field is barren and uninhabitable.

The response involved a total of 119 agencies from all levels of government including the National Guard, the Coast Guard, the State Emergency Management Division, FEMA Region X, Snohomish County, the Department of Natural Resources, EPA, neighboring jurisdictions such as King and Pierce counties and the City of Seattle among others as well as dozens of relief organizations. Over one thousand individuals were part of the response.

When categorizing the Oso/SR530 disaster along the Fischer Scale (Fischer, 2003, p. 100), this incident can be classified between DC-4 and DC-5 (small town to small city with major scale, duration, and partial scope). It was not anywhere near a DC-8 (massive large city) disaster or a DC-9 catastrophe (affecting several densely populated areas). Nevertheless, the response to this DC-4-to-5 incident was enormous in scale and duration, and it required the mastery of highly complex managerial, operational, and tactical tasks.

Since 2004, the National Incident Management System (NIMS) with its core, the Incident Command System (ICS), has been mandated and used to facilitate and unify the coordination and management of emergency and disaster response across the United States (Anonymous, 2008). NIMS along with the National Response Framework of 2013, which "describes the principles, roles and responsibilities, and coordinating structures for

delivering the core capabilities required to respond to an incident" (Anonymous, 2013, p. i), provide the nationwide foundations for responding to all kinds and scales of hazards in the US. ICS, when combined with other pillars of NIMS, including Preparedness and Resource Management, establishes a governance framework for multifunctional and multi-jurisdiction preparedness, response, recovery and mitigation. This framework of "good practices" is designed to provide an efficient means of delegation of authority, joint decision making, coordinated operations and resource management as well as information sharing. The emergency management community has adopted NIMS to mitigate challenges that are rife in ad-hoc or unstandardized planning and response. Standardized training is available for all levels of government (local, state, and national). Practitioners, that is, emergency managers and responders, however, emphasize that classroom training is imperative but is only effective if combined with planning, coordination, training, exercises, and, of course, real world experience.

While the mostly linear-hierarchical structure of NIMS/ICS appears highly robust and well-suited for smaller-scale and smaller-scope incidents such as wildfire responses, despite the strong support from the practitioner community, in academia it has been seriously questioned regarding its effectiveness and suitability for larger-scale, larger-scope, and longer-duration incident responses such as national disasters, and, in particular, catastrophes (Wenger, et al., 1990), for example, of the magnitude of the 2011 Eastern Japan earthquake-tsunami-nuclear incident.

Although a number of empirical studies have been conducted attempting to identify and understand the specific managerial challenges, which responders face in disasters of higher order (DC-3 and higher), the results are anything but clear-cut and rather at variance, somewhat vague, and high-level. By and large, practitioners are in support of NIMS (Cole, 2000; Hansen, 2007), whereas a number of academics have remained critical of the framework (Buck, et al., 2006; Kapucu, 2009; Waugh Jr, 2009). Yet, no clear evidence for the efficacy of NIMS/ICS or the systemic absence thereof has been produced by empirical studies in recent years.

The object of this study is to help further identify, describe, and understand specific managerial challenges in disaster response as they were observed and analyzed in the context of a DC-4/DC-5 category disaster. Furthermore, the study also focuses on the practice or absence of along with obstacles to use ICS and the NIMS framework in this particular disaster with the aim of assessing its acceptance and versatility in a fairly complex response.

For this study, first responders from several levels of government were interviewed, among whom were the local responders first on site, members of the Snohomish County Emergency Operating Center, the incident commanders, responders from neighboring municipalities and counties under mutual-aid agreements as well as urban search and rescue teams (USAR) along with the State Emergency Management Division (EMD), the WA National Guard, and FEMA Region X.

The paper is organized as follows: First, the extant literature on managerial challenges in disaster response and on NIMS/ICS is reviewed. Then, the study's research questions are outlined, followed by the methodology section. Next, detailed findings are presented. Finally, a discussion of the insights from the findings is presented, and conclusions are conferred along with directions for future research on the subject.

RELATED WORK

The challenges to organized behavior in the response to disasters has been studied for decades (Dynes, 1970; Dynes and Aguirre, 1979). Quarantelli pointed at three particular areas of concern, (a) information flows between and among responder units (particularly, in the context of inter-organizational and cross-jurisdictional information flows), (b) range and specificity of response tactics relative to the range and specificity of disasters, and as a result of these, (c) inter-organizational and cross-jurisdictional coordination problems (Quarantelli, 1988). In a later contribution the same author cautioned against the belief that information and communication technologies (ICTs) alone could completely address and potentially solve the information flow and coordination problems (Quarantelli, 1997).

Such worries notwithstanding, over the years practitioners and academicians alike have proposed and introduced ICTs as adequate means to help address and improve all three areas of concern in disaster preparedness and response. Socio-technical systems including decision-support systems have been proposed to improve all aspects of response management (Comfort, et al., 2004; Mendonca, et al., 2001; Militello, et al., 2007). Multiple empirical studies have confirmed and illustrated the centrality of information in coordinated disaster response (Bharosa, et al., 2010; Dawes, et al., 2004; Scholl, et al., 2017). Amongst the many obstacles for sharing information during disaster response the lack of pre-disaster aid agreements, different organizational cultures, time pressures during the response, information overload, bounded rationality under duress, tunnel vision and lack of big picture, and the lack of knowledge regarding information needs of other collaborating responders were repeatedly observed (Bigley and Roberts, 2001; Endsley, 1995; Kapucu, 2005; Scholl, et al., 2017). The simplification of the information process, the adherence to coordination and facilitation procedures, and the implementation of information filters have been proposed to deal with the observed complexity of the response (Kapucu, 2005).

On federal level within FEMA and its State-level equivalents such information sharing procedures had been developed to some fair degree; however, in the course of the forming of the Department of Homeland Security (DHS) and FEMA's fold-in into the then new organization many of these procedures might initially not have been maintained (Waugh and Streib, 2006).

As shown elsewhere (Endsley, 1995; Endsley, 2015; Endsley, 1995; Scholl, et al., 2017), both vertical and horizontal information sharing are prerequisites to shared situational awareness (SSA), which in turn allows for the development of a shared common operating picture (COP) that collaborating responder units, which do not necessarily belong the same jurisdictions during a response, are able to jointly adopt, and upon which they are enabled to base their coordinated response. Coordination of response efforts and collaboration of responder units, hence, ideally go hand in hand based on open communication and information sharing channels among them in both vertical and horizontal directions. However, as scale, scope, and duration of disasters (Fischer, 2003) increase, the complexity of collaboration, coordination, communication and information sharing also increases significantly (Chen, et al., 2008; Comfort, et al., 2004; Dawes, et al., 2004; Drabek and McEntire, 2002; Dynes and Aguirre, 1979).

As a case in point increased complexity of coordination, collaboration, communication and information sharing during the response to the 9/11 terrorist attacks has been reported in a number of studies of the account (Comfort, 2002; Dawes, et al., 2004; Kendra and Wachtendorf, 2003; Wachtendorf, 2004). As one of the reactions to the 9/11 attacks, in 2004 the Federal Government made the National Incident Management System (NIMS) and its core, the Incident Command System (ICS), a national framework and standard for the response to all hazards including man-made disasters (Tierney, 2009; US_Department_of_Homeland_Security, 2008; Waugh Jr, 2009). NIMS and its ICS core implement a predominantly hierarchical command and control structure representing an extension and further development of the original wildfire response-based ICS (Cole, 2000), which had been developed by firefighters over several decades (Stambler and Barbera, 2014). Despite its strong support by practitioners (Cole, 2000; DeCapua, 2007; Hansen, 2007) even the original wildfire-based ICS had drawn quite some criticism from various academics (Drabek and McEntire, 2002; Neal and Phillips, 1995; Wenger, et al., 1990) who saw the system prone to information losses and ill-suited for large-scale responses beyond a narrow set of tasks specifically pertaining to wildfires even before ICS was expanded and became the core of NIMS. In particular, the integration of non-governmental organizations and volunteers in the response was characterized as weak under ICS (Wenger, et al., 1990).

After the formal introduction of NIMS/ICS as national incident response framework and standard in 2004 the academic commentaries on the system did not become any more favorable, at least not immediately: While some scholars bemoaned a dilution of ICS within the new all-hazards framework (Stambler and Barbera, 2014), or, found information flows negatively impacted by the command-and-control structure (CCS) (Kapucu and Garayev, 2016; Kapucu and Hu, 2016), or, claimed a lack of equal effectiveness of NIMS/ICS across hazards other than wildfires (Jensen and Waugh, 2014), yet other scholars appear to have at least begun considering the aforementioned supportive practitioners' accounts along with a more empirical evidence-based approach to assessing and evaluating the emerging impact and effectiveness of NIMS/ICS (Jensen and Thompson, 2016). The latter two authors clearly indicate that they found the empirical basis for the extant academic evaluation of NIMS/ICS to be still extremely small. In particular, by not empirically covering the wide scale, scope, and duration of disasters (Fischer, 2003)it is difficult to draw any clearcut conclusions regarding the system and its effectiveness across hazards and disaster types.

Subsequently and as outlined above, this study's object is to help narrow the identified empirical gap by better understanding the specific managerial challenges during a DC-4/DC-5 disaster, that is, the 2014 Oso/SR530 Landslide disaster. In particular, the study investigates the uses (or, non-uses) of NIMS/ICS during the response, which leads to the following two research questions.

RESEARCH QUESTIONS

Research Question #1 (RQ#1): What were specific managerial challenges during the multi-agency/multi-level response to the 2014 Oso/SR530 Landslide?

Research Question #2 (RQ#2): What were the specific challenges regarding the use of NIMS/ICS during the multi-agency/multi-level response to the 2014 Oso/SR530 Landslide?

METHODOLOGY

Instrument and Coding Scheme

Based on the conceptual framework of resilient information infrastructures (RIIs) (Scholl and Patin, 2014), a semi-structured interview protocol was devised upfront, which covered six topical areas of (1) management and organization, (2) technology, (3) governance, (4) information, (5) information infrastructure, and (6) RIIs/resiliency. A total of thirty-six interview questions and probes were incorporated.

Sample

The sample was purposive (Ritchie, et al., 2003) and included responders from nine different groups: the (1) local responders, (2) County Emergency Operations Center, (3) urban search and rescue teams, (4) WA State (type-2) response teams, (5) responders from neighboring jurisdictions under mutual aid agreements, (6) State Emergency Management Division, (7) WA State Department of Transportation, (8) WA State National Guard, and (9) Federal

Emergency Management Agency (FEMA), region X. A total of 31 individuals were interviewed.

Data Collection

Interviews were conducted in person between September 2014 and March 2015 and lasted between 55 to 261 minutes. One interview was conducted via Skype video conferencing. All interviews were audiotaped, transcribed, and coded by at least two coders for analysis. During the interviews also notes were taken and participant interaction was observed and recorded. Moreover, other documents such as after-action reports and press interviews were collected, reviewed, and coded as appropriate.

Data Analysis and Coding

The initial codebook, which was based on the aforementioned conceptual RII framework, contained six category codes (one for each topical area) and 134 sub-category codes. Additional codes were inductively introduced during data collection, in individual coding sessions, and inter-coder sessions. Since a codebook in a hybrid approach of deductive and inductive analyses (Fereday and Muir-Cochrane, 2006) is designed to be open to extension, it ultimately encompassed 151 sub-category codes in the six main categories.

At least two researchers coded each transcript and document by means of a cloud-based software tool for qualitative and mixed-method data analyses (Dedoose main versions 6 and 7, dedoose.com). The coded data were compared one by one and demonstrated high inter-rater reliability.

The code frequency table revealed the highest numbers of code applications in the areas of "management and organization" (2,219), "technology" (968), and "information" (711). For the purpose of the specific analysis on managerial challenges the code intersection represented by the sub-codes of "managerial structure," "address challenges of organizing," and "address challenges of improvising" was selected, which produced a total of 928 excerpts for all nine distinct responder groups.

Excerpts, which were between two and three paragraphs in length, were organized per responder team and conceptually analyzed. Recurring themes and main concepts were identified and named by means of key phrases and keywords. These concepts/context clusters were transferred to the "canvas" of a cloud-based mapping tool (CMAP, version 6.01.01). The concepts/context clusters were inspected and sorted into topical "bins" or "baskets," in which chronological, logical, and other relationships were identified. Relationship links between concepts/context clusters were established whenever evidence from the data supported that link.

Research Team and Processes

The research team consisted of the principal investigator (PI) and more than fifty research assistants (RAs), both for-credit and voluntary. The PI and RAs worked individually and in small teams to transcribe, code, and conceptually/contextually analyze, and map the concepts. The research team met weekly in person or online and communicated via the research project site and the project listserv as well as via individual face-to-face and group meetings. All weekly meetings were streamed and recorded, which kept the whole research team in sync over extended periods of time.

FINDINGS

Ad Research Question #1 *(What were specific managerial challenges during the multi-agency/multi-level response to the 2014 Oso/SR530 Landslide?)*

Overview of Response and Early Recovery

Unlike other emergencies and disasters such as earthquakes, high-wind storms, flooding, wildfires, and "regular" mudslides, for which responders in the Northwest region of the United States are routinely and relatively well prepared, the 2014 Oso/SR530 landslide marked an exception in terms of scale and scope, and finally, also duration (with regard to the recovery effort necessary). Responders' acquaintance to seasonal mudslides, particularly, after extended periods of precipitation, had made those emergencies a routine response endeavor. So, when the disastrous landslide occurred in the late morning hours of Saturday, March 22, 2014, the incident did not trigger an immediate non-routine response, since the order of magnitude of the slide was not understood until much later that day, and its ramifications became only clear after days had passed by. As discussed elsewhere (Scholl, et al., 2017), situational awareness and a common operating picture were only slowly developing, so that responders initially acted mostly on information that presented itself right in front of them. Helicopter rescue crews, for example, although aware of the geographical extent of the disaster, focused first and foremost on searching for and rescuing lives rather than sharing information with other layers of emergency management to create a bigger picture. Likewise, although the responders on the ground palpably experienced the enormity of the damage, they hardly comprehended the enormous destruction along with the dilation and depth of the muddy and treacherous debris field right in front of them. Moreover, since the massive landslide had physically divided the whole valley into two separate entities within a minute's time by deeply burying the highway at a length of a mile,

by disrupting the communication connections, and also by extirpating all identifiable landmarks, the management of the incident was highly difficult and complex from the first moment.

Until darkness made further search and rescue operations impossible on the first day, local responders primarily organized and executed the response. In the interviews they pointed out how uncertain they had felt about the extent of their own responsibility. They further reported about what they had perceived as a lack of clarity regarding processes and procedures. The local responders also described their confusion with regard to how to request resources and support from outside their jurisdiction and the County. Interestingly, the Snohomish County EOC never fully activated during the response and recovery and was left unmanaged by the director of the County Department of Emergency Management. According to EOC personnel, initially and in the absence of any respective preplanning for an incident of that particular caliber, experienced a sense of disconnectedness and disorganization with regard to personnel assignments. As a result, instead of functioning as a hub of coordination and information sharing, the EOC was said to rather have hoarded valuable information and processed resource requests slowly. Adding to the complication, the County's Office of Medical Examiner, when facing mass fatalities for the first time and without respective planning either, turned to a mode of non-cooperation and non-collaboration with other response units including towards the County EOC. This stance would not significantly change even in the following weeks.

On the day after the massive landslide had occurred (day 2), a regional type-3 incident management team (IMT) took over from the completely overwhelmed and exhausted local responders. Meanwhile the State Emergency Operations Center had been fully activated, and FEMA Region X had begun to tentatively, that is, without request, deploy assets and an incident support team to the disaster site. Also, under various mutual aid agreements responders from neighboring jurisdictions arrived at the disaster site. On day 5 (Wednesday, March 26), it became finally clear that the incident was larger than any type-3 IMT could handle, and a State-level type-2 IMT was activated, which shadowed the type-3 team on day 6 (Thursday, March 27) and took over the management of the incident response the following day. The type-2 IMT's expertise lay predominantly in the area of fighting wildfires rather than in complex urban search and rescue operations and respective tactics, which were much needed in this particular incident response. By the time the first type-2 IMT had assumed the management of the response, the Washington National Guard (WANG) had over one hundred personnel on the ground on various missions. Activated WANG personnel would more than triple in number over the next weeks. Urban Search and Rescue Task Force teams were brought in along with FEMA support teams among quite a few others. With the massive influx of response personnel and equipment, however, the coordination task quickly became huge. The first type-2 IMT was replaced by a second type-2 IMT on day 20 (Thursday, April 10). Finally, a month after the incident had happened, the regional type-3 IMT was reactivated and took over the management of the recovery effort.

Coordination, Communication, and Collaboration Challenges

Jurisdictions and Functional Responsibilities

Although compact, relatively small, and in mostly unincorporated county territory, the remote one square-mile area impacted by the landslide spanned several jurisdictions: Snohomish County, the Washington State Department of Transportation (State Route 530) and Washington State Patrol, the US Coast Guard (North Fork of the Stillaguamish River), City Light of the City of Seattle (with respect to the maintenance and access road to power feeder lines along the valley), and several federal agencies such as the Environmental Protection Agency (EPA) and the Department of Natural Resources (DNR) among others. Furthermore, functional responsibilities involved various fire districts around the incident area including the City of Arlington and the town of Darrington. Arlington was also involved with regard to suspected downriver effects, and Darrington was concerned with regard to upriver flooding and affected by transportation cutoff.

The Evolution of a Unified Command Structure During the Response

In part due to the unclear jurisdictional scope, in other part owed to slowly increasing situational awareness and only partial comprehension of the incident's magnitude, a unified command structure evolved in several phases. While the initial local responders (Oso and Darrington fire stations, and Snohomish County Fire District 21) and the Snohomish County Sheriff's Helicopter Rescue Team were on site within less than an hour after the landslide had occurred, on day 1 the coordination between responders on the ground and in the air was minimal, which changed the next day when the regional type-3 IMT took over the management of the incident response and provided superior operational capabilities. The type-3 team operated out of the EOC established at Arlington City Hall. Said one local responder on the ground,

> "When I got to the EOC, I didn't know what Northwest IMT meant, what they did. So I quickly had to learn who these guys were. We did a lot of unified command stuff, but I was not aware that you could call a group of people to come in and manage an incident like that. That was the first big hurdle for me to learn. The second hurdle was ensuring that all the players that needed to be involved were there." (quote #01)

However, the absence of local knowledge regarding the roles and functions of IMTs and the formal aspects of unified command were compounded by the County EOC's disapproval of decisions made at the incident command post (ICP), for example, regarding the involvement of volunteer experts from the Darrington timber company

who helped cut up tumbled trees on the debris field. Likewise, the County resource request processes and procedures appear to have been cumbersome in the first days, if not in first two weeks. Another local responder's response illustrates the problems with establishing a unified command and the tensions between the County EOC and the ICP,

> "So I called over there <that is, the County EOC> and said, listen, we are using them <the volunteers>, period, you can go pound sand... We got to a point of just, screw the system, I don't care about that, I care about getting <needed resources>...and we did. And then <County EOC> logistics they were getting pissed. All right, then get me what we need." <insertions by authors> (quote #02)

The Snohomish County EOC appeared to be caught rather flat-footed by the incident. The director of the County Office of Emergency Management strangely refrained from personally engaging in managing the EOC response operations, but rather left this task to a newly hired deputy who was unfamiliar with both premises and players. As one responder remembered,

> "When I got there on Monday afternoon <day 3, March 24, 2014>, the EOC in my opinion was in a disarray. It was not organized, there was instant command really set up in there. H. was trying to put the pieces together, but she was a new employee, and she didn't know anybody, she didn't have those relationships built. Another challenge was that the county as an organization did not support their emergency management group well." <insertions by authors> (quote #03)

Responders called in under mutual-aid agreements reported that Snohomish County EOC neither issued update reports nor took systematic efforts to share information resulting in skewed information flows, which led to an inability to react to the cascading effects of the still unfolding disaster. The mutual-aid responders also pointed at a lack of transparency regarding task assignments and resource request tracking. Under these circumstances, a unified command structure, which integrated and coordinated the burgeoning influx of responders and resources from outside the jurisdiction, evolved slowly. This would only change when the County under the heavy burden of the response and relieved by the State disaster declaration finally agreed to have the first State-level type-2 IMT take over incident response management and operational coordination on day 6.

When the first State-level type-2 IMT took over responsibility, a unified command structure, which coordinated all response units, finally evolved further, but not without ongoing challenges. For example, still, the lack of compatible radio channels and technical breakdowns would hamper communications. Still, not all response units would have a clear understanding of their assigned roles. Still, uncoordinated and unauthorized public communications would go out. And still, information sharing outside the ICP situation room was difficult. As the incident commander observed,

> "There wasn't really a way that anybody else would know that unless you were right in the command room. There wasn't any posting of that information. There wasn't any dissemination, there really wasn't, so that all the people working the incident had a common operating picture. You know, I just don't, there's just didn't have the organization to do that, or the technology, or that infrastructure that would be required." (quote #04)

The fact that the incident response was managed from the ICP on the Arlington side of the debris field with only a satellite on the Darrington side (which due to the state route cutoff was hard to reach on the ground) caused some frustration on the latter side. Not only was the town's culture with its own mayor and structure very different from Arlington, but the officials and responders felt left out of the loop and not equally included although the response on the Eastern half of the debris field was operated from the Darrington side. Rather than creating an area command structure, the incident commander later deployed a deputy commander to the Darrington side, which was obviously seen as a more parsimonious approach. However, still frictions remained throughout the response, since the debris barrage and the state route cutoff negatively impacted the up-valley communities for months.

Effects of Unwillingness to Collaborate

While most responders reported of great willingness and commitment to collaboration among diverse teams during the response, several groups (including the County EOC) found working with the County's Medical Examiner (ME) had been extraordinarily difficult. While the Office of the ME claimed exclusive jurisdiction over handling all fatalities, at the same time it obviously failed to provide instructions, procedures, plans, or facilities for handling extracted human and animal corpses and body parts. As a result, the urban search and rescue task force (USARTF) had to improvise plans and even set up a makeshift morgue. Said one USARTF commander,

> "In this incident, the medical examiner never showed up, so all investigation was handled by the task force, all documentation was handled by the task force, and we did a great job. I'm very proud of the job that was done. But that's not what we normally do. Normally we find them, extract them, you know, to a place that ... even before we extract them there's somebody documenting it. But in this case, there was none of that. We handled it, and then, in addition, we handled all the protocol for how were we going to move them in the presence of family, in the presence of relatives, and there were no policies that were established by command." (quote #05)

Lack of Standardized Resource Request Procedures

Also, resource request procedures would still not be standardized and effective, and on part of the IMT the County EOC was seen as a difficult partner in the transition. As the first incident commander summed it up,

> "For the first couple of days that we were there, to make sure that we were all on the same page with all of the agencies and people who had been in charge are now following our lead and then working with the County EOC and making sure, we were on the same page with them, was probably the most challenging thing we had." (quote #06)

Interviewees from the Washington State EMD also acknowledged a lack of interagency and inter-level coordination and collaboration due to the lack of practice and rehearsal in large-scale incident response except for responders from FEMA region X. The unified command structure could have been implemented earlier, had the type-2 IMT been activated and involved earlier. The non-standardization of resource request procedures statewide along with insecurity about the source of funding, particularly in the area of search and rescue, was identified as problematic and in need of change. According to one EMD responder, resource requests stalled,

> "So the incident management team requests something, and they request it because it's an operational need for something for them to be able to do something. In the EOC, the question will come up, OK, how are we going to pay for this? And the fact that, you know, if there's doubt — how can we pay for this, or how is this going to work? — that, then, all of a sudden can stall filling the request." (quote #07)

The Problem of Scaling-up the Response Effort

Federal responders from FEMA region X also identified coordination and collaboration problems, which made it difficult to form a unified command early and effectively, part of which were seen as attributable to turf struggles over competencies and jurisdictional reach between State and County, while other problems related to the lack of preparedness at local levels. However, the federal side had difficulties of their own with integrating into a unified command, since not all federal agencies involved would embrace the federal requirement of being coordinated by FEMA in their response efforts. Yet, as mentioned FEMA region X had preemptively moved numerous assets and resources close to the disaster site, but had to hold back on committing them until requested by the State. Yet, the requests came with a substantial and unnecessary delay (from a FEMA perspective). As one FEMA interviewee stated,

> "I think that they <the County and State> thought they could manage it the whole way through. And they really tried to keep control, and I think that things would have gone better if they had asked for help earlier or at all. Because, the help they asked for was very limited, they kind of cafeteria style of I want a little bit of this a little bit of that, and they didn't want to full robust response. It wouldn't have made any difference in saving lives, but I felt the response overall could've gone better in the early stages if they had asked for help earlier. I felt like by the time they had stated asking for help they were already behind." <insertion by authors> (quote #08)

In summary, specific managerial challenges in the response included a lack of comprehending the magnitude of the disaster at local and State levels accompanied by a lack of preparedness at local levels for a disaster of that particular type and magnitude. Further challenges included the confusion over jurisdictional responsibilities and the slow forming of unified command, which would have allowed to assign tasks more effectively, request and deploy resources in a timely fashion, and ramp up the capabilities as necessary more quickly across levels and jurisdictions.

Mitigation of Challenges in Coordination, Communication, and Collaboration

Across teams responders emphasized that better information sharing and information integration would have greatly helped overcome the challenges in coordination, communication, and collaboration. Many interviewees emphasized the importance of in-person and over-the-phone meetings. However, it was said that relying on the spoken word alone would not suffice, but rather systematic integration of relevant and consolidated information (including visualization) was essential, which then had to be disseminated or made accessible vertically and horizontally. Developing pre-disaster face-to-face relationships (via exercises and meetings) was seen as a key pre-requisite to successful coordination and collaboration. Interviewees also stated that using stickers, vests, or other visual identifiers would have helped to determine any individual's role at the ICP, the EOC, as well as on and around the debris field. Inter-agency and inter-team communication as a pre-requisite for coordination and collaboration during the response can also be improved by systematically deploying liaisons who embed with the respective other units and make the inter-organizational connection work. Said one State EMD officer,

> "This is another lesson learned, that we need to do far more work in terms of preparing our liaison officers, making sure that they have the horsepower to go out there and speak for the agency, and that our expectations of them are very clearly understood. So we put somebody into the County EOC immediately, and we rotated folks through there, and they did a good job. If I had it to do over again, I would put a person in the EOC and I would also put another person in the incident command post." (quote #09)

Ad Research Question #2 *(What were the specific challenges regarding the use of NIMS/ICS during the multi-agency/multi-level response to the 2014 Oso/SR530 Landslide?)*

The Lack of Training and Experience with NIMS/ICS

While Washington State EMD and quite a number of county and city EOCs in the State had embraced NIMS/ICS and the National Response Framework (NRF), others such as Snohomish County EOC, public works, or the police had not had any systematic ICS training at the time the landslide occurred. The military, that is, the National Guard, although deeply involved in the response, had its own command structure, and did not use NIMS/ICS structures and procedures. However, in particular, local responders in the impact area had had no formal training in ICS and NIMS-related structure, procedures, and principles prior to the incident. This lack of training showed in the response to the landslide. The principle of unified command was initially not fully embraced. Furthermore, neither the local responders nor the County EOC were prepared to connect with the incoming mutual-aid responders, the various task forces, the type-2 IMTs, and the State agencies on the basis of NIMS/ICS. Absent respective training, no ICS-related planning and no ICS-compatible forms had been prepared. Said one County EOC deputy in hindsight,

> "One of the things I'm going to have them do is I'm going to have them go back to ICS forms. On a day-to-day basis, on their computers. I'd like to see them actually make some ICS forms that look like ICS forms, so when their guys are coming in and logging in in the morning doing different things, they're looking at an ICS form. Because then you know what? When we have the disaster and we hand out an ICS form, they know what it is! If we're going to have tools that we only pull off the shelf in a disaster, one of two things is going to happen: we're not going to know how to use them, or they're going to be broken. Or missing. So whatever you come up with, it has to be something that we can integrate into the system today to some extent and get the people utilizing it. And if you can't, I don't think you'll be successful." (quote #10)

Confusion Between NIMS/ICS and ESFs

Before this backdrop, it was only consequential that the County EOC had serious problems with coordinating the county-wide emergency support functions (ESFs), which coordinate county agencies' and others' support in the case of an emergency, and with integrating them into the ICS structure, which the type-2 IMT and other responder teams expected to be used. This became particularly evident in the handling of resource requests and in the disjoint of logistical structures causing tremendous confusion, multiple ordering, delays, and unnecessary tensions over who was entitled to make what decision. As one mutual-aid responder described the situation,

> "In the EOC, I was kind of amazed at how informal it was when I first got there…Who's in charge? I told all of the responder guys together and all of our PIOs, both personally in the field on our side of things, as well as during the conference calls. I said, 'Guys, there's only one correct answer to this question. It is the incident commander. The incident commander works for the county. He's in charge of all this.'" (quote #11)

The Lack of Standardization in NIMS/ICS and Rising Complexity in Larger Incidents

While NIMS/ICS provides a general frame of structure and procedure, the details of implementation can still vary to some extent, which can make the actual management of an incident response difficult. In so-called home-rule states such as Washington State, where local jurisdictions maintain the final say over a response and over what slices of responsibilities are effectively delegated to incident commanders, the effective management of a response can become fairly complex and even cumbersome, particularly, if the delegation of authority is only partial. As one senior EMD officer stated,

> "It took a while to get a formalized delegation of authority to the IMT, Snohomish County kept the public messaging piece and the resource ordering piece. So, you know, immediately, you have two major functions of an IMT that is not part of the delegation of authority, which tended to interrupt their normal way of doing business, because they now had touch points with the Snohomish County EOC that are not part of their normal procedures." (quote #12)

The delegation of authority in a small incident is a straightforward undertaking, for example, in the case of a wildfire-engulfed small municipality all authority necessary is transferred from the mayor to the IMT. In larger events, this delegation is a far more complex undertaking, and more entities are and remain involved in the decision-making process. Besides the jurisdictional and organizational complexities, which NIMS/ICS mitigates in part, during this response teams also had to work together using a plethora of different technology platforms and only partly interoperable information and communication systems (ICTs) as already reported elsewhere (Scholl, et al., 2017), which made the complex response undertaking even more challenging.

Mitigation of Challenges Regarding the Use of NIMS/ICS

According to responders from almost all levels and teams, more ICS-related training and more frequent exercises and rehearsals using the ICS structure and procedures down to the local levels would make a major difference in preparedness. It became clear in the interviews that the vast majority of responders accepted and welcomed the use of NIMS/ICS as a framework and tool. It was also stated that the integration of ESFs into the ICS structures needed more attention. Moreover, interviewees noted that the use of NIMS/ICS in an all-hazard (rather than predominantly wildfire) settings needed to be practiced and further developed. In particular, the USAR Task Force found the type-2 IMT too wildfire oriented and not familiar enough with the requirements and all aspects of urban search and rescue missions. Said one USAR TF commander,

> "The direction that we get from the incident management team normally would be through the form of an incident action plan. And that's the way the incident commander communicates their expectations to the people who are responding. In our case, we published a task force tactical action plan, and we developed our own search planning effort for the first two weeks. And even after the first two weeks, when the incident management team started creating an incident action plan that they shared with us, they still, when it came time to planning the search effort and deciding how we were going to proceed, they still left that to us to decide." (quote #13)

DISCUSSION AND CONCLUSIONS

With a total of 119 government agencies and non-governmental entities involved, the DC-4/DC-5 magnitude disaster, which struck the Steelhead Drive community near Oso, WA on March 22, 2014, triggered one of the most comprehensive multi-agency response efforts in the history of Washington State. Since scale and scope of this type of incident was unprecedented in the State and County's history, responders were not specifically prepared by ex-ante planning nor previous experience, which forced them to improvise also with regard to coordinating their efforts, communicating with each other, and collaborating on a scale and scope, only few of the over 1,100 responders had ever experienced before. As the findings show, information integration and communication problems, both technical, organizational, and procedural, were at the core of a resulting asymmetry of information distribution leading to a lack of a shared common operating picture (COP), which in turn initially hampered effective response coordination and collaboration.

Intense information sharing as a prerequisite for the coordination of efforts across multiple levels and areas of responsibility (Comfort, et al., 2004), however, requires the effective integration of shared information into a shared COP. The technical basis in terms of integrated radio and voice communications among responders, which accounts for the lion's share of all response communication, was not immediately available and only established after several days into the response. Moreover, the systems used for integrating voice and data, for documenting, for resource requesting, and for consolidating data into actionable information at the ICP, EOC, as well as the supporting units were not easily interoperable, produced enormous amounts of reduplication and error, and required a lot of creative improvisation. Making information and communication systems interoperable and standardizing resource request forms and procedures appear as important steps towards more effective response coordination, which the State's 2014 SR 530 Landslide Commission Final Report (Lombardo, et al., 2014) also found. However, while integrating responders' radio channels and modernizing voice and data communication capabilities (via FirstNet, www.firstnet.gov, and Washington's implementation, OneNet, https://onenet.wa.gov) along with standardizing resource request mechanisms are necessary statewide measures, which address important lessons learned from the incident, the integration and exchangeability, and maybe even, standardization of forms, templates, and documents used in information systems within the operations, planning, logistics, and finance sections as well as in the various IMT and EOC staff functions appear as consequential further steps.

Such integration and standardization of applications used on information systems could help further propagate and unify implementations of NIMS/ICS structures and procedures. The variety of NIMS/ICS implementations, to which responders from various response units were accustomed, presented problems, which, however, were minor compared to the complete absence of NIMS/ICS-related practice and basic understanding observed at the local levels during the incident. As many interviewees repeatedly expressed, more ICS training and more NIMS-based practical exercises would have been desirable before the incident and would have made a major positive difference. However, practical exercises were said to be time and cost intensive, which would present a steep barrier for smaller and less resourceful jurisdictions, unless funding was secured from external sources such as the State or the Feds.

Yet, despite ample NIMS/ICS expertise and experience from practice, responder teams may still bring fairly different task and hazard-specific experiences to the table. It was noted that the type-2 IMTs predominantly had specific wildfire fighting experiences, which would not easily translate to dealing with other hazards such as landslides or earthquakes as effectively. During the incident response this absence of hazard-specific experience became visible when the urban search and rescue task forces interacted with and unsuccessfully looked for direction by the IMT and finally decided to make their own plans and execute them without coordination by the IMT. So, similar to extending and intensifying NIMS/ICS training across responder communities and beyond its traditional origin in the emergency support function 4 (fire fighting), the extended training for "all" hazards will be a time and cost intensive undertaking.

In the Oso/SR 530 landslide response, the described deficiencies notwithstanding, the extent, to which NIMS/ICS

was known and practiced, had a positive influence on coordination and collaboration between fairly diverse response units including non-governmental organizations such as the American Red Cross, which had also embraced and trained along the lines of NIMS/ICS. In contrast, the National Guard had had initial difficulties collaborating on the basis of NIMS/ICS, which led to a number of misunderstandings and coordination problems. These difficulties were attributed to the different (military) core mission of the Guard, which implicates its respective own command structures and procedures that are not specifically attuned to emergency and disaster responses. Interestingly, the Guard concluded from the incident to at least train Guard liaison officers and other personnel in NIMS/ICS in order to better coordinate with non-military responders during future incidents.

As outlined above, the overriding skepticism and outright rejection, with which NIMS/ICS had been met by very prominent and fairly outspoken members of the academic disaster research community in the US (Buck, et al., 2006; Dynes and Aguirre, 1979; Wenger, et al., 1990) until very recently (Jensen and Thompson, 2016), stands in stark contrast to the overwhelming support of NIMS/ICS in the US practitioner community (Cole, 2000; DeCapua, 2007; Hansen, 2007). Also in this study, not a single responder in the Oso/SR530 landslide who was interviewed related any of the above reported coordination, collaboration, or communication problems to NIMS/ICS; but rather to the contrary, the interviewees firmly held that given better training and more practical experience with the framework, its structure, and its procedures on part of all responders involved, would have made the response more effective and better coordinated much earlier.

The notion in the literature that NIMS/ICS solely represents a rather hierarchical command and control structure appears to be correct only at face value. As Hansen observed, in any given practical response the incident command system rather needs tweaking and adjusting to the particular needs and specific requirements of the disaster at hand. Furthermore, given that most resources and support capabilities in the response are provided through the horizontal structure of the fifteen emergency support functions (ESFs) and the military, the disaster response organization rather resembles a multi-layered matrix organization, in which multiple stakeholders with various and sometimes overlapping authority and influence congregate and form a unified command (including area commands, if necessary), which becomes more effective and efficient the more all players understand the structure and its procedures. Advocates of spontaneous disaster response self-organization seemingly disregard that disaster response management, after all, is, not in a small way, a sizable budgetary, fiscal, and economic undertaking, where somebody has to pick up and pay a massive bill in the end. In the US, in the majority of cases and for the most part this will be the federal taxpayer. However, this implies that control with regard to orderly, responsible, and restrained spending of funds and resources needs to be secured via due processes and procedures, which NIMS/ICS is chartered to provide.

This study's object was to report on the specific managerial challenges of a recent major disaster in the Pacific Northwest of the United States. In particular, the study intended to produce additional empirical evidence with regard to the effectiveness of the much criticized National Incident Management System, and its core, the Incident Command System, which became the national standard for response operations in the US in 2004.

The authors would like to note that they are currently studying the Cascadia Rising exercise of 2016—the largest catastrophic emergency exercise in United States' history, which, unlike the DC-4/DC-5 magnitude disaster as the Oso/SR530 landslide, mimics a DC-9/DC-10 magnitude catastrophic incident. This study will complement our earlier efforts as several participants in the Cascadia Rising exercise also responded to the Oso landslide. We anticipate that this follow-up study will reveal some of the improvements made as a result of lessons learned documented in the after-action reports including our research of the landslide. In addition, we expect that chronic or systemic issues might surface again or become further supported by empirical evidence, thereby complementing our research of the Oso landslide.

In summary and in conclusion, this study of the Oso/SR530 landslide response suggests that beyond wildfire fighting, NIMS/ICS appears to work reasonably well, at least, when responding to a massive landslide incident of a scale and scope of a DC-4/DC-5 disaster (Fischer, 2003). This assessment even holds despite the relative unpreparedness and unfamiliarity with NIMS/ICS of local responders, provided regional and State response capabilities are experienced enough using the NIMS/ICS structure and procedures. In future research, the authors intend to study the specific managerial challenges along with the challenges regarding situational awareness and the development of a shared common operating picture in the context of a large-scale exercise mimicking a DC-9 catastrophic event.

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