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Twenty Challenges in Incident Planning

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Abstract:
Disasters create overwhelming demands to affected communities and pose unique problems that complicate efforts of orchestrating the response. It is in such environments of uncertainty, operational friction, time-constraints and the need for interagency coordination that disaster and crisis managers are required to develop incident plans to address multiple demands. Based on observations from 50 disaster exercises, we have identified twenty critical points in incident planning, that is, those incident planning activities which are most challenging for emergency managers, are poorly implemented or otherwise constitute an area for improvement. The most challenging components of the incident planning process were information gathering from the field, running estimates of the situation, response-generated demands, resource capabilities and mobilization time, course of action development and analysis, and decision-making under uncertainty. In addition, this study identified three good practices in incident planning. First, the process is iterative and planners revisit several steps in a back-and-forth fashion. Second, both rational and intuitive decision-making processes are likely to be used during the course of any one incident, based on the time available for planning. Third, better plans are produced when flexibility is built into courses of action to address expected developments of situation or when decision-making is decentralized.

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1 Introduction

Disasters create overwhelming demands to affected communities and pose unique problems that complicate efforts of orchestrating the response. They are complex events that cannot be adequately managed merely by mobilizing more resources. Early disaster research highlighted that emergencies require organizations to develop new goals and objectives, to refine their internal structure, to coordinate and share resources with other organizations, and to establish new structures altogether (Auf der Heide 1989). Emergency planning endeavors to build an emergency response system before disaster strikes (Perry and Lindell 2006).

However, disasters are notorious for running counter to plans (Mileti 1999; Karagiannis, Piatyszek, and Flaus 2010), inevitably necessitating additional planning as the situation unfolds (McEntire et al. 2013). Here, we focus on incident planning, that is, "planning associated with an actual or potential incident, likely under emergency conditions, that involves developing procedures for responding to actual or projected effects" (Federal Emergency Management Agency 2012). In contrast to emergency planning, which takes place before a disaster strikes, incident planning is conducted when a hazard is imminent or after it has occurred, and incorporates situational analysis, decision-making and the development of a plan of action (Perry 2003). Our objective is to elucidate the challenges faced by incident planners and understand whether existing paradigms work in practice as intended.

Previous research has revealed a number of reasons why planning in the aftermath of disasters is extremely difficult, including the volatility and uncertainty of the situation (Larsson, Ekenberg, and Danielson 2010; Johnson et al. 2011), high stress and time pressure (Cosgrave 1996), and various operational impediments, such as resource shortages, conflicting objectives and damage to critical infrastructure (Pauchant, Mitroff, and Lagadec 1991; Flin and Slaven 1996; McEntire 2006; Moynihan 2009). Moreover, the sheer number of different responding organizations and the existence of multiple decision-making centers combined with rapid information flow can rapidly paralyze a response system (Salmon et al. 2011; Huder 2012; Rimstad et al. 2014). Although collaboration and a common operational picture are necessary for achieving speed, unity of effort and interagency coordination, horizontal decision-making often takes more time (Buck, Trainor, and Aguirre 2006; Stambler and Barbera 2011; Boersma, Wagenaar, and Wolbers 2012; Groenendaal, Helsloot, and Scholtens 2013; Curnin and Owen 2014; Jensen and Waugh 2014).

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In addition, the post-disaster operational environment adversely affects situational awareness and is seldom favorable for the rational decision-making approach of everyday management (Barton et al. 2015). Decisions are usually taken intuitively, based on prior experience (Klein 1995; Pearson and Clair 1998; McLennan et al. 2006; Lubitz et al. 2008; Klein, Calderwood, and Clinton-Cirocco 2010). Furthermore, several authors have linked poor decision-making and failures of emergency response systems with unstructured incident planning paradigms (Blanco, Lewko, and Gillingham 1996; Synolakis and Kong 2006; Karagiannis, Piatyszek, and Flaus 2013; Synolakis and Kanoglu 2015).

Despite a growing body of literature on decision-making and organizational aspects of emergency response, incident planning has not been the focus of much research. Here, we begin to address this dearth, using an inductive approach to identify the challenges faced by emergency managers as they navigate through the incident planning process. We investigate incident planning as conducted in the field during disaster exercises, which serve as the standard for validating emergency operations plans. First, we present the incident planning process and provide a brief outline of the major activities involved. Then, we review the implementation of incident planning during fifty disaster exercises. Last, we discuss the practical implications of our results for incident planning and emergency management.

2 An outline of Incident Planning

Incident planning includes analysis and synthesis (Karagiannis and Synolakis 2016). The former involves the organization of critical information, with a view to the identification of the needs generated by the disaster. An appropriate course of action is then proposed and a corresponding plan developed for a determined operational period. The process is circular, with a new operational planning process beginning as each developed plan is approved (Figure 1).

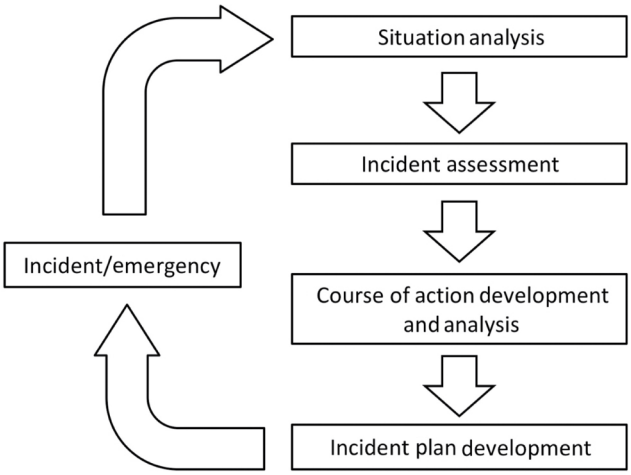

Figure 1: Incident Planning Process.

Incident planning may be implemented by different groups at one or more administrative echelons, which may operate from different locations, depending on existing regulations, the structure of the emergency response system and incident needs (Haddow, Bullock, and Coppola 2008). For a simple incident, such as a small wildland fire or a hazardous materials spill, incident planning will likely be conducted by senior members of first responder agencies, such as fire, police and emergency medical service departments, operating in an Incident Command Post (ICP) (Bhandari, Owen, and Trist 2015). As the incident expands or if multiple incidents occur (for example in an earthquake or flood), local or regional multi-agency coordination groups will likely develop incident plans to provide direction to first responder agencies and support incident management (McEntire 2006). In this case, incident planning will be implemented by emergency managers and senior agency staff in an Emergency Operations Center (EOC). If a disaster becomes a national emergency, incident planning may be carried out by the affected country's national emergency management agency staff. If the disaster warrants an international response, incident planning may be conducted by disaster managers from national agencies and international organizations (United Nations Office for the Coordination of Humanitarian Affairs 2013).

The tiered response principle suggests that emergencies are managed at the lowest possible jurisdictional level, and supported with additional resources and expertise where required. Therefore, incident planning efforts at each level are concurrent rather than mutually exclusive. At the incident level, planning conducted at

an ICP is focused on incident management. Incident action planning identifies objectives and courses of action, assigns tasks to accomplish incident objectives, and addresses direct control to resources assigned at the incident. Beyond the incident level, planning conducted at EOCs is directed towards incident support. This type of incident planning revolves around situational awareness and resource coordination. As the demands generated by the disaster exceed local capabilities, regional and sub-regional EOCs provide situational awareness and develop plans to prioritize the allocation of resources among multiple incidents, to coordinate the deployment of mutual aid resources within their geographical jurisdiction, and may eventually request additional resources from higher levels. National EOCs provide situational awareness to support policy-level decision-making, and develop plans to provide resources to support sub-national efforts and prioritize the allocation of national resources (Federal Emergency Management Agency 2011a, 2011b).

Several organizations have developed documentation to guide the incident planning process (Pandélé 1998; Ständige Konferenz für Katastrophenvorsorge und Katastrophenschutz 2000; International Federation of Red Cross and Red Crescent Societies 2012; North Atlantic Treaty Organization 2010; Federal Emergency Management Agency 2011a; 2012; United Nations Office for the Coordination of Humanitarian Affairs 2013; Interagency Standing Committee 2014; US Army 2014). Despite some differences in the approach followed by each organization and at different jurisdictional echelons, the incident planning process is generally described in four sequential phases (Table 1).

Table 1: Incident Planning Outline.

Phase	Description
Situation analysis	Collect critical and accurate information, in an organized fashion, about the incident. Build running estimates of the situation, based on hazard analysis and information from the affected area.
Incident assessment	Use the information collected during the previous phase to *determine the needs generated by the disaster*. *Analyze resources* to determine the extent to which they can cover disaster- and response-generated demands. *Estimate the required capabilities, assess what is available*, and take action to acquire what is required, but unavailable. *Develop incident objectives*.
Course of action development and analysis	*Develop one or more alternative courses of action*, depending on staff experience and the time available. Courses of action should include specific tasks, the organization or subordinate unit the task is assigned to, the location and time of the action, as well as the available and required resources. *Analyze courses of action* to identify the probable consequences of the actions being planned, including potential difficulties or coordination problems.
Incident plan development	Submit the results of course-of-action analysis to the appropriate decision-maker, who is required to select, approve, modify or disapprove courses of action. The incident plan may be written or oral, depending on the complexity of the situation and the incident tempo.

3 Methodology

Our inductive study of incident planning attempts to fathom the challenges faced by incident managers in the aftermath of a disaster. The visualization of the incident planning process described in the previous section was used as an initial abstraction to relate our research to the existing body of literature, to identify relevant factors, and to provide the connections necessary to structure and frame the problem (Jonker and Pennink 2010). Data collection and analysis were conducted concurrently, following a grounded theory approach (Corbin and Strauss 2008).

3.1 Research Sites

Data collection took place during 50 disaster exercises conducted in Europe (Greece, France and Malta) from 2000 to 2015. Emergency planning and incident management are at different levels of maturity throughout Europe. The following is a brief overview of emergency planning, incident management and disaster exercise doctrine in those countries, based on the authors' experience. It is not intended as a critique, a comparison or a comprehensive overview of emergency management systems in these countries, rather as an outline of the organizational environment in which our sample exercises were conducted.

"Xenokrates" is the code name for Greece's "General Civil Protection Plan". It is essentially a framework for the development of emergency operations plans throughout all levels of government. Since 2003, Greek civil protection regulations have required each level of government to develop a different plan for each hazard. National-level plans established for wildfires, fixed-site hazardous materials releases, and mass fatality management generally follow a traditional functional format (Federal Emergency Management Agency 2010). Guidance for sub-national emergency planning is based on the structure and content of national-level plans. The "Civil Protection Exercise Policy" provides a framework for the design, conduct and evaluation of interagency disaster exercises. This exercise program manual is modeled after the US Homeland Security Exercise and Evaluation Program. Since its publication in 2009, Greece has designed and conducted several exercises, including the first tsunami exercise program in the European Union Civil Protection Mechanism in 2011 (Karagiannis, Saini, and Synolakis 2014).

Incident management is based on geographical and functional jurisdiction, but there is no requirement for unified incident command. Incident support is provided by "Civil Protection Coordinating Instruments" established at the local, sub-regional and regional level. These multi-agency coordination groups include delegates with decision-making authority from a wide range of organizations involved in emergency management. Very few local, sub-regional and regional jurisdictions maintain functioning EOCs. However, the General Secretariat for Civil Protection, the country's national emergency management agency, operates a 24/7 EOC which fulfills a nation-wide response watch function and is the main hub for national-level incident support and multi-agency coordination.

In France, the "ORSEC" system (French acronym for "ORganisation des SECours", or organization of emergency response) is a nation-wide network of interconnected emergency operations plans at all jurisdictional levels. Under ORSEC, jurisdictions are required to develop all-hazards emergency operations plans, each including a basic plan and hazard-specific annexes. With a view to speeding the response, ORSEC is constantly active, therefore eliminating the need for a formal activation of emergency operations plans. Local emergency operations plans are not officially part of ORSEC and have a narrower scope, focusing primarily on evacuation, mass care and public information. However, ORSEC plans are required to be integrated with city/town plans. Emergency plans are based on sub-regional disaster risk assessments, conducted every 10 years by the Department fire service. Since 2004, French civil protection regulations have required each Department (sub-regional level of government) to conduct one full-scale exercise per year. A number of official publications provide guidance for the design, conduct and evaluation of table top, command post and full-scale capabilities-based exercises.

The ORSEC system also integrates the incident management and support functions. When an emergency occurs, or is imminent, the Chief Elected/Appointed Official of the affected jurisdiction becomes the Director of Emergency Operations (in French: "Directeur des Opérations de Secours") and has overall responsibility for incident response. The Director of Emergency Operations coordinates and oversees incident support, and delegates incident command to the Commander of Emergency Operations (in French: "Commandant des Opérations de Secours"), usually a Fire Service Officer. As the incident grows in size and complexity, ORSEC establishes a process for the transfer of incident command to higher-ranking Fire Service Officers and of authority over incident response to officials from higher levels of government. Incident action and support planning are modeled after military tactical and operational planning approaches. Incident action planning is well-established in Fire Service doctrine, and generally follows the process outlined in the previous section. Incident support planning is starting to become institutionalized. Most French Departments maintain a functioning EOC.

Given Malta's size, public administration is centrally organized, and several individual government agencies are mandated to develop plans to deal with emergencies in their functional jurisdiction area. Malta's Critical Infrastructure Protection Directorate, within the Office of the Prime Minister, coordinates national-level emergency preparedness. The Emergency Management Forum, includes representatives from various agencies with a primary role in emergency response. Individual agencies and departments are conducting disaster exercises, and the need for an interagency exercise program has been identified as an area for improvement. In accordance with Maltese Law, the highest-ranking Civil Protection Department officer at an incident site automatically becomes the incident commander. Incident support is coordinated in the Government Contingency Center, which Government Contingency Centre, which functions as a national EOC.

3.2 Data Collection

Our sample consisted of 5 table top exercises, 40 functional exercises and 5 full-scale exercises. Exercises are a critical disaster preparedness activity, aimed at training personnel and putting emergency response systems to the test under realistic conditions (Erickson and Barratt 2004; Decker and Holtermann 2009; Ottis 2014; Van Niekerk et al. 2015). They help assess emergency management systems, and identify strengths and areas for

improvement. Exercise scenarios in our sample included a mass casualty incident, an earthquake, a tsunami, a hazardous materials release and a public health threat. The training audience (also referred to as exercise players) included local and regional emergency managers, as well as seasoned incident managers from Fire/Rescue Departments, Emergency Medical Services, the Police, Armed Forces, Red Cross/Red Crescent and other government agencies, as well as volunteer organizations active in disaster response. The scope of the exercises ranged from local (one municipality) to international (several countries). The diversity in exercise type, scenario, scope and training audience enabled us to observe incident planning in action, under different performance conditions, and interview people having considerable experience with incident planning.

One or both of us were invited to participate in the design, conduct and evaluation of each exercise. As part of the exercise planning team, we worked alongside experienced emergency managers to determine the exercise objectives and build a scenario to achieve them. Setting up experiments to recreate real-world conditions is challenging in all scientific research, but the difficulty is more pronounced in the realm of social sciences. Disaster exercises are designed to replicate, to the extent possible, a realistic learning environment for participants to practice various emergency response functions. Carefully planned and sequenced events and incidents are injected in the exercise play to prompt players to perform the same actions they would in a real emergency. In our study, several injects were designed to gage key aspects of the incident planning process. For example, actors impersonating "journalists" queried incident management team members about the number of injured or dead, the status of critical facilities and other issues to assess players' situational awareness. Other actors played "decision-makers" who asked to be briefed about alternative courses of action. Following the principle of theoretical sampling, the injects were varied methodically among successive exercises, with a progressively shifting focus from how incident managers plan in volatile environments under uncertainty and time-constraints, to the specific activities of the incident planning process.

Data was collected through a combination of unobtrusive observation, focus-group discussions, unstructured interviews and reviews of various types of documentation. Throughout each exercise, we identified critical points, that is, those incident planning activities which were most challenging for incident managers, were poorly implemented or otherwise constituted an area for improvement. During the conduct of each exercise, we observed the implementation of incident action or support planning. Specifically, we contemplated incident action planning during 39 exercises and incident support planning during 12 exercises. The locus of our observations depended on the type, objectives and structure of each exercise (Table 2). Most functional exercises in our sample focused on incident management, therefore lending themselves to the study of the incident action planning process. Full-scale exercises addressed both incident management and support; however, their fast tempo and bottom-up structure provided a fertile ground for the observation of incident action planning. On the other hand, table-top exercises and some functional exercises had a slower tempo and were better placed to accommodate observations of incident support planning. Last, during two full-scale exercises, we had the opportunity to survey both incident action planning (implemented in the Incident Command Post) and incident support planning (implemented in the Emergency Operations Center).

Table 2: Incident Action and Incident Support Planning.

	Incident Action Planning	Incident Support Planning
Table top	0	5
Functional	35	5
Full-scale	4	2

As exercise staff, our access to exercise venues and participants was, in most cases, only limited by exercise safety and evaluation rules. After each exercise, we attended the after-action review (often referred to as "post-mortem" analysis), a focus-group discussion designed to capture key players' view of their performance during the exercise and validate strengths, areas for improvement and lessons identified. The duration of after-action reviews ranged from 30 minutes to 2 hours, depending on the type and complexity of the exercise.

Following each after action review, we conducted unstructured interviews with incident planners, asking them to expand upon the challenges they had experienced throughout the process. Interviewees were asked to describe incident planning activities which were challenging or poorly implemented during the exercise. Based on their initial answers, informants were asked a series of follow-up queries intended to elicit responses helping to further identify and elucidate critical points in the process. Handwritten notes of observations and interviews were taken in the field. Informants were emergency managers and officials from agencies involved in disaster response (fire/rescue service, police, emergency medical service and military) with various levels of training and experience in incident planning. In addition to handwritten notes, we analyzed archival data, including after-action reports, training manuals and field guides.

3.3 Analysis

Detailed analyses of archival material and of the transcripts of field notes were conducted throughout the data collection phase. Concepts and categories were gradually developed using an iterative process of analyzing qualitative data and reviewing the relevant literature. Critical points became the basic units of analysis and were categorized based on the activities of the incident planning process. Once identified, these categories became the foundation for sampling on theoretical grounds. As data became available with each successive exercise, conceptual categories and relationships pertinent to the emerging theoretical elements were provisionally identified. While developing the process-driven interpretation of the data, we revisited the conceptual model of incident planning to correlate our data with the theoretical description of the process, and ensure that the model remained a reasonably accurate depiction of the sequence and activities conducted by incident managers. On each iteration, we compared these ideas to existing research and new data to determine whether to retain, revise or discard our initial concepts. Concepts and categories were considered saturated when no new critical points emerged during 10 successive exercises.

4 Findings

Figure 2 illustrates the frequencies of critical points for each phase of the incident planning process. Each phase is discussed in detail in the following sections.

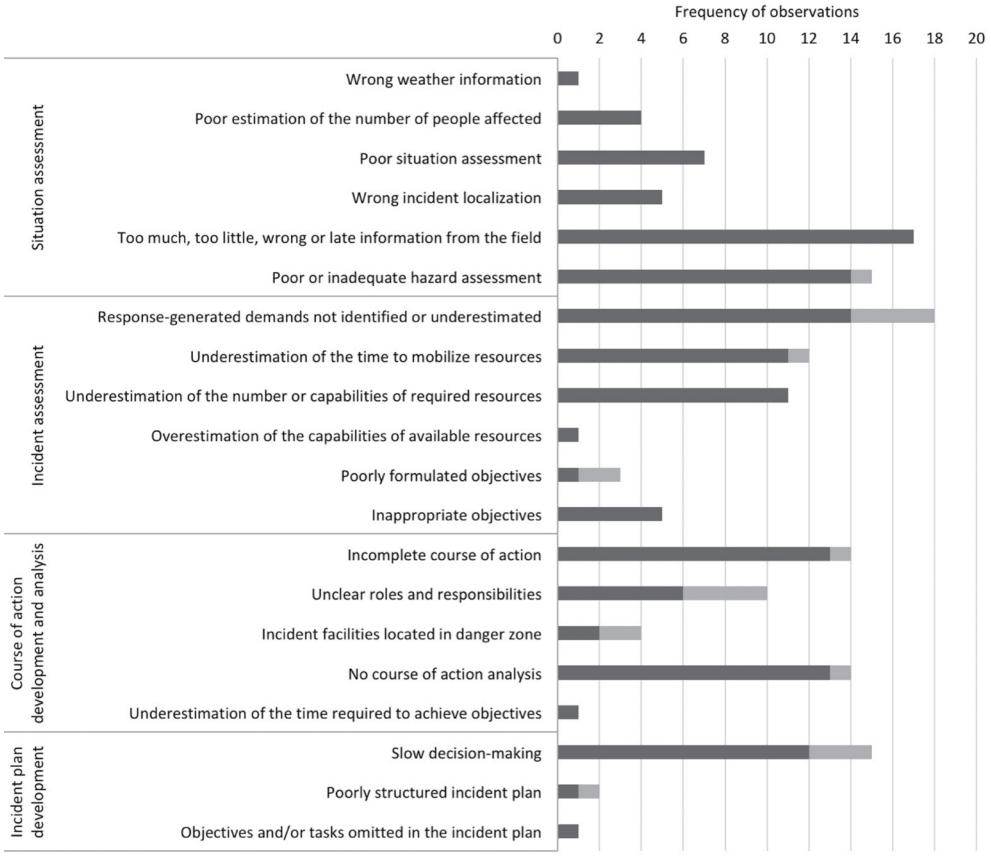

Figure 2: Frequency of Observation of Critical Points.
The darker color indicates observations made during incident action planning, while the lighter color corresponds to observations made during incident support planning.

4.1 Situation Assessment

Our findings indicate that this was the second most challenging phase of the incident planning process, with n_1 = 49 out of N = 160 observations occurring here. Hazard assessment and the flow of information from the field were the biggest challenges for incident managers. Information from the disaster-affected area was problematic in about one third of the exercises in our sample. Insufficient information was the most frequent challenge,

especially with regard to the number of victims and the location of the incident. In addition, reports from the field often arrived late and/or did not accurately describe the situation.

In some cases, information was presented in a way which made its interpretation difficult for non-specialists. For example, in the one mass casualty incident simulation, the triage categories of victims were reported as "red, yellow, green and black", instead of "immediate, delayed, minimal and expectant", making it very difficult for anyone without medical training to understand the ranking. In other instances, information was too elaborate and inundated the incident command post or emergency operations center with data, doing more harm than good. For example, during another mass casualty incident simulation, when the incident command post requested a report on the number of victims, emergency medical services came back with a long list that included a description of the condition of every patient they had triaged, treated and dispatched. Although the number of casualties was relatively easy to extrapolate from the list, time was lost both in compiling the list and extracting the information that was originally requested.

In addition to information from the field, hazard assessment was also an issue for incident managers in our sample, especially in hazardous materials releases. Responders and incident managers encountered difficulties in identifying the substance, determining the size and shape of the affected area, and estimating the potential consequences of toxic gas releases, explosions and fires. For example, in one chemical facility, crisis managers had traditionally relied on material safety data sheets as their only source of information about hazardous substances in the plant. When exercise controllers "misplaced" the material safety data sheet of the substance that was supposedly released in an accident simulation, players spent half an hour trying to find the document, although several alternative sources of information were readily available to them.

This phenomenon was not limited to hazardous materials releases. Throughout our study, incident managers were almost exclusively dependent on information gathered from the field to assess the situation, and avoided developing running estimates based on their analysis of the hazard. When information from the field was readily available, situation analysis was relatively straightforward. However, when exercise controllers simulated inadequacies or delays in information flow from the field, an all too common issue in disaster response, incident managers would sometimes wait until information became available, bringing the planning and decision-making process into a standstill. Furthermore, in a few isolated cases, when faced with limited information from the field, inexperienced incident planners tended to make assumptions based on convenience. For example, some hypotheses implied that the effects of a hazard would be minimal, that agent- and response-generated demands would remain manageable, that evacuations would proceed at an unrealistically rapid pace, and that the outcomes of response actions would be entirely successful. In both cases, when asked to comment on this during after action review discussions, incident planners spoke of a lack of confidence in their technical knowledge about hazards and threats, and emphasized the importance of having access to hazard expertise.

4.2 Incident Assessment

Incident assessment was the most challenging phase of incident planning in this study, amounting for $n_2 = 50$ of our observations. The majority of issues during this phase were related to the balance between demands and resources. First, the underestimation of response-generated demands was the single most frequent observation throughout our study. In more than a quarter of our sample, incident managers underrated and sometimes missed logistics needs. For instance, during one earthquake table top exercise, the need to establish a temporary camp to provide shelter to those affected was promptly identified. However, the camp location was never established and players did not consider the number of tents, beds and other non-food items required to set up the shelter.

Second, several critical points occurred during the evaluation of resources, making this one of the most difficult steps of the incident planning process. Specifically, incident managers tended to be optimistic in their estimation of resource mobilization time and reinforcement requirements. In several cases, external reinforcements arrived considerably later than anticipated, because of daily traffic congestion, mechanical failures or exercise artificialities. Whether simulated or real, the possibility of extended mobilization time was oftentimes not accounted for in the incident planning timeline. Yet such delays were a major operational impediment, especially in situations when the timely engagement of resources was critical to mission success. Moreover, incident managers would sometimes overestimate the capabilities of available resources or request less reinforcements (for example mutual aid or on-call resources) than was needed to achieve their objectives.

Third, two additional critical points stood out in a minority of incident simulations during the incident assessment phase. One, objectives were poorly formulated, that is, they did not specify the expected end result or the time frame for its accomplishment. And two, they were inappropriate, not addressing the needs of the incident. Examples include the absence of post-extinction surveillance of fire scenes, or the establishment of a smaller isolation perimeter than what was warranted by the incident. However, such occurrences remained isolated events.

4.3 Course of Action Development and Analysis

Course of action development and analysis was the third most challenging phase of the incident planning process in our sample. Incomplete courses of action, unclear roles and no course of action analysis were the most frequent observations. In most cases, the tasks that needed to be performed to accomplish the incident objectives were identified, and the general task organization was described adequately. However, in about one third of our sample, task assignments were problematic. Either tasks were not assigned to a specific organization, or the same task was assigned to more than one resources of the same type, leading to duplication of effort. In one example, three search and rescue teams were dispatched to one sector, where only one team was needed, while another sector was left with no resources. In addition, unclear roles and responsibilities undermined incident managers' efforts at structuring the response in about one fifth of our sample. In two cases, the role of a recently established multi-agency coordination system was poorly understood, leading to complications in resource management. In several other examples, when no unified command was established, lines of authority were blurred and it was unclear who was in charge.

In addition, course of action analysis was foregone in about one third of our sample due to severe time constraints. Although this choice saved incident managers planning time, it also led to serious synchronization problems. For example, during one exercise, an area exposed to a toxic gas plume was evacuated, but the order to open disaster shelters was not given until the first evacuees got to the shelter locations. Had a proper course of action analysis been conducted, incident managers would have anticipated the time required for the order to be processed and the action to be implemented, and the shelters would have been activated a lot sooner. In other cases, the courses of action were analyzed rather hastily and critical aspects of the operation were overlooked. Two notable examples include the incident command post being located inside a toxic plume and the base of operations being located a few meters from the beach during a tsunami simulation. In both these cases, appropriate hazard maps were readily available to incident managers, so this was not a hazard assessment problem. In another instance, the operation lasted considerably longer than initially anticipated.

4.4 Incident Plan Development

Incident plan development was the least challenging phase in this study. Slow decision-making was the most frequent observation, occurring during about one third of the exercises in our sample. In most of these cases, decision-makers were uneasy with the uncertainty of the disaster response environment and reluctant to approve a course of action based on limited information. Decisions with potential political ramifications, such as activating emergency operations plans, evacuating endangered areas and releasing information to the public, were oftentimes delayed to gather additional information, a practice which limited the time available to execute the decision. On several occasions, the decision-making was delayed until the decision was no longer relevant. During one tsunami exercise, for example, the decision to issue a warning was delayed until after the first elevation wave (Tadepalli and Synolakis 1996) had arrived.

Another example transpired during a command post exercise simulating a potential public health threat. The scenario simulated several victims on a docked cruise-ship suffering from acute generic symptoms of unknown origin. As these symptoms could be associated with several illnesses, the incident management team promptly ordered that the necessary tests be conducted to identify the cause. However, they delayed all other actions until the test results came back.

Furthermore, course of action selection and validation was slower when decision-making authority was spread among more than one organizations. Our data was insufficient to establish a quantitative model linking the number of organizations and decision time, largely because of the diversity of decisions that had to be made under different conditions. However, more time was consistently required to choose a course of action every time an additional organization had to be involved in group decision-making, even when this occurred during the same exercise. The process was even slower when organization representatives were located at remote locations, such as department operations centers. For example, during one hazardous materials release exercise, the decision to evacuate or shelter-in-place was legally vested upon the Prefect, but the Mayor of the affected community had to advise which areas to evacuate, in what order, where evacuees could be provided temporary shelter etc. In addition, while the order to evacuate was formally issued by the Prefect, it was carried out by the Mayor, so the latter's consultation was required before any decision was made. However, as the Mayor was absent from the Prefecture EOC and unreachable by phone (due to a simulated saturation of the telephone network), several decisions had to be delayed until it became possible to re-establish communications.

4.5 Incident Action vs. Incident Support Planning

During this study, we had the opportunity to observe both action-oriented and support-oriented incident planning. Although they both follow a similar approach, their focus is different, which begs a discussion of the differences between incident action and incident support planning. Although only about 20% of our sample involved incident support planning, the following is a discussion of how planning performance across the 20 critical points varied between action-oriented and support-oriented planning.

All but one of our observations during situation assessment involved incident action planning. The one incident support planning challenge identified transpired during a command post exercise, where EOC staff failed to request information from the ICP. In addition, 7 out of 50 observations involving the incident assessment phase occurred during the implementation of incident support planning. Identifying response-generated demands was the most frequent challenge in both incident action and support planning. There were also a few instances of poorly formulated objectives. However, other than a single case of response time underestimation, resource evaluation seemed to be less of a challenge during incident support planning.

Unclear roles and responsibilities were the most frequent challenge observed during the course-of-action development and analysis phase of incident support planning. Other challenges included the location of incident facilities in the danger zone and a lack of course-of-action analysis. Last, slow decision-making was the most challenge observed during the incident plan development phase of incident support planning.

5 Discussion

Our study has identified critical points in incident planning, or planning conducted under emergency conditions to deal with an actual or projected event. In what follows, we first present successful incident planning practices which emerged during this study. Then, we discuss some practical implications for emergency management practice. We conclude with a consideration of possible limitations and implications for future research.

5.1 Successful Incident Planning Practices

Our study focused on critical points in incident planning, that is, those activities which were most challenging for incident managers, were poorly implemented or otherwise constituted an area for improvement. However, during our observation of the implementation of the incident planning process, it became apparent that three practices were consistently conducive to better planning outcomes.

First, incident planning is described in a linear fashion and planners are expected to analyze the situation, identify needs, determine objectives, and come up with a course of action more or less sequentially. However, the process is in reality iterative, and planners revisit several steps in a back-and-forth fashion, as plans are produced. As more information on the situation becomes available, disaster-generated demands are in perpetual change, leading incident planners to modify the incident objectives. Objectives and courses of action may also be refined to match the capabilities of available resources. In our sample, incident planners who consciously developed running estimates about demands, capabilities and constraints when information was lacking, constantly sought to confirm or disprove their assumptions, and adjusted their objectives and courses of action based on new information, consistently produced more appropriate incident plans faster.

Second, notwithstanding the disparity among incident planning approaches regarding the number of courses of action to be developed, Crichton, Lauche, and Flin (2005) have pointed out that both single and multiple course-of-action approaches can be used during the lifetime of a single incident. Time was the determinant factor in this study. When time was available, incident managers developed and analyzed between two and four courses of action. However, when time was pressing, they only focused on only one or two. "Post-mortem" discussions revealed that in most cases, this choice was made fairly intuitively and the decision was driven by the mere realization that time was short. Yet the incident plans that achieved more objectives faster and got better feedback from exercise evaluators were developed by incident managers who adapted their modus operandi to changing conditions, by switching between multiple and single course of action modes as time allowed.

Third, decision-makers in this study were systematically uneasy with selecting a course of action based on limited information, which is somewhat typical in emergencies. As discussed in the previous section, when faced with the need to decide under uncertainty, some decision-makers tried to reduce the uncertainty by requesting that additional information be gathered and analyzed. However, this only increased planning time and delayed the development of an incident plan, without necessarily adding certainty to the decision-making

process. On the other hand, more successful incident plans were developed and implemented by incident managers and decision-makers who used one or both of the following strategies to reduce the level of certainty required to reach a decision. One, they adapted their decisions based on how the situation was expected to develop and integrated a lot of flexibility in their courses of action to deal with a wide range of anticipated contingencies. Two, they decentralized decision-making to field resources, while maintaining overall strategic direction.

5.2 Practical Implications for Emergency Management

Our findings point to three areas for improvement that may warrant consideration by emergency management agencies. First, situational awareness was found to be one of the most challenging components of incident planning. For instance, when faced with limited information from the field, incident managers in this study sometimes avoided developing running estimates to advance incident planning, because they felt uncomfortable with their level of knowledge about hazards and threats. Experts are often called in to provide estimates about the effects of a hazard. However, not all incident managers may have access to subject-matter expertise about every hazard in their community, or experts may not be able to provide on-the-fly educated guesses. Therefore, incident planning could be improved by enhancing emergency managers' knowledge of the hazards and threats they may face. In 16 out of 20 undergraduate and graduate degree programs in emergency management and related disciplines, offered by universities in the United States and Europe, which we reviewed, natural and technological hazards were only covered as part of an introductory course on emergency management, or in a hazard-mitigation course. Although few would ever expect an emergency manager to be as knowledgeable on earthquakes as a geologist or an engineer, universities and colleges could consider devoting more credit hours of their emergency management degree programs to natural and technological hazards.

Second, identifying response-generated demands, estimating resource capabilities and mobilization time, and developing and analyzing courses of action were also challenging components of incident planning in this study. Concurrently, incident planning guidebooks point out that experience plays a major role throughout these incident planning activities. Therefore, the effectiveness of incident planning can probably be improved by activities that enhance practical knowledge, such as training provided in university curricula and professional development courses. Here, incident planning skills are acquired through a series of progressively more complex practical exercises, requiring trainees to organize themselves in small groups and develop action and support plans to respond to simulated emergencies. Training organizations may revise the objectives of these drills may have to allow students to practice the skills related to the critical points identified in this study.

Third, in addition to information gathering and course of action development and analysis, our study underscores the criticality of decision-making speed; as we found, by the time some decisions were taken, they were no longer relevant. We found that decision-making became slower as more agencies shared jurisdiction and decision-makers were at remote locations. As today's operational environment is fraught with multiple agencies, the added decision-making time should be factored in emergency operations plans. This is especially important when synchronization of activities is critical, such as when planning for evacuations. Developing a common operational picture (Wolbers and Boersma 2013) can save time by facilitating joint and parallel planning.

5.3 Limitations and Future Research

The objective of our study was to identify the challenges in incident planning, with a view to better understand disaster response dynamics and inform emergency management practice. Our findings are based on observations of the implementation of the incident planning process during disaster exercises, which require incident managers to react to emergencies under simulated emergency conditions. One may argue that exercise artificialities reduce a crisis to its essentials so as to advance a predetermined scenario, and that the inferences made based on exercises are not indicative of how incident planning would be implemented in a real setting. This is a similar issue as faced in the physical sciences, where when running physical experiments or mathematical modeling, many prototype details are simply not reproduced and deemed second-order. On the other hand, emergency management practitioners generally agree that meticulously designed and well-conducted exercises test emergency response systems under realistic conditions.

In addition, this study has identified the components of incident planning that posed the greatest difficulties to incident managers and were highlighted as challenges or areas for improvement during disaster exercises. Incident planning methodologies have a solid foundation on management science, have developed from years of disaster response experience, and are highly valued among emergency management practitioners. In our

research, incident managers who followed these guidelines produced better courses of action faster and operations were conducted with less complications. However, data was insufficient to establish a direct correlation between critical points and the selection and implementation of appropriate objectives.

Further research is clearly required to more precisely ascertain the relationship between critical points and the accomplishment of response objectives. Understanding the dynamics of incident planning appears to be an important emergency management skill. By being aware of the potential flaws in their thinking process, emergency managers may be able to navigate the uncertainty of and address the overwhelming demands posed by disasters more effectively.

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