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12 The Role of Responder Networks in Promoting Community Resilience
Toward a Measurement Framework of Network Capacity

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INTRODUCTION

Population shifts and a changing climate are expected to contribute to greater vulnerability to disasters in rural America (Jensen, 2009). In an effort to build more resilient communities, a key focus in the study of disasters has been identifying local-level capacities that can improve the community's ability to respond to—and subsequently minimize hardship from—future disasters (Adger et al., 2004; Birkmann, 2006; Norris et al., 2008). Managing a large-scale disaster usually entails working within an intergovernmental structure with overlapping jurisdictions (Moynihan, 2009). This means local community agencies (e.g., law enforcement, Red Cross, utility companies) need to work collectively with federal disaster management teams to coordinate a response—usually in a networked structure. Integrating the diverse array of responding agencies into a coordinated response can be fraught with challenge, especially under the stressful conditions of disasters. Nonetheless, the ability to effectively navigate these complex relationships has been recognized as an essential element of resilience in disaster management (Cutter et al., 2008; Norris, et al., 2008).

These realizations have contributed to two major trends in the field of disaster response. First, there is increasing interest and emphasis in understanding how local-level capacities developed in advance of a disaster can contribute to better performance and thus greater community resilience during and following a disaster (Kapucu, Arslan, & Collins, 2010). Second, there has been increasing interest in shifting the level of analysis toward an examination of whole networks of responders and their interactions with one another (Comfort & Haase, 2006; Kapucu, 2006; Kapucu, 2005; Magsino, 2009).

Despite these trends, empirical research on the capacities of whole networks before a disaster and their impact on network performance during a disaster remains in its infancy (Magsino, 2009). Such a research agenda is hindered, in part, by a dearth of frameworks and tools for conceptualizing and assessing both local-level pre-disaster capacity and during-disaster performance in whole responder networks (Brower et al., 2009). While the

literature on resilience abounds with works tackling resiliency frameworks, the dominant emphasis has been on frameworks that span temporal aspects of disaster preparedness, response, recovery, and mitigation as well as levels of analysis including individual, organizations, institutions, communities, and even whole ecologies (Birkman, 2006; Manyena, 2006; Norris et al., 2008). Such macrotheorizing is valuable for considering the dynamics of resilience that may transcend scale, context, and temporality. However, in trade-off, it necessitates a level of abstraction that creates challenges in empirical operationalization and can obscure important elements of context that can advance our theories of resilience. Without frameworks tailored to specific populations, levels of analysis, phases of disaster, and even the unique disaster context, our ability to advance the science of disaster response toward more resilient communities is limited.

Subsequently, in this chapter, we focus specifically on resilience as it relates to one phase of a disaster cycle—the response phase—and is bounded to the actions of one specific collection of actors that we refer to as "the responder network." To accomplish this, we proceed in two ways. First, we advance the definition and conceptualization of a responder network and associated performance goals as a key level of analysis for assessing resilience during the response phase of a disaster. Second, we introduce the concept of *network capacity* and position it within the broader academic discourse on adaptive capacity and community resilience. Drawing from our field research as well as current literature, we discuss five key network capacities for responder networks, focusing our attention on one of the most frequently occurring disasters in the U.S.: wildfire. The clear articulation of key network capacities as well as performance goals is essential to fully understand what we are building capacity for and how it can be measured. Refining concepts like responder network and network capacity are important steps in the effort to empirically claim we are moving toward more resilient community responses as a society.

Following the recommendations of Hilhorst (2003), we proceed inductively, extrapolating broader theory from our field research in this context and integrating it with what is currently known in the literature. In particular, we focus on wildfire that occurs at the wildland-urban interface (WUI) or the area where private homes and other human development meet or intermingle with undeveloped land.

DISASTER MANAGEMENT IN THE WILDFIRE CONTEXT

The field of disaster management has been strongly shaped by the lessons and innovations that have come out of the management of wildfire (Irwin, 1989). This trend is likely to continue as wildfires are one of the most frequently occurring disasters in the U.S. (EM-DAT, 2012) and are increasing in both scale and intensity, and the effects they have on human populations. Many

factors contribute to the current wildfire problem including climate change, declining forest health, drought, invasive species, and a history of fire management that has favored suppression (QFR, 2009; Hale et al., 2006; Kitzberger et al., 2001). The problems associated with these factors are magnified by the growing number of people inhabiting places that are increasingly at risk for large wildfire. Wildfire is most likely to occur in these areas that abut forests; consequently, wildfire is largely, but not exclusively, a challenge for more rural areas. Shifts in community and residential patterns during the 1990s and early 2000s have meant that more people have moved into the WUI. The encroachment of human settlements into the areas of the greatest wildfire risk has parallels to other disaster contexts in floodplains and coastal areas. Across the nation more than 10% of land area in the continental United States resides in the WUI, and the population living in the WUI grew by nearly 20% from the 1990s to the 2000s (Hammer et al., 2009). Nearly 50% of all housing units in the West are located in the WUI (11.1 million units), and this percentage is projected to grow in the future as baby boomers retire to amenity rich, rural areas (Hammer, Stewart, & Radeloff, 2009; National Interagency Fire Center, 2009). Consequently, disaster response to wildfire represents a critical context for informing theory development toward the creation of more disaster-resilient communities.

DEFINING A RESPONDER NETWORK

To proceed in developing a framework for conceptualizing and measuring network capacity in responder networks, we must first delineate what is being referred to by a responder network. This task is not as straightforward as it might seem. While it would be simple to imply a responder network is comprised of individuals, organizations, and agencies active in responding to a disaster, upon reflection, it becomes apparent that such a definition is hardly discriminating. This is because during the course of a disaster and its immediate aftermath, everyone who is affected will likely fit this definition. As the incident unfolds, residents will take action to protect their lives and property, seek out information about the status of the situation, and reach out to help their friends and neighbors. Local organizations and agencies with formal responsibilities to minimize and cope with damages will spring into action. As community needs become apparent and go unmet, individuals and organizations may extend, alter, or completely step outside of traditional roles to try and meet those needs (Drabek, 1985; Drabek & McEntire, 2002, 2003).

Sociologists have characterized different types of structural entities that take action during disasters as established, expanding, extending, or emergent (Drabek & McEntire, 2003). None of these terms adequately captures what we mean by the responder network, but elaborating on how these

fit together is essential for conceptual clarity. At one end of the spectrum are established structures, which are best characterized by the bureaucratic agencies and organizations that have formal missions, mandates, and charters related to emergency management and are traditionally tasked with emergency response. They often take on a command-and-control structure and have been criticized for their inflexibility (Neal & Phillips, 1995). In contrast, at the other end of the spectrum are emergent structures, which are characterized as those made up of private citizens and public organizations and agencies that develop new tasks and structures organically in response to the crisis (Stallings & Quarantelli, 1985). Expanding and extending structures each embody either more regularized tasks within new structures or non-regular tasks in old structures.

What is missing from these characterizations is the ability to combine forms under one larger networked umbrella. Our definition of responder network is based on a priori understanding of agencies and organizations with formal disaster management responsibilities in the event of a disaster, as well as expectations about organizations, agencies, and individuals who might be expected to take action as part of the emergent structure. It is this collection of established and emergent actors with sustained involvement in coping with the disaster on behalf of the community that researchers look to as the primary participants in the disaster response. For our purposes, we refer to these actors as *responders.*

Collectively, these actors comprise what we refer to as the *responder network.* A basic definition of a network is a collection of actors linked together through some form or relationship or dependency (Brass et al., 2004). We use the concept of a network intentionally to highlight a specific set of attributes that are theoretically important in reflecting on the nature of disaster response. First, the concept of a network infers interdependency among members; however, it is different from a group in that a network has no assumption of an overriding common identity that is shared across members. Whether an organizational leader thinks about their organization as being part of a network is merely an attribute of network membership, not a pre-condition for it. Second, networks are conceptually distinct from other collective enterprises such as organizations, consortia, or collaborative partnerships in that a network by our definition (Provan & Kenis, 2008) does not necessitate an explicitly shared goal except in the broadest sense of minimizing harm from the disaster. Last, the concept of a network does not assume universal connection among all actors. Consequently, it is a concept that is well adapted to characterizing the pluralism and loosely coupled, sometimes underorganized, domains of responders active in a disaster response. Accordingly, we define a responder network as *the collection of individuals, organizations, and agencies that have sustained involvement during the event who aim to serve the community in minimizing and coping with damages brought on by the disaster.*[1]

JUSTIFYING A RESPONDER NETWORK LEVEL OF ANALYSIS

Resiliency can be theorized across different populations and levels of analysis which begs the question of why scholars and practitioners should concern themselves with resiliency as it relates specifically to a responder network. We pose that an emphasis on a responder network level of analysis is a critical addition to scholarship on resiliency for two reasons. The first and most straightforward reason is that during the response phase of a disaster, it is the responder network that actively engages in efforts to help the community cope with and minimize impacts from the disaster. Therefore, they represent a critical domain in which the propositions of resilience theory can be examined.

The second and most important reason is that disaster response is inherently a networked phenomenon that can never be assumed to nest neatly under any one jurisdiction or command structure (Kapucu, 2005, 2006; Magsino, 2009). In light of this absence of hierarchy, network forms of governance have been advocated as the most viable option (Comfort & Kapucu, 2006; Moynihan, 2008, 2009). This latter justification requires some explanation, rooted in an analysis of the Incident Command System and how local, state, and federal governments parcel out responsibility for incident management. We describe this structure as it applies to the wildfire context to provide a more contextually grounded description however, similar structure and parallel jurisdictional issues exist across disaster contexts.

Like most large disasters, a large wildfire event typically is managed through the Incident Command System (ICS). The ICS was developed in the 1970s out of a need to centralize authority among multiple organizations during wildfire incidents (Irwin, 1989) but has since been adopted by local, state/provincial, and federal/central emergency management organizations to manage disasters. The ICS provides a model for using common language, management concepts, and communication strategy during the chaotic conditions of disasters.

Local and state governments are responsible for responding to a disaster with assistance from the federal level (Tierney, 2008). However, when a wildfire occurs, the governmental entity upon whose jurisdiction the fire is burning assumes responsibility for managing the incident within the scope of their expertise and resources. We refer to this entity here as the lead agency. If the fire spreads across jurisdictional boundaries (e.g., from federal to county lands) or there are multiple fires (as is often the case in lightning related incidents), the jurisdictions may elect to manage the incident jointly under a structure referred to as unified command. Under the ICS the incident is generally managed by an organizational structure called a incident management team (IMT). An IMT is part of the ICS. When the costs and complexity of an incident overwhelm the local-level resources and expertise, governments are authorized to request a regional or federal

IMT to assume command of the incident. While these regional or federal IMTs have extensive expertise in incident response, they may have little to no past experience with or knowledge of the affected communities.

The IMT receives its delegation of authority from the lead agency that requested the IMT's assistance. In our research, we have focused on WUI fires either within or adjacent to U.S. Forest Service (USFS) land. The USFS is the largest firefighting organization in the world, responsible for managing 193 million acres of land (NIFC, 2009). There are 155 national forests in the U.S. Each national forest is managed independently and serves as the lead disaster response agency for wildfires started within its borders. Between 2008 to 2010, 59.29% of all wildfires requiring a Type 1 (federal) or Type 2 (regional) IMT occurred on USFS land (NIFC 2011). When a regional or federal IMT is brought in by the USFS Forest (the lead agency on fires on USFS lands), their delegation of authority must lie within the authority of the USFS for managing the incident. The IMT assumes command over all operations and resources operating under the authority of the USFS but generally will not have jurisdictional authority over "the incident" in any holistic sense. For example, an IMT that obtains its delegation of authority from a USFS forest does not generally have direct jurisdictional authority or responsibility for road closures, evacuation of county residents, mass care (e.g., sheltering) of evacuees, or the management of utilities. These functions lie under an often confusing and incomplete patchwork of responders that can span different agencies, levels of government, and sectors.

This ICS structure has two important implications. First, it means that although hierarchical relations are embedded throughout the network, there is no single superordinate entity that has the means, expertise, or authority to assume command of all aspects of the incident. Second, it means the responder network is an emergent entity comprised of both responders from the local area with limited experience with disasters and external responders who may have little or no knowledge of the area. Yet, it is the collective and combined efforts of all of the responders that constitute the disaster response aimed at minimizing harm from the event. As a result, the concept of a responder network and network capacity emerges center stage to our understanding of resilience in the response stage of a disaster.

COMMUNITY RESILIENCY AND CAPACITY

The notion of community resilience has been widely embraced and legitimated by the disaster community in the U.S. and worldwide as a hallmark of effective disaster preparedness and response (Birkman, 2006; Cutter et al., 2010; Manyena, 2006). Recent reviews of the disaster resilience literature have highlighted some of the major themes in the definitions and uses of the term resilience (Birkman, 2006; Cutter et al., 2008; Manyena, 2006;

Norris et al., 2008). Central within these debates is the question of whether resilience is simply the ability to absorb shocks or disturbance and readily return to a pre-incident status or whether resilience also incorporates adaptation and learning toward an improved state (Birkman, 2006; Cutter et al., 2008). As a return to the status quo is problematic in communities identified as systemically vulnerable to disasters, the latter conceptualization has been particularly appealing to those scholars seeking to characterize resilient communities (Manyena, 2006). Consistent with this, Norris et al. (2008) describe community resilience as both a set of adaptive capacities as well as a process through which these capacities are engaged to enable adaptive action in response to a disturbance.

Cutter et al. (2008) offer an integrated definition of resilience as the ability to survive and cope with a disaster with minimum impact and damage, including the capacity to reduce or avoid losses, contain the effects of disasters, and recover with minimal social disruptions. In the Cutter et al. (2008) Disaster Resilience of Place (DROP) model, resilience is viewed as embedded in a set of pre-conditions that influence the coping response, absorptive capacity, and adaptive learning that occurs during a disaster. These, in interaction with the inherent vulnerability of the community and characteristics of the event itself, define the impact of the hazard and degree of recovery. Accordingly, while resilient communities are viewed as less vulnerable (Cutter et al., 2008), vulnerability is also recognized as rooted in larger ecological and societal factors that cannot be fully mitigated through capacity-building endeavors (see Chapter 15). Disaster resiliency is therefore understood as a set of capacities as well as the process through which these capacities are leveraged to minimize a negative impact on the community and strengthen the community's ability to deal with future disasters (Norris et al., 2008). This suggests the need to focus on process as well as outcome elements that can be measured. These propositions lead to the question: What are the capacities within the responder network that facilitate an adaptive response during a disaster?

A PERFORMANCE FRAMEWORK FOR ADAPTIVE RESPONSE WITHIN RESPONDER NETWORKS

To answer the above question, one must first address the question of what an adaptive response to a disaster looks like. As Cutter et al. (2008) aptly point out, an analysis of resiliency necessitates an articulation of resiliency of whom, for what, as the conditions defining resilience differ across domains and levels of analysis. Capacity is defined by its intended goal given that any attribute of a community could be theorized as either a capacity or liability depending on the focal referent of interest. For example, bureaucratic structures that are lauded by some for promoting accountability and stability are criticized by others as fostering structural inertia and limiting adaptability (Morgan, 2006).

It then follows that if we are to think about building capacity within a responder network to promote community resilience, then we must first clarify the goals we seek to advance through these capacities. This requires normatively ascribing to the responder network a set of responsibilities that are believed to advance the overarching goal of promoting resilience. Consequently, the framework of performance goals that follows is essential if we are to understand what comprises a resilient response. Based on our field research and review of the literature, we identify two outcome and three process goals that are generally ascribed to wildfire response networks. These goals can serve as the basis for evaluating performance and for ascertaining which attributes of network capacity are important for achieving these goals, as detailed in Figure 12.1. We focus our attention specifically on the response phase of the disaster. While we illustrate our points with wildfire responder networks here, we anticipate these goals will generalize to a variety of technological and natural disasters.

Goal #1 (outcome): *Minimize injury, loss of life, and damage to values at risk in a manner that advances broader community goals as opportunity allows.* This goal emerges from the National Cohesive Wildland Fire Management Strategy ("Cohesive Strategy") which sought to identify concise, mutually accepted goals and guiding principles that encompassed federal, state, tribal, local, and non-governmental organizations related to land management and wildfirerelated risk (Cohesive Strategy, 2012). The Cohesive Strategy establishes three national goals, including improving wildfire response by diminishing injuries and loss of life to the public and firefighters (Cohesive Strategy, 2012). Goal #1 is essentially an extension of this first performance measure presented by the Cohesive Strategy in two ways. First, it recognizes that the focus on safety embedded within the Cohesive Strategy is necessitated by the reality that protection of other values at risk (e.g., structures, forests, wetlands, watersheds, livestock, biological species
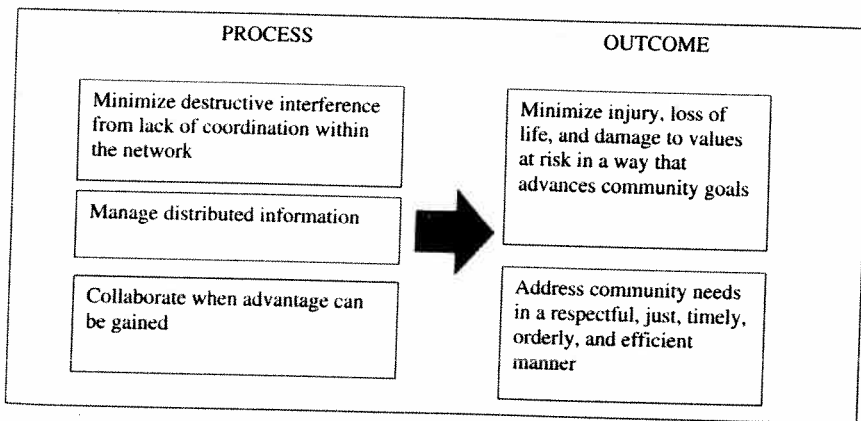

Figure 12.1 Process and outcome performance goals in responder networks.

of concern, sites of cultural significance, etc.) remain a prominent concern during a wildfire event, historically leading to employment of aggressive and sometimes dangerous fire suppression measures being used. Second, we use the phrase "advance broader community goals as opportunity allows" to reflect a dialogue occurring in the wildland fire community about the role of fire in fire-dependent ecosystems and the effects of full suppression fire management policies on increasing the severity and risk of future fires (Dombeck, Williams, & Wood, 2004). The essential recommendation resulting from this dialogue is that fire be viewed as a natural part of fire-dependent ecosystems and that it be managed in accordance with community goals and priorities for protection of lives, structures, and other values at risk. In some cases, this suggests possibilities for more flexible fire management strategies that reduce vulnerability for future fires and pose less risk to firefighters (Steelman & McCaffrey, 2011).

The clear challenge in the actualization of Goal #1 lies in the assumption of community-level goals, values, and priorities. Such terms imply a consensus of thought which may or may not exist. The passage of the Healthy Forests Restoration Act in 2003 stipulated that communities wishing to receive funding for hazardous fuel reduction to mitigate risk associated with wildfires needed to create a Community Wildfire Protection Plan (CWPP). CWPP planning efforts bring together residents, property owners, local, state and federal agencies, and others to create and prioritize a vision for addressing hazardous fuel treatments and wildfire management in the WUI (Steelman & Burke, 2007). However, if there have been no community-level forums for discussing short- and long-term risks, identifying community concerns and goals, and establishing priorities, the assumption that a set of values, understanding of risks, and collection of prioritized goals exists to guide the responder network during the response is tenuous.

Goal #2 (outcome): *Address community needs in a respectful, just, timely, orderly, and efficient manner.* This second goal focuses on the responder network's performance in meeting the needs of the community during the response phase of the wildfire. This would encompass actions that address the physical, economic, social, psychological, and spiritual well-being of those affected by the event. Such needs are widespread and may include needs for information, mass care for the evacuated and displaced including pets and livestock, a meaningful role for volunteers to play in responding to the event, and social support.

One clear challenge in the operationalization and actualization of this goal is the fact that community needs are not monolithic. They vary across groups and are dynamic as the event unfolds. Evacuated populations have different needs than non-evacuated (McCaffrey, Velez, & Briefel, under review), business owners and major landowners may have different needs than community residents for access to their property, individuals who are elderly or have disabilities may have different needs for assistance with evacuation than those who are not (Bloodworth et al., 2007). Another clear

challenge is the ever-present reality of limited time and resources. For the responder network to be able to address community needs, they must first be aware of what the perceived needs in the community are and the risks associated with failures to address these needs for the physical, economic, social, psychological, and spiritual well-being of the community. They must then prioritize needs and expectations given scarce resources.

Goal #3 (process): *Minimize destructive interference (from lack of coordination) within the network.* Whereas the first two goals speak to *what* we want from the responder network, the remaining three goals speak to the question of the *manner in which* they should attempt to accomplish these goals to maximize a resilient response. We refer to these as process goals. The first of these speaks to appeals heard throughout the fire management community as well as the hazards community for greater coordination among responders within the responder network. The root of this need stems from functional interdependencies within a responder network. These interdependencies create conditions such that individual actions during the disaster can have significant, and often negative, implications for other actors in the network (Bouwen & Taillieu, 2004). In the absence of coordination, this means that actors making up the responder network can undermine each other's ability to achieve their goals, thereby detracting from the effectiveness of the responder network as a whole in minimizing harm from the event.

Take for example the interdependent actions of an electricity company and the Operations section of the IMT. Each of these actors is bureaucratically autonomous as there is no superordinate authority coordinating their actions. Each has an important function to carry out. The electric company has to restore power to community residences and businesses. IMT Operations has to move large numbers of trucks, equipment, and personnel to fight the fire. For the electric company to accomplish its goal of meeting community access to power, it needs to get access to power lines that lay beyond the fire line. For the IMT Operations to accomplish its goal of minimizing damages to values at risk, it needs to restrict access to the roads behind the fire line to ensure fire equipment can move swiftly and safely. In the absence of coordination among these two parties, either the IMT Operations will interfere with the goal accomplishment of the electric company by restricting their access to needed sites, and/or the electric company will interfere with the goal accomplishment of the IMT Operations by moving electric trucks onto a service road which blocks or slows access by firefighting personnel. Accordingly, a key performance outcome of the responder network relates to the degree to which they minimize destructive interference by coordinating effectively with other members in the network.

Goal #4 (process): *Manage distributed information.* During a disaster, a fundamental management challenge is communication and information exchange in what is usually a highly complex and uncertain environment (Kapucu, 2006). In these conditions, communication and information

needs are diverse, unpredictable, and continuously changing with regard to scope, urgency, and information type (Comfort & Kapucu, 2006). Consequently, effectively coordinating relevant information among and across actors within the responder network can be a significant challenge. In our work (e.g., Steelman et al., under review), we have explored this aspect of the responder network as an information market. The metaphor of an information market frames the challenge of effective information exchange during a disaster as a problem of information asymmetry among those who possess information (suppliers) and those who need it (consumers).

Information asymmetries arise in situations when one individual or organization has knowledge that another does not. As a disaster situation evolves, so does the market as new suppliers and consumers enter the marketplace and the types of information in demand shift in response to changing conditions. As with most economic interactions, the patterns of who exchanges information with whom are not explained purely by relations of supply and demand. Rather, they are embedded within broader social networks governed by preferences for similarity, familiarity, and trust (Nowell & Steelman, under review; Frank, 2009; Granovetter, 1985).

Similar to other disaster contexts (e.g., Comfort & Kapucu, 2006), information asymmetry situations are acute in dynamic wildfire contexts. One dynamic that is of particular concern is the asymmetry that exists between responders such as a federal IMT that comes from outside the local area and the local responders. External responders from outside the area who come to assist the community may have broad expertise and experience in disaster response functions but likely have limited knowledge of the local context. Local responders generally have extensive knowledge of the local context but may have more limited knowledge of disaster response functions. However, situational awareness necessary to guide adaptive action requires both broadly grounded theoretical knowledge of wildfire and incident response as well as an understanding of local context. It is through possessing both of these forms of knowledge that general principles can be productively applied to make sense of actual events as they unfold (Weick, Sutcliffe & Obstfeld, 2005). Consequently, the ability of responder networks to effectively address this information asymmetry is proposed as a key performance metric in the process of minimizing harm from the incident.

Goal #5 (Process): *Collaborate when advantage can be gained*. The last performance goal echoes calls heard throughout the broader literature on disaster response for greater active collaboration and collective effort across jurisdictions, sectors, and response functions (Drabek & McEntire, 2002; Auf der Heide, 1989). This goal transcends the ambitions of Goal #3 in simply avoiding destructive interference among responders or Goal #4's aims to get information to those who need it to inform their independent operations. This goal calls for responders to work together and share resources to achieve what would be difficult for any responder working alone to achieve (Bryson, Crosby, & Stone, 2006). Here we

highlight two challenges that have emerged from our fieldwork as particularly prominent for understanding collaboration within the responder network during a wildfire.

The first challenge concerns the issue of cost share. Wildfire incident response is big business, costing millions of dollars in suppression and response (Calkin et al., 2005). There is opportunity for some of this money to be spent locally to offset some of the negative economic impact the event generally has on the local economy (Moseley & Toth, 2004). However, concerns and confusion over who is responsible for paying for what becomes a key barrier to effective and timely collaboration. Collaboration in the context of wildfire response often entails different jurisdictions or agencies pooling or contributing resources as needed. However, these resources (e.g., personnel, equipment, vehicles) are part of the costs associated with the fire. Therefore, their utilization requires some agreement on who is going to pay for their use. For example, if the county fire department or local volunteer fire department contributes engines and personnel to the U.S. Forest Service to aid in the fire response, it is expected that the USFS will reimburse these local agencies for the use of these resources just as they would reimburse for any resource dispatched from another forest. However, without cost share agreements assembled ahead of time, valuable time can be wasted waiting for negotiations of reimbursement before local resources are released. Similar challenges have been recorded across other disaster contexts (Urban Institute, 2006; Pipa, 2006; GAO, 2008).

The second challenge that hinders collaboration comes from the need to clearly communicate expectations related to shared resources and actively manage the collaborative relationships over the duration of the event. Another example is instructive here. On the Schultz fire, the local law enforcement collaborated with the USFS and IMT to man road closures on USFS roads to prevent tourists from entering dangerous areas of the forest. While all parties described this collaboration as exemplary of interagency cooperation, there was frustration expressed on the part of the local law enforcement that the USFS and IMT continued to utilize those resources beyond the initial crisis. Local law enforcement saw staffing USFS roads as under the jurisdiction of the USFS and felt they should have prioritized finding USFS resources to man the road closures as soon as possible to release county law enforcement personnel to be reallocated back to their primary law enforcement responsibilities.

Perceived failures on the part of the IMT and USFS to do this or communicate to the local law enforcement when their personnel could be released were viewed by the local law enforcement as problematic. Reports of this same incident by the IMT and the local forest revealed no particular conflict or concern suggesting that they were unaware of the challenge this created for the local law enforcement. The collaboration literature emphasizes the importance of collaborating partners becoming familiar with the strengths, constraints, and limitations of each partner agency so that partners can

anticipate how their actions will affect their partners (Nowell & Foster-Fishman, 2011). However, in the disaster context, the responder network is activated by a relatively uncommon event, making the kind of long-term relationship building that occurs in other collaborative contexts more difficult. As a result, partners must be particularly conscientious to communicate expectations clearly concerning resource sharing, focusing attention on cost sharing, and when resources can be expected to be released back to their home units.

A NETWORK CAPACITY FRAMEWORK

The articulation of performance goals and associated challenges is essential to understand what kind of capacity characteristics are needed to facilitate the achievement of these goals. Next, we focus on those collective-level capacities that have emerged from our field research as well as in the current literature as critical in helping responders to overcome the inherent challenges associated with these goals. We refer to these capacities as *network capacities*.

Network capacities are a specific classification of capacity that can be positioned within existing global resiliency frameworks (Cutter et al., 2008, 2010; Norris et al., 2008) almost entirely under the domain of social capital. Social capital has been widely embraced as a critical dimension of disaster resilience (Dynes, 2002; Norris et al., 2008; Cutter et al., 2008). Part of its appeal lies in its very flexibility as a construct. Scholars have considered social capital as both 1) the presence of structures (e.g., neighborhood associations), patterns (bridging and bonding network ties, structural holes), and relational characteristics (trust, friendship, affiliation) of social connectivity that facilitate collective action, as well as 2) the potential resources that are available through a network of relationships (Adler & Kwon, 2002; Kadushin, 2004; Nahapiet & Ghoshal, 1998). Social capital, like community resilience, is defined primarily by its function (Coleman, 1988). Consequently, most of the network capacities discussed here can be conceptualized under a rubric of social capital as they all are network attributes that facilitate cooperation and collective action. However, to advance both scholarship and community assessment, it is critical to unpack specific dimensions of social capital that relate to our targeted performance goals.

Accordingly, our goal in this section is to leverage insights from the wildfire context toward the development of a network capacity assessment framework that could be applied and tested across disaster contexts. In Table 12.1, we pose capacity assessment questions that transcend disaster contexts to provide insight into how our conceptual metrics of network capacity can be operationalized in different settings. These key questions are the first stepping stone toward a standardized set of attributes that

can guide network capacity assessment. We envision the value of such a framework to be twofold. First, it will provide a starting point for community dialogue and discussion on current capacity of the local responder network. Second, it will help define a research space aimed at understanding the attributes of responder networks across disaster contexts and their relationship to network performance in coordinating, communicating, and collaborating during disasters. We pose five dimensions of network capacity in the following sections: trust and familiarity, local knowledge, leadership for integrating newcomers, system perspective, and communication infrastructure.

Familiarity and Trust

A generally accepted proposition is that actors who work together prior to a disaster event are likely to work better during the event because they have built up a level of familiarity and trust among each other (Kapucu, 2006). Familiarity is posited to aid in coordination, facilitate the flow of information, and reduce the risks associated with collaboration because it makes responders more predictable to one another (Okhuysen & Bechky, 2009). The basic narrative of this literature argues that when responders know what they can expect from one another, they are better able to adjust their actions accordingly to avoid destructive interference. If they can anticipate the information needs present within the network, then they are in a better position to judge the risks associated with collaboration (Nowell & Foster-Fishman, 2011). Trust is defined by an emphasis on norms and values, which is prevalent in the work of scholars such as Coleman (1988) and Putnam (2001). It entails a belief that other responders will follow through on their commitments and will not act opportunistically (Dirks & Ferrin, 2001). Based on a review of the literature examining trust in organizational settings conducted over the past forty years, Dirks and Ferrin (2001) found evidence that trust can impact the likelihood of cooperative action by both reducing the degree of perceived risk involved as well as through pre-disposing actors to evaluate the actions of those they trust as benevolent in their intention, thereby reducing conflict.

Responders in the wildfire context highlighted familiarity and trust as rooted in the network at three levels: the interpersonal, the interprofessional, and the interorganizational. At the interpersonal level, familiarity and trust are rooted in personal relationships between the leaders within the responder network. Consistent with Granovetter's concept of embeddedness (1985), these interpersonal relationships among local responders often transect professional, personal, and community domains as individuals have worked together, gone to school together, and lived in the same community over time. Consistent with predictions, our research found the level of familiarity between two responders to be significantly positively

related to increased frequency in communication and a decrease in the risk for problematic communication (Nowell & Steelman, under review). At the interprofessional level, responders may not know one another personally but they describe familiarity with the professional role another responder plays. This familiarity was identified as valuable in facilitating coordination and information exchange because it gave responders insight into the needs, capacities, and constraints of that position. For example, a USFS archeologist noted the advantage of having worked with an IMT in the past because he knew what their job looked like during different phases of the incident so he was able to gauge the most opportune time to approach them about the protection of archeological values at risk. Finally, interorganizational familiarity and trust are embedded within cultures of cooperation between responder agencies regardless of interpersonal familiarity, as well as formal planning and cost share agreements to facilitate collective action. Organizations and agencies develop identities and reputations that make them more predictable just like people. Individuals active in the responder network are generally acting as agents of these organizations and agencies. Subsequently, familiarity with and trust in an organization or agency can facilitate coordination, communication, and collaboration by the same mechanism as interpersonal trust and familiarity. Conversely, historical tensions among responding organizations and agencies can likewise cast a shadow of suspicion and mistrust that can ultimately undermine network goal achievement. For example, in the wildfire context, responders commonly reference historical tensions between local landowners and the USFS (Carroll et al., 2006) as a challenge to effective communication and cooperation.

In assessing network capacity (Table 12.1), central questions focus on the level and distribution of familiarity and trust across interpersonal, interprofessional, and interorganizational domains within the network. Much scholarly research related to this domain is needed. For example, in settings where there is a lesser degree of social embeddedness, it is reasonable to suspect that interprofessional and interorganizational aspects of social capital will be more important. Further, based on our research, we anticipate that disaster contexts will differ in the degree to which personal relationships are a prominent form of network capacity within the responder network. For example, they may be disproportionately prominent in disasters occurring within more rural settings where personal networks are more likely to overlap. There may also be differences in the density of interpersonal ties within the responder network stemming from professional affiliations. In the wildfire context, a significant proportion of the responder network is comprised of responders who have professional backgrounds in fire or forest management. This profession was described by some responders as a tight-knit group, where key leaders knew one another in various professional capacities over the course of their careers. Understanding the social and demographic characteristics that correlate with different network capacity profiles is an important area for future research.

Local Knowledge

A second dimension of network capacity concerns the bank of local knowledge that is widely accessible by the responder network and relates to what Nahapiet & Ghoshal (1997) referred to as a cognitive dimension of social capital. Cognitive social capital is based on the notion that a shared sense of understanding can facilitate better outcomes because diverse individuals in a system with a similar understanding can benefit the entire collective if there is mutual understanding about desired actions or goals (Portes & Sensenbrenner, 1993). In practice, this dimension concerns the degree to which there exists a shared community consciousness within the responder network regarding key attributes of local knowledge related to the disaster, including the geophysical, cultural, social, political, environmental characteristics of the area. It also concerns the degree to which the community has developed (through some form of community-level dialogue) a set of prioritized goals and understanding about land management, values at risk, and vulnerable populations and ecologies which may have unique needs during a wildfire event. Because our focus here is to define network capacity for the response phase of the disaster, we do not address other key aspects that could facilitate a more comprehensive collective understanding such as priorities in hazard mitigation. However, these would also be aspects of local knowledge.

Local knowledge has broad capacity implications across the five goals of network performance discussed above. Most directly, local knowledge is an essential prerequisite for the responder network to perform well, overcome the challenges associated with minimizing harm to values at risk, meet community needs, and advance broader community goals. Perhaps most importantly in the wildfire context, local knowledge is an essential capacity to enable a local community to interface effectively with external responders such as a federal IMT. Remarks from federal-level Incident Commanders indicate that communities vary greatly in the degree to which they are able to provide concise and well-organized information about local conditions, geography, values at risk, and fire management priorities. In the absence of some collective sense of community goals and values, the local responder network cannot effectively communicate priorities to external responders. Specific needs of vulnerable populations may go unmet if knowledge of these needs is distributed among a few responders while knowledge of potential resources to meet those needs are distributed among a different set of responders. However, if community vulnerabilities and needs are more broadly understood, knowledge of potential resources to meet those needs can be better channeled through the responder network.

Network capacity assessment questions related to this domain focus on the identification and documentation of community needs, vulnerable populations, values at risk, goals and priorities, and vital aspects of community context during a disaster (Table 12.1). Developing a shared vision and

Table 12.1 A Framework for Assessing Network Capacity Characteristics

	PROCESS GOALS		
	Minimize destructive interference from lack of coordination within the network	Manage distributed information	Collaborate when advantage can be gained
Familiarity and trust—relational characteristics that exist before the incident that can facilitate response (e.g., trust, goodwill, familiarity)	To what extent are responders sufficiently familiar with one another to anticipate how their actions will affect the actions of other responders? Where is this familiarity the strongest? the weakest? Do responders have personal contacts that they can contact to resolve destructive interference as quickly as possible?	To what extent are responders familiar enough with one another to anticipate information needs of other responders? To what extent are responders willing to go out of their way to supply information to known consumers?	To what extent do responders have personal trusting relationships with other leaders in the responder network that they can call upon if needed? To what extent do responders trust one another to not act opportunistically? How willing are responders to commit resources to collective efforts as need arises? To what extent are cost, share, and other agreements in place prior to the event to facilitate collective action between actors during the event?
Local knowledge—cognitive elements of social capital, shared sensemaking, collective vision and understanding	Is there collective agreement and awareness of local land management goals and values at risk that are in potential conflict with broader disaster management goals.	Are local values at risk, including social, economic, archeological, cultural, and ecological resources identified and documented? Are local priorities in the protection of these values at risk identified through community-level forums? Are the unique vulnerabilities and needs of different populations within the community widely understood? Are pertinent local characteristics documented in a format and location that is known to and accessible by local responders? Can this information	Is there shared understanding of community needs and land management resource protection goals and priorities to facilitate collective action?

Leadership for integrating newcomers	To what extent is there a local responder who can help external responders understand how their actions may influence the work of other responders? Does this local responder have sufficient legitimacy among both external and local responders to serve as a broker?	To what extent is there a local responder with sufficient familiarity and legitimacy who can translate local information and its significance to external responders?	Is there a local responder with sufficient reputation and legitimacy to serve as a convener, bringing responders together as needed, and helping external responders understand who they need to be networked with?
Community-level perspectives	To what extent do local and external responders view themselves as part of a larger response during a disaster?	Do external responders (e.g., IMTs) recognize the importance of local context information, local goals and priorities? Do they have strategies for how to seek it out and incorporate it into their operations?	To what extent is there a strong sense of community and a culture of cooperation among responders?
Communication infrastructure—forums and technology	Are there sufficient fora and communication technology to facilitate coordination?	To what extent are there plans, technology, and forums for facilitating communication in the event of a disaster? Is there sufficient redundancy in these systems in anticipation of damaged infrastructure during the event?	Are there sufficient forums and technology to enable collective action?

making collective sense about local contextual features is crucial to avoid destructive interference, manage distributed information, and collaborate proactively across the network to avoid undesired performance outcomes.

Leadership for Bridging between External and Local Responders

Another aspect of network capacity that has received less attention in discussions of disaster resilience has to do with leadership for bridging between external and local responders. The arrival of external responders is a reality in large-scale wildfires, just as they are in other disaster contexts. When the scale and scope of an event overwhelms local-level capacity, state and federal resources are called upon to assist. Frequently, this assistance includes not only resource and operational support but assistance in the management of the event itself. More seasoned IMTs are brought in to take command of the operations. Consequently, while all disasters are local, they are frequently not managed by locals. This means that a key area of capacity for both the local and external responders concerns how they will integrate together into a coordinated responder network. As discussed previously, pre-existing trust and familiarity can aid coordination among local responders. However, these attributes are frequently lacking in network ties between external responders and local responders, necessitating a different form of capacity for promoting effective communication, coordination, and collaboration.

During our field research, we have discovered that the lack of relational social capital can be mitigated by the presence of a local agency who can serve as a bridge between the external IMT units and the rest of the local responder network. In the wildfire context, the agency best equipped to fill this role tends to be the local branch of the USFS. The role of this agency is threefold: First, they serve initially as an information broker, moving information back and forth between the local responders and IMT. They channel local context information to the IMT and facilitate the distribution of information from the IMT to the local responder network and broader community. Second, they serve as a relationship broker, facilitating introductions between IMT unit leaders to key local counterparts with whom the IMT will need to interact with directly, helping to establish the legitimacy of both parties to build trust more quickly. Last, they serve as a network manager throughout the incident, monitoring the network to ensure information asymmetries are being addressed, efforts are coordinated, and opportunities for collaborative advantage are recognized and acted upon. The ideal agency for this position is one that has significant reputational legitimacy with both the external and local responders. The more both external and internal responders trust and respect this agency, the better positioned they will be to perform this leadership function within the network. It is also important that this intermediary agency has sufficient familiarity of the local context, local responder network, and external responder

to navigate interactions with this diverse group, helping to translate across professional boundaries.

Network capacity assessment questions related to this domain focus on key elements associated with bridging roles between internal and external responders, as indicated in Table 12.1. These questions help identify whether and how leaders play a role in minimizing destructive interference, manage distributed information, and capitalize on opportunities where advantage can be gained. Additional scholarly work is needed to better understand this capacity domain across different disaster contexts. Key research questions include: 1) Is this form of brokerage more or less important in different disaster contexts and if so, how? 2) Who are the key brokers in different contexts? To what extent do they share similar characteristics? 3) What are the organizational capacities needed to best fulfill this brokerage role?

Community-Level Perspectives

This domain speaks to whether there is the awareness and motivation needed for responders to act in a coordinated manner. A coordinated, multi-organizational response to a disaster frequently requires organizational representatives to view themselves as part of a larger collective response and prioritize cooperation over organization-centric interests. Psychological Sense of Community (PSOC) is defined as "the perception of similarity to others, an acknowledged interdependence with others, a willingness to maintain this interdependence by giving to or doing for others what one expects from them, and the feeling that one is part of a larger dependable and stable structure" (Sarason, 1974: 157).

The theory of PSOC posits that individuals and collectives with a greater sense of community have a high concern for community and a cognitive disposition toward advancing community interests (McMillan & Chavis, 1986). As a result, the theory states individuals with higher PSOC are more likely to transcend individualistic or opportunistic behaviors and engage in collective efforts to promote community interests and well-being (Nowell & Boyd, 2010). This theory has received substantial empirical support in non-disaster contexts, with PSOC predicting a range of community-oriented types of behaviors such as civic engagement, political participation, and volunteerism within the general population (Chavis & Wandersman, 1990; Hughey, Speer, & Peterson, 1999). PSOC has also been theorized to lead to better performing and more socially responsible organizations (Block, 2008; Mintzberg, 2009; Nowell & Boyd, 2010). Subsequently, there is reason to suspect that local responder networks characterized by higher sense of community and responders who view their agency as one part of a larger system of response will be more active coordinating and sharing information, and have a greater willingness to collaborate.

Accordingly, network capacity assessment questions related to community-level perspectives focus on the extent to which responders in the

network share a strong sense of community and view themselves as part of a larger response system, as detailed in Table 12.1. For external responders, assessment questions relate to their understanding of how they fit within the local responder network and are motivated to seek local knowledge to inform their operations. While scholars have argued for the importance of sense of community as an aspect of community capacity for disaster resilience (e.g., Norris et al., 2008), there is very limited empirical work conducted within this domain. Therefore, there is much to be understood about how responders' connection to place influences their interactions within a responder network before and during a disaster. Further, we know little about how responders view themselves in relation to the responder network and the influence of these cognitions in aggregate on the performance of the network to act in a coordinated and coherent fashion. These questions will be critical to address to gain insight into how destructive interference within the network can be avoided, diffuse information can be better managed, and responders can identify areas for more profitable collaboration.

Communication Infrastructure

Disaster scholars have emphasized the necessity of adequate infrastructures for supporting communication, coordination, and collaboration during the response (Carley & Harrald, 1997; Comfort & Haase, 2006; Green, Kliener, & Montgomery, 2007), particularly those that facilitate communication between local and external (e.g., state and federal) responders (Eikenberry, Arroyave, & Cooper, 2007; Kapucu, et al., 2010). Network capacity related to this includes communication technology that is robust, scalable, and interoperable to allow for integration of an increasingly complex number of responders and array of information. As disasters frequently damage communication infrastructure, taking out phone lines, electricity, and cell phone towers, the presence of backup systems in anticipation of such disruption is a valuable aspect of network capacity (Comfort & Haase, 2006).

However, technology such as radios, cell phones, satellite phones, and computers are only one dimension of a community's infrastructure capacity for supporting communication, coordination, and collaboration within the responder network. Of equal concern are spaces, fora, and boundary objects for facilitating information sharing and coordination. We found that key meeting spaces among those in the responder network, including structured as well as ad hoc meetings, were essential in light of disrupted communication technologies. For instance, an established meeting at 8 am for all cooperating agencies as well as the IMT was a reliable mechanism for giving and receiving information in light of uncertainties associated with cell phone and electrical disruption. Additionally, our research found that people most frequently tap into the information sources during a disaster that were most familiar to them before the disaster, even if they recognized these sources as less trustworthy and less adequate for their

needs than other sources available to them (Steelman, McCaffrey, Velez, & Briefel, in prep.). This suggests that existing community infrastructure such as radio stations, television stations, newspapers, friends, family, listservs, websites, contact lists, and community meeting spaces that facilitate communication among local responders before a disaster will also likely serve as resources for supporting communication and coordination during an incident (Majchrzak, Jarvenpaa, & Hollingshead, 2007).

Network capacity assessment questions related to this domain focus on communication technology as well as lower tech meeting space and opportunity to operationalize this final aspect of network capacity for our framework (Table 12.1). Additional questions that remain to be addressed in this domain include more fully understanding the comparative advantage of different communication modalities in different contexts, what factors contribute to perceptions of trustworthiness as a communication option, and how various high-tech and low-tech communication infrastructure modalities fit together for optimal mixes under the unpredictable circumstances of disaster.

CONCLUSION

Measuring community resilience to disaster is a key challenge for disaster scholars at this time. Across the fields of disaster research there is interest in identifying local-level capacities that can improve a community's ability to prepare for and respond to disasters. In this chapter, we have attempted to increase understanding of how local-level capacities are related to greater community resilience. Our contribution has been to focus on more narrowly identified capacity characteristics that exist among a specific subset of actors that we define as the responder network. We distinguish network capacities in their relationship to network-level performance goals as well as their level of analysis. While community competence may reside at the resident or organizational level, network capacity is conceptualized as an attribute of the responder network. We focus specifically on network capacity as it relates to performance during the response phase of the disaster.

To understand how one measures network capacity in this context, it was essential to specify performance goals for which network capacity characteristics must be targeted. The specification of process and outcome performance goals in conjunction with network capacity characteristics provides a framework for understanding whether responder networks are indeed moving toward or away from more resilient outcomes. We feel that these concepts are an essential stepping stone in the broader collective effort to make empirical claims about whether we are moving toward more resilient responses as a society.

Some limitations associated with our proposed framework are important to note. We investigated these issues within the context of wildfire. It

is not clear how this framework would apply to other disaster contexts. We believe that the concepts are applicable, but that is an empirical question worthy of further investigation. Wildfire occurs in a predominantly, but not exclusively, rural setting. We have reason to believe that the number and density of responder relationships may increase in more urban settings relative to rural settings. The concepts suggested here should still hold, but may need to be implemented among a larger number of responders who presumably would be needed in a more populous urban area.

Much research remains to be done on disaster network capacity. In addition to the specific areas suggested in the previous sections related to network capacities, we propose a broader agenda for more fully developing network capacity as a robust measurement framework for community resiliency. A tentative research agenda for moving forward would: 1) confirm and expand upon these network capacity characteristics, examining their generalizability and translation across disaster contexts; 2) test and refine assessment questions to see if there is broader agreement on them within the disaster community; 3) once there is agreement on the network capacity characteristics and questions, develop a set of standardized measurements to provide more empirically precise insight into how the capacities and process goals relate to the performance goals. The ultimate vision with these steps is to move us in the direction to better understand what we mean by resilience at different levels of analysis and across different contexts as presented by several examples in this book.

NOTES

1. In operationalizing the responder network on large-scale wildfires, we have found it useful to distinguish three key stakeholder groups: 1) the federal Incident Management Team (IMT) that assumes command in managing a large-scale disaster response; 2) the local lead disaster response agency that requests the IMT and may coordinate local disaster planning and preparedness efforts; and 3) local cooperators which consist of the array of local organizations and agencies that have specialized roles and responsibilities related to the disaster response and preparedness (e.g., public safety, information evacuation, sheltering, infrastructure protection and repair) not under the jurisdiction of the lead agency.

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