Community Innovation and Disasters

19

Tricia Wachtendorf, James M. Kendra
and Sarah E. DeYoung

I'll be happy to give you innovative thinking. What are the guidelines?

Cullum (2005)

Contents

19.1   Introduction

Much is made of the American spirit of innovation, yet innovation is certainly not a process isolated to the United States nor is it always embraced in American communities (Fagerberg, 2005). How do we come to understand community innovation, particularly as it concerns practices related to disaster management? Indeed, innovation is a much-studied subject with a vast corpus of research literature that is conflicted and contradictory. Community, too, is a troubled and often imprecise term, its colloquial meaning often at odds with the complex and sometimes antagonistic social relationships existing in a place (McMillan & Chavis, 1986; Rappaport, 1987). Yet much of disaster research and practice is grounded in at least an implicit recognition of the importance of both community and of innovation (e.g. Palen et al., 2010). If people in a community are under threat from a known hazardous condition, what do they do to change that condition? And if people do, indeed, experience a disaster, what do they do to manage its effects? How does the community adapt to instability? Hence the study of innovation in communities is central to the study of disaster, and innovation in communities is itself central to mitigating hazard, responding to emergencies and disasters, and recovering afterward.

In this chapter, we examine community innovation. We begin first by conceptualizing community and innovation as they relate to hazard – understood as a mismatch between human, natural, and technological systems (Mitchell, 1990; Palen et al., 2010) – and disaster. We identify the difficulties inherent in the terms *community, innovation,* and *community*

T. Wachtendorf (✉) · J.M. Kendra
University of Delaware, Newark, USA
e-mail: twachten@udel.edu

S.E. DeYoung
University of Georgia, Athens, USA

innovation, presenting some working concepts that seem to align best with overall disaster research experience. We examine the characteristics of communities that make innovation both necessary and difficult, using examples of innovations drawn from the United States and internationally. This discussion will point toward some directions for future research, including an understanding of community that might be suitable for newer, complex, and diffuse hazards – such as bioterrorism, cyberterrorism, and slow onset hazards related to climate change. The discussion will also point to some needed reorientations in policy that might proceed from either subsequent or existing research.

19.2   Concepts and Definitions

Before considering community innovation as a feature of pre-disaster mitigation and preparedness and of post disaster response and recovery, we must first consider carefully what we mean by each of these terms. The terms not only have conventional uses but they also take on different technical meanings in the research literature. Moreover, *community innovation* itself requires some explanation. It barely exists as a term in disaster research. Lindell and Perry's (2001) work on Local Emergency Planning Committees (LEPCs) is a noteworthy exception, but they make little use of the innovation literature in their analysis of the effectiveness of LEPCs.

Community innovation is, however, a subtext of most work in the hazard and disaster area, and when used elsewhere has a broad diversity of meanings, emphases, and implications.

19.2.1   Community

The word community evokes an image of people in a certain geographical setting, socially organized via the mechanism of a local government for the good of the people who live in that place. One of the principal definitions of disaster (Fritz, 1961) emphasizes a strong spatiality in the very concept, and indeed, most disaster research has looked at disasters via their impact on socio-political collectives - cities, towns, and states. The fundamental assumption is that the people who live there share common interests, needs, or aspirations. But there are really many more kinds of community: professional communities, linguistic communities, ethnic communities, and religious communities that may or may not be tied to certain locations but that are instead linked by interests apart from geography. Moreover, socially organized groups sharing a certain geographic setting are often comprised of many such communities within its boundaries. This is reflected by the analysis of defining community across contexts and levels – primarily in community psychology literature and studies related to community intervention research (Kelly, 2006; Nelson & Prilleltensky, 2010; Perkins et al., 1990). More recently, disaster preparedness has been linked with a psychological sense of community (DeYoung & Peters, 2016). Taking a geographical setting perspective, one might assess the devastating impact on the community of New Orleans, Louisiana following Hurricane Katrina in 2005. Yet we know that the experiences of those from that city were quite varied in their ability to evacuate, their experiences throughout the response, and their recovery outcomes, and their participation in decision-making during that extended time period (see, for example Beatley, 2009; David & Enarson, 2012; Elliott & Pais, 2006).

We know that over the past two to three decades, there is an increasing focus on the forces internal to the social system that lead to disasters or increased risk (e.g. Wisner et al., 2003) leaving particular communities of individuals within that system differentially vulnerable and resilient (see Thomas, Cutter, Hodgson, Gutekunst, & Jones, (2003) for a review) despite sharing common political boundaries. In disaster research, as Peacock, Morrow and Gladwin (2000) point out, the warm and positive connotations of community are often more wishful thinking than reality. They see community as a collection of competing interests. Their concept of a *socio-political ecology* holds that various

groups - themselves shifting continually in composition - negotiate with each other for power and resources. Given this conception, community is characterized as much by conflict as by consensus, and the outcome of this process may lower the community's overall resistance to disaster. Moreover, it may result in distributions of risk that are unequal across the various residents. Coordination, defined as "agreed-upon relationships between independent organizations," (Gillespie, 1991, p. 55) is generally regarded as an important feature of emergency management. Comfort, too, strongly emphasizes coordination in the development of systems adaptive to threat, characterized by such features as sense of shared risk, and "common understanding" about remedial measures (Comfort, 1999, p. 31). Yet the coordination, mutual understanding, and information exchange that are necessary to respond to threat are undermined by the fractious nature of communities, and innovators may struggle for expression in such places.

19.2.2 Innovation

Innovation, like community, is a recurring theme of disaster studies, though often more implicitly understood than explicitly mentioned. Survival requires innovation. This statement is regarded as axiomatic in the corporate world, where organizations must respond to constant shifts in the competitive landscape with new products or services, more efficient communications and information technology, and streamlined, flexible, "organic" structures. Outlined in classic innovation research by Mitzberg (1979; as cited in Lam, 2005), organizational structures vary in degrees of flexibility for adaptation and periods of instability. In a highly flexible organization, innovation becomes more likely (Damanpour, 1991). Innovation itself, of course, has a reflexive quality, since it is innovations or changes occurring elsewhere in the operational environment that compel other organizations in that environment themselves to seek new strategies or methods. Innovation, then, is a key survival

attribute, but it is one with a central paradox - though it denotes a break or departure from customary methods or structures, the break itself is necessary for the continuity of the organization in question. This could include either the continuity of their reputation or perceived legitimacy; the continuity of socially-constituted parameters of performance; or in extreme cases, the continuity of the organization's existence: its survival.

We examine, principally, innovation as a capacity or a process, rather than as the product, and the unit of analysis is a community (again, not necessarily linked by geography or political boundaries) that does something new in the face of crisis, either a crisis that is potential or one that is realized. The emphasis is on a departure from an established way of conceiving danger. This departure could include novel ways of thinking about potential perils, developing strategies for mitigating them in advance, becoming better prepared for threats that eventually result in disaster, and responding to disastrous events when they occur.

Much work on innovation has been done at the organizational level, and some of these findings have applicability to our consideration of community innovation. A community can be viewed as analogous to an organization because they have varying capacity to be adaptive in sudden and catastrophic events, as reflected in hazard research (Norris et al., 2008). In the disaster science literature, for example, this innovation may demonstrate itself through considerations of the manifestation of emergence – either through the structural arrangements in operation, the resources utilized, or the tasks and activities engaged in (Brouillettee & Quarantelli, 1971; Kreps & Bosworth, 1994; Webb, 1998) – in the immediate post-disaster period. Researchers generally distinguish between innovation and change, looking at change as "the adoption of a new idea or behavior by an organization [whereas in contrast, organizational innovation is seen as] the adoption of an idea or behavior that is new to the organization's industry, market, or general environment" (Daft, 2004, p. 404). However, Daft (2004, p. 404) goes on to note that when managing change in organizations,

"the terms…can be used interchangeably because the **change process** within organizations tends to be identical whether a change is early or late with respect to other organizations in the environment." We also will not make a distinction between whether the innovation is completely new, never before seen anywhere, or instead is new to that locality. In looking at creativity, for example, a concept closely allied to innovation, Amabile (1997) considers organizations that do new things to be creative, even if the idea was also thought of elsewhere. The key issue is doing something new in a given context, not necessarily being first. Similarly, Damanpour and Gopalakrishnan (1998, p. 3) argued that innovation can be brought into the organization; that is, it can originate in the organization or can be imported after being developed elsewhere.

Not only is the research literature on innovation large, it is also fraught with conflict and contradiction. For example, Bigoness and Perreault (1981, p. 69) commented that studies tend to be "inconclusive or contradictory," and they note that other researchers have arrived at a similar assessment, stating that "factors found to be important for one innovation in one study are found to be considerably less important, not important at all, or even inversely important in another study." Levi and Lawn (1993, p. 226) found a "lack of integrating theories," and suggested that fully-developed widely-applicable theory may actually be impossible, while Damanpour and Gopalakrishnan (1998, p. 2) argued, "Despite their efforts…researchers still cannot identify with certainty the causes and effects of organizational innovations." The principal challenge is the great differences in such variables as organization type, size, configuration, and environment. Even organizations that appear to be similar may differ enough to defeat attempts at generalizing factors relating to innovation.

These challenges are arguably more complex at the community level where members may be less formally bonded to each other than members of a highly structured organization or alternatively be comprised of multiple organizations. There is a further difficulty in applying existing research to the problem of community innovation, and that is that most research examines private-sector companies (see Kraemer & Dedrick, 1997). There is less literature on innovation in public sector organizations, and what there is suggests that innovations follow a somewhat different trajectory with different factors of facilitation or obstruction, especially because different demands are placed on organizations in these contexts. The same may be true for communities based around non-private sector definitions.

19.2.3   Community Innovation

The literature on innovation, as noted earlier, is quite sizable. However, much of this literature is concerned with technical or industrial innovation, and "R&D" (research and development). Research focuses in particular how new products circulate through different markets, known as diffusion of innovation (Meade & Islam, 2006; Robertson, 1967).

Diffusion is a key part of the policy process because it impacts the degree to which the policy change is successful (Shipan & Volden, 2008). Furthermore, according to Fagerberg (2005), "Diffusion is one of the three pillars on which successful introduction of new products, processes, and practices into society rests, along with invention (a new idea) and commercialization/innovation (reducing the invention into practice)" (p. 478). An innovative policy is one in which a new policy is created and diffusion occurs when the policy spreads from government to government (or jurisdiction to jurisdiction): "Pressure for policy innovation also can come from outside the polity, with the spread of innovations from one government to another, a process known as policy diffusion" (Shipan & Volden, 2008, p. 841).

Another clear description of policy diffusion is described by True and Mintrom (2001): "Taken at the most general level, diffusion studies asks the following question: In a given social system, how can we explain patterns of innovation adoption?" (p. 33). This description is

compelling because it can be applied to governments, nonprofits, and commercial organizations, since they all arguably are comprised of actors within a social system. Policy diffusion can be measured by tracking changes at the international, national, state, and local levels. Furthermore, policy diffusion can be impacted by a variety of settings (e.g., Laraway & Jennings, 2002), stakeholders (Cohen, March, & Oldsen, 1972; Kingdon, 1995, as cited in Godwin & Schroedel, 2000), and interest groups (Godwin & Schroedel, 2000). Themes from many studies on policy diffusion reveal similar mechanisms, though the authors might then operationalize them differently (e.g., emulation versus imitation). Temporal and spatial measurements are important quantitative measures in scholarly articles on policy diffusion, although limitations exist in the measuring and assessing trends of conceptual mechanisms (such as cognitive and moral legitimacy).

Community innovation, as such, is less often examined in the broad sociological literature. It is very conspicuous in urban studies and planning, and management and organization science but, again, there is a marked technological or industrial focus, looking at the distribution of new products or services, or the uptake of new technology in firms. The literature explicitly on community innovation follows a similar approach, looking at how communities or regions attract or retain certain industries or become known for producing new goods and services. However, there are many community innovation *programs*. These consist of community innovation grants and sponsorship activities associated with community social or economic development. These are themselves vast topics and include accessible technology, social entrepreneurship, sustainability, low-income support, public health interventions, anti-poverty initiatives, and an infinity of other such enterprises.

For example, the Institute for Community Innovation at Florida International University emphasizes the viability of community-based organizations such as art groups in the South Florida area, but it also has an international reach. One project focuses on rural economic development in the agricultural sector of Central America (Institute for Community Innovation, ND). Elsewhere, the Sustainable Community Grants program, a partnership of the Southern Region Sustainable Agriculture Research and Education (SARE) Program and the Southern Rural Development Center (SRDC), provides grants for projects that connect agriculture, industries, local or regional economic development, and sustainable agricultural practices (Southern SARE and SRDC, 2005). Some suggested projects include those that foster local leadership capability, public-private partnerships, and entrepreneurship. The significance for this chapter is that community innovation is a concept filled with whatever meaning potential innovators want to put in it; there is no consensus as to its content, though invariably there is a positive connotation. Initiatives are meant to create some improvement in their locales. Since all the literatures at issue here are profoundly vexed, it seems reasonable to place attention on innovations that hold both illustrative and instructional value.

19.2.4 Innovating in Communities

Given Peacock et al.'s formulation, the characteristics of community can be opposed to the characteristics of social relationships that are required for innovative action. For example, Comfort (1999) has highlighted the importance of a sense of shared risk in order for communities to be able to organize to minimize the risk. Yet, if the risks are differentially distributed across the terrain of the community, then mobilizing attention and resources is likely to be more difficult. Moreover, differential distribution may result in disparities in risk perception, which in turn may weaken community will or present barriers to decisive action.

Of course, many of the conflicts that Peacock and his colleagues identified are very deeply rooted in systems of production, of economic exchange, or in the debilitating persistence of racism or sexism. The difficulty of communities

to deal with problems that crystallize locally but whose ingredients swirl in the social mix nationally or even globally is well-documented (e.g., Patterson, 2002). In particular, the most profound social vulnerabilities – those rooted in macro-structural systems of organization – often equate to the most serious risks (Wisner et al., 2003). Thus public officials are, in their effort to reduce risk, compelled to try to take account of vulnerability as well. Reducing such vulnerability is sometimes possible at the local level, though the root causes are in conditions usually far beyond the power of local officials to affect.

The significance of Peacock et al.'s conception of community, though, is that "communities" do not innovate; individuals, groups, and organizations innovate. These might be government agencies, non-governmental organizations (NGO), citizen groups, pressure groups, or other collectives. And this means that it is appropriate to look at community innovation from an organizational perspective, because communities, fractured and schismed as they are in the sociopolitical ecology model, are conglomerates of organizations, whether acting individually or working together. *Community innovation*, therefore, takes place as *innovation in communities*.

Much of the job of public officials, as a consequence, is to try to bring about the processes of coordination that Comfort outlines while functioning in the environment that Peacock et al. (2000) have described. Peacock et al.'s conception is of the conditions that *exist* in a certain time, and Comfort's analysis shows what *ought to exist* in order to identify goals that the community as a whole can work toward. Given the differences in what *is* versus what *ought to be*, some aspects of the social organization of the community may have to be changed, on at least some functional level, in order to be aligned with the capacities that Comfort has outlined. Innovation and change, however understood, are necessary in this effort; in other words, innovative thinking and organizational arrangements are needed for innovative action.

19.2.5 Innovation Across the Disaster Phases

Disaster scholars and emergency managers customarily divide the concept of disaster into four phases: mitigation, preparedness, response, and recovery. Some argue that this is not the most conceptually sound breakdown (Neal, 1997) and, more recently, concern about national security has yielded an additional stage of the disaster cycle: prevention. Borrowing from a division of the disaster timeframe used by Quarantelli (1980) in a different sort of study, we find it useful in discussing innovation to divide the disaster timeframe into three phases: pre-impact, trans-impact, and post-impact.

The time that is available for innovating is perhaps the single greatest difference in the nature of innovation across the disaster phases. In the pre-impact phase, there is time for weighing options, considering different strategies for reducing disaster, and evaluating and adjusting new methods or techniques as their effects are observed. Sometimes these can include more modest programmatic efforts, but often these are large-scale, policy-level shifts intended to change people's perception of risk or risk-reducing action that they can take, or to actually change the way people understand and interact with the natural environment. Innovations in the trans-impact phase (immediately before, during, and after impact) include not just those that are policy-oriented but also operationally-oriented, made under great time pressure and are sometimes more appropriately referred to as certain forms of improvisations (see Kendra & Wachtendorf, 2004, 2016; Wachtendorf, 2004; Wachtendorf & Kendra, 2005). The post-impact phase, early and long-term recovery, also includes operationally-oriented innovations but may additionally include innovative approaches for handling some of the difficult decisions to be made during this phase, such as whether or how to rebuild damaged areas. In the next section, we consider innovations in these three phases, but

recognize that the boundaries between them are not distinct – that they may blend into each other at different times.

19.2.6 Pre-Impact

Most conceptions of hazard are now gathered around the premise that hazards do not exist as "things" by themselves or only as forces of nature. Rather, the idea of hazard includes, to a large extent, the choices that people make, especially in terms of where they live. Understanding those choices, particularly from the cognitive dimension, was the motivation behind much of the early hazards research (White, 1973). During the mitigation phase, public officials, emergency planners, and the community in general must *imagine* the threat they are facing. Even if it is one that has transpired before, memories of such events are often short.

Later work (e.g., Hewitt, 1983) argued that the "choices" people make were often not real choices, but were the narrowed options resulting from social, economic, and political marginalization. From these research directions, however, emerged an understanding of hazard as a mismatch of social, natural, and technological systems (Mitchell, 1990). Human activities, particularly with respect to land for settlement, clash with the climatic or geophysical forces of certain places. Mitigation then can take either or both of two directions: to modify the natural environment to redirect or contain the earth's processes, or to modify the human uses of space that are incompatible with the natural events that occur there. Examples of the former, termed structural mitigation, include such engineered systems as dams and levees but might also include more personalized devices such as home lightning rods. Non-structural mitigation involves redirecting human uses, such as keeping development out of hazardous areas through land-use regulations, bracing furniture to walls in earthquake prone areas, or education and information campaigns to alert people to local dangers (Verchick, 2010). Many of the non-structural and innovative mitigation solutions can also improve

development, and also improve overall health outcomes. Environmental pollution and unsustainable fuel reliance systems have severe impacts on human health, thus green mitigation intersects with human and environmental well-being (DeYoung, 2016). In a sense, viewing global warming as both a human cause *and* a human consequence is an innovative solution for inducing behavior change in the form of introducing new systems for extracting fuel and developing land.

As Cannon (1994) stated, mitigation is too often hazard-centered rather than people-centered. Because disasters are tied to social processes, strategies that aim to reduce disaster vulnerability must pay attention to vulnerabilities in both the built and the social environment. Among scholars and emergency managers, structural mitigation has fallen out of favor as a principal strategy. White's (1973) early work showed that flood losses continued to increase even after the establishment of an elaborate flood management system on the western rivers. Development simply increased, placing more life and property at risk and, as the 1993 Midwest floods and the 1997 Red River Flood revealed, very extreme events can surpass the design parameters of such vast systems and lead to even greater flood losses. Thus, while the spectrum of mitigation strategies includes a mix of both structural and non-structural programs, the preferred emphasis is now more toward non-structural methods. Given the understanding of hazard as a mismatch of human-environment relations, non-structural mitigation requires adjusting human action. This involves, from the perspective of the hazards paradigm founded by Gilbert White, shifting people's choices away from hazard and, from the vulnerability perspective emphasized by Hewitt, ensuring the capacity of individuals, groups and communities to understand and minimize the risks of decisions, especially with respect to location and land-use.

The fundamental requirement of hazards mitigation - moving people away from areas that threaten particular land uses or, when those uses are urgent enough to merit tolerating some risk,

to promote awareness and foster protective measures - are straightforward in concept but surpassingly difficult to achieve in practice. Indeed, disaster scholars often regard localities' failure to move people away from hazard as a principal shortcoming of local mitigation strategies. Yet the challenge should not be understated. For the prelude to Hurricane Katrina, several hundred thousand residents did, indeed, depart from a hazardous location. Their departure – for the short- or long-term – has provoked multiple economic crises in the host areas, amounting to a serious national problem. Land-use is inextricably connected to social and economic patterns. Adjusting land use decision-making or adjusting other behaviors that bear on risk in communities requires modifying how people perceive the character of their environments and the potential danger they might be exposed to. This often necessitates helping people to see their environment in new ways, and to do new things. In short, it requires innovation, at all levels of community life, to enact the social changes that are reflected in different land uses or different organizational relationships that can increase the overall capability of various members to mitigate the impacts of various hazards.

An example of such a program directed at sustained change in human-environment relations was Project Impact (PI). This initiative, introduced by the Federal Emergency Management Agency (FEMA) in 1997 under the Clinton administration, provided seed money to local communities in the broad area of funding disaster mitigation and building disaster resistance. In addition to fundamental efforts to facilitate local adoption of hard mitigation projects, the initiative – where most successfully implemented – was a large-scale programmatic effort to effect the alignment of community social organization with the capacities needed for change. The program began with just 7 pilot communities, each eligible for up to $1 million in "seed money," though ultimately some 250 communities participated. The Disaster Research Center (DRC) at the University of Delaware completed a multi-year evaluation of Project Impact, concluding that many communities were successful

in elevating local awareness of hazards and their willingness to implement mitigation measures (see Wachtendorf, Connell, & Tierney, 2002).

Project Impact stressed education, outreach, partnership building, and a sustained emphasis on measures that individuals as well as government could take to reduce their risk. Part of the emphasis was first to identify and publicize risks in the community. Certainly, leveraging financial resources within the community toward mitigation efforts was a central component to the initiative, but it also involved (though not explicitly expressed as such) leveraging of awareness to create shared identities of mutual exposure that could cut across the various group boundaries established by the ongoing competitions that normally exist among community groups. After the hazard was identified it was publicized through brochures, public service announcements and advertisements, educational programs in the schools, and even through direct communication, such as door-to-door public awareness campaigns by local scout troops or other organizations. Outreach materials were added as inserts in pay stubs and electric bills, handed out at sporting events through partnerships with NASCAR, and disaster expos.

Although implemented to varying degrees of success across the country, effective communities attempted to transcend conflict between its constituents by emphasizing shared risk. PI coordinators made explicit efforts to build alliances, especially between the public and private sector. These could take the form of bi-directional relationships between the PI office and business, public agencies, or community based-groups, or could involve multi-directional relationships among and between several organizations or businesses at the same time – for example, through the involvement of the local Chamber of Commerce or other consortiums of organizations. Some PI communities were able to build upon mutual interests between departments, developing innovative approaches to achieve common goals. For example, one community identified ways to leverage funds from environmental groups, leisure groups, a parks department, a planning department, and

emergency management to buy out flood-prone property and develop green space for recreational use.

The programs that were initiated under Project Impact were not necessarily, in themselves, new ideas. They were often the kinds of ground-level efforts that most disaster researchers have come to believe are important in community-level mitigation, and they often did not differ from other kinds of community development initiatives. Education, building partnerships across government agencies and the public and private sectors, and developing programs to fund various projects or to encourage people to take self-help measures are not new. And, taken as a class, these activities were not necessarily new in these communities, either. Public-private partnerships have previously tackled other kinds of public problems. The use of other trappings of Project Impact - such as mascots, advertisements, school education programs – had been done before. But all these aforementioned initiatives were deployed in new ways, for new purposes, and their ambition was to foster new thinking within the community, among the people who lived there. By shifting mitigation from a top-down initiative (for example, through structural engineers and other stakeholders carrying out mitigation) to a more bottom-up approach, this shift in who has agency over mitigation was innovative. In other words, the various initiatives under PI marked real departures from customary ways of regarding and using the natural environment, and from established norms of individual, group, and organizational relationships. Some local PI communities made commendable strides in fostering what they called a synergy on mitigation issues. Leadership spearheading mitigation initiatives were found to be key in the process and sustainability of community efforts (Wachtendorf, Connell, & Tierney, 2002). This aligns with classic innovation research that indicates the critical role of knowledge brokers for effective innovation diffusion (Cillo, 2005; Hargadon, 2002; Zook, 2004). Clearly there is an interpersonal aspect to innovation that cannot be overlooked. Mulgan (2007) also indicates that

relationships can facilitate or serve as barriers in social innovation.

19.2.7   Trans-Impact

In this chapter we have adopted a fairly broad definition of innovation, essentially referring to any new and creative program, procedure, or technique that a community implements to meet the demands of their environment. In the period before a disaster, this demand is registered as a sense of risk—the belief that some aspect of the community's condition is dangerous and needs to be addressed. The change, following Amabile's (1997) definition of creativity or Daft's (2004) specifically relating to both innovation or change, does not have to be totally new, never seen anywhere before. It only has to be something that is new to the community.

Response involves "Actions taken immediately before, during, or directly after an emergency occurs, to save lives, minimize damage to property, and enhance the effectiveness of recovery" (Godschalk, 1991, p. 136). This phase of the emergency management cycle puts a premium on timely action. The temporal scale for mitigation and preparedness spans months or even years. In response, minutes or hours is the more likely span for innovating, as emergency managers assess the situation and adapt plans for the general disaster envisioned in advance to the specific disaster unfolding before them. Or, as might also happen, they must develop plans for contingencies not imagined at all. Responding to disaster is likely to yield innovative techniques or procedures that are new to those people, but given the urgency of time they are likely to also be, more accurately, *improvisations, or* combinations of new and existing knowledge made in real time (Weick, 1998). One may be tempted to say that large complex disasters generate more improvisations than smaller events, but lesser events require improvisation, too. In fact, Tierney (2002) argues that if an event does not require improvisation, it is not a disaster, so that improvisation is actually a distinguishing feature

of disaster. Wachtendorf (2004) and Wachten-dorf and Kendra (2005) have identified several types of improvisational actions, based on the extent to which structures, activities, resources, or tasks serve as substitutes for a missing capability (reproductive improvisation), adapt an existing capability (adaptive improvisation), or create a capability that had not existed before (creative improvisation). We note here that discussion of innovation and improvisation brings us into potentially confusing questions of scale and the boundary between what is established or old, and therefore, not innovative, and what is new and thus innovative. New York City's effort to reconstitute its Emergency Operations Center (EOC) following the September 11, 2005 terrorist attacks serves as an example of *reproductive improvisation*. After the original EOC was destroyed as a result of the attacks, it was reproduced within days at a cruise ship facility on the Hudson River. In this sense the EOC as an organizational structure, as an emergency management function, and as a place (Perry, 1991) was not an innovation, though the original might have included innovative equipment and, indeed, the new facility required considerable innovation in its equipment and operations (see Kendra & Wachtendorf, 2003a, 2003b). The September 11 attacks on the World Trade Center did, however, yield many innovations in technologies, organizations, and strategies for accomplishing multiple response-related needs. One such *creative improvisation* strategy was the emergent waterborne evacuation of several hundred thousand commuters and others from Lower Manhattan using a wide range of vessels not previously involved in any evacuation planning efforts or schema (Kendra and Wachtendorf, 2016). After the attack, residents and workers from Lower Manhattan fled, mostly by foot, in all directions —uptown, or over the Brooklyn Bridge, or south. Those fleeing south were halted at the waterfront. Even before the towers collapsed some ferries turned around with their passengers, while others returned to pick up their regular clientele. Simultaneously, tugs and other craft moved toward Manhattan. Some vessels asked

and waited for permission from the Coast Guard, but others acted on their own.

The waterborne evacuation was an unplanned use of resources. Although segments of existing crisis management plans were available for some participants (the United States Coast Guard (USCG) had contingency plans for a water parade in 2000), most participants were unaware of this or any other contingency planning. In fact, significant dimensions of the operation were developed in the earliest stages of the response, as when the USCG and local harbor pilots developed a traffic management plan for vessels around the tip of Manhattan. At the same time, many participants reported no external direction for their actions (Kendra, Wachtendorf, & Quarantelli, 2003; Kendra & Wachtendorf, 2016). Hence, this effort was not merely innovative; it was collectively innovative in the part of the harbor community, with a set of goals, norms, and procedures that emerged across a large number of participants. Over the course of a few hours, a shore-side system of directing evacuees to particular locations developed, buses deployed to bring evacuees to marshaling points, and decontamination strategies materialized at points of disembarkation. No one activity was particularly innovative, but the "collective induction of new meaning" (Weick et al., 2005) that manifested itself brought about an innovative solution to the closure of tunnels and bridges for anything but foot traffic, during an unfolding crisis, around an island. Shared collective identity (based on Weick, 1995), shared knowledge (as in Comfort, 1999), recognizing the limits of knowledge, and reworking norms according to an emerging ethos appear to be significant features of how this transpired (Kendra & Wachtendorf, 2016).

19.2.8   Post-Impact

During the mitigation phase, public officials, emergency planners, and the community in general must *imagine* the threat they are facing. Even if it is one that has transpired before,

memories of such events are often short. Innovation during the recovery stage tends to encounter conditions of support, and resistance that are similar to those seen in the mitigation phase. The issue in this phase is one of perceived risk, and in trying to foster the sense of shared risk that Comfort argues is urgent for community action, public officials are often engaged in what Gioia and Chittepedi (1991) have termed "sensegiving," imparting a comprehension of events that should inform the actions of others. As community consensus, fleeting though it may be, emerges after impact, it is possible to see processes of sense*making* (Weick, et al., 2005; Kendra & Wachtendorf, 2016) as multiple individuals and organizations read changing events through their congruent identities that foster similar interpretations and sets of possible actions. Innovations, many of them tactically oriented, appear at a rapid pace. But as has been seen after all disasters – and especially after technological disasters (Marshall et al., 2003) – previous divisions and lines of conflict re-emerge. The therapeutic community (Barton, 1969) gives way to the previous order as groups compete not just for resources, but also for legitimacy and hence for a voice in the recovery. In terms of innovation, this phase looks something like the mitigation phase: politically charged and contentious, especially in places in which the political climate is unstable and rapidly changing. Indeed, since ideally the recovery phase should include mitigation, this is not totally surprising. But, while preparedness and response are devoted to crisis, mitigation and recovery are devoted to a vision of what the community should look like. Such visions are never achieved collectively without struggle. The debates in New York City regarding the appropriate use of the former World Trade Center site (which took place in earnest for over a decade and, particularly as it relates to the storage of remains, continues) – or Ground Zero – epitomize the way competing interests can clash regarding appropriate recovery strategies. Whether or not office space should be part of the rebuilding plans, whether or not the footprints of the towers should remain relatively untouched, the aesthetics of site buildings, and the proper way to memorialize the site and those who died there, were all heatedly debated.

There are examples, however, of successful recovery innovations. One such short-term recovery approach was undertaken by the City of Santa Cruz, California after the 1989 Loma Prieta earthquake. The city suffered widespread damage to both structures and infrastructure, but also damage to its downtown business district. Faced with the need to both reestablish commerce for local businesses in the short-term, at first in response to business closures and later in reaction to customer leakage, the city countered the leakage trend by establishing pavilion tents to temporarily house dislocated businesses. Added support from labor unions and Vision Santa Cruz – a downtown recovery group with representatives from the private and public sector, as well as the community at large – was instrumental in the pavilion's quick construction and overwhelming success. Indeed, the pavilions allowed businesses to take advantage of important holiday season sales. Respondents reported a synergy and market-like or "festive" atmosphere in tent pavilions. Santa Cruz engaged in numerous promotional activities to attract customers to the city and to rebuild community spirit, including a promotional Christmas rally and a "Shake, Rattle and Roll" celebration. Customer attrition was a phenomenon that proved difficult but not impossible to reverse due to the innovative recovery approaches of the community. As we have seen in other sections, the innovations implemented in Santa Cruz are not necessarily new in their concept. The creation of temporary locations for businesses was not unique to this community. What was innovative, however, was the festive atmosphere created through the way those temporary locations were constructed and promoted in this particular community. This kind of innovation may be particularly beneficial not only for recovery of the local economy, but also for the psychological sense of recovery in the population impacted by the earthquake (Ekanayake et al., 2013).

The emergence of Tangshan, China as an economic center displays a number of large-scale

innovative aspects. The city was nearly completely destroyed by an earthquake in 1976, but Mitchell (2004) notes a number of new initiatives incorporated into the rebuilt city. For example, considerable care was devoted to the long-term treatment of people with very severe injuries, including psychological treatment, vocational readjustment, and social reintegration. This latter point includes marriage and new family life, but also having the survivors help to preserve memories of the event through writing about it and working with youth groups. The city has established a museum for the event with displays highlighting the recovery and growth since then, and implemented a number of mitigation and preparedness initiatives - a seismic monitoring system; projects considering the significance of water level and animal behavior; trained civilian observers; and anti-seismic construction techniques (Mitchell, 2004, p. 4–6).

Another example of innovation from China includes the process of bridging devastated and non-impacted communities following the 2008 Wenchuan China earthquake. The devastated areas were divided into districts and matched with distinct localities across the country to provide recovery support, including in-kind personnel and expertise (Lee, 2008). The strategy distributed the burden of support across China. Although top-down in its implementation, the partnership was an innovative way of establishing connection and responsibility between communities.

Innovation is important in communities' effort to be less vulnerable or more resilient. Consider an example of community innovation following the Indian Ocean tsunami. A community education and development group, Disaster Mitigation Institute (DMI), worked closely with a number of communities in the weeks following the disaster. From their perspective, vulnerability to hazard was a development issue. Homes were destroyed that were not insured; boats, motors, and fishing equipment were destroyed that were not insured; and moreover, some fishers had outstanding loans on boats that were now gone. Given that the government assistance package included loans (albeit low-interest) for replacement

equipment, deepening debt was the likely prospect. Even setting aside the serious vulnerability inherent in living in coastal living, economic vulnerability was deeply implicated in this disaster, largely through reliance on a single industry.

DMI's approach was to broaden the economic base, by building the earning capacity of women. Many women had worked in small manufacturing or other jobs; capitalizing on these existing skills would strengthen the community's capacity. Diversifying resources is a key element of resilience because it promotes redundancy, a vital component of resilience (see Kendra & Wachtendorf, 2003a; Bruneau et al., 2003). At the same time, it decreases vulnerability. And in communities with a strong patriarchal social structure, involving women is a compelling social innovation as well, bringing their skills into the resource mix. Though perhaps the monetary sums are small, the magnitude of change in social relationships may be quite large if the communities follow through.

19.3 Facilitating and Obstructing Innovation

Damanpour and Gopalakrishan (1998, p. 4) argue that, "Innovation adoption is a means of changing the organization to facilitate the adaptation to changing environments in order to sustain or increase organizational effectiveness." External requirements often spur innovation; these relate to the survival or viability of the organization and are generally tied to some aspect of competitiveness, including such metrics as profit or market share or more hard-to-measure but still important features as reputation. Some sort of a perceived need is generally, as depicted in most research, a principal requirement for innovation in an organization. Of course, in the corporate realm, the need generally relates to productivity or profit requirements, either in an absolute sense – the company is falling behind in profit or market-share – or relative, in terms of how the organization's performance is measured against expectations of major constituents, such

as shareholders. In this sense, the need for innovation is really a response to preserving or enhancing competitive stature. While competitiveness itself is a troubled term, as Schoenberger (1998) noted, and few companies can define what is competitive enough, most commercial organizations have a sense of competitiveness tied to their prosperity and even survival.

Public organizations do not face exactly the same competitiveness demands. Their role is generally to provide a service and thus they do not have to show a profit and, except in spheres of activity that are being privatized (prisons, package delivery) they rarely face an open market of potential competitors. This does not mean, though, that they do not face demanding stakeholders or that efficiency and effectiveness are of no consequence. Maintaining legitimacy and the public trust are the public sector analogs of competitiveness and are often the reasons for the adoption of new equipment or procedures. Having the latest technology in an emergency management office, for example, conveys the image of preparedness and competence that emergency managers' desire.

In a broad way, researchers group the factors that bear on innovation into those that are either internal to the organization or external to it (Levi & Lawn, 1993). Internal characteristics relate to the structure of the organization or to the size and composition of the workforce. External factors are those relating to the organization's environment, especially competitive pressures. This general categorization is reflected in Daft's (2004, p. 404–406) assessment of five required elements of change: *"novel ideas"*; *recognition of need*; *adoption; implementation;* and *resources* (of people, skill, and money). Of these, *need* is probably most associated with externally-oriented demands and may dominate other considerations; ideas, according to Daft, may be either internal or external to an organization. Forces spurring the adoption of innovations are generally, though not exclusively, external to the organization; forces impeding innovation tend to be, though are not always, internal to an organization. Levi and Lawn (1993) found that firms are generally more alert

to external factors but are less attentive to internal forces that can hinder innovation. Daft (2004, p. 426) outlined a number of potential impediments, including e*xcessive focus on cost*; *failure to perceive benefits*; *lack of coordination and cooperation*; *uncertainty avoidance*; and *fear of loss*. These factors are based on research on organizations; however, similar factors are evident at the larger community scale. These various elements of change and of potential obstruction are not precisely opposites of each other, but they share some opposing characteristics. For example, when resources are plentiful, or needs are more easily recognized, there may be less concern about cost. At the same time, some elements are clearly related to and affect each other. If perceived benefits are low, costs may seem too great. In this next section, we discuss principal elements of innovation facilitation and obstruction in the context of communities.

19.3.1   Recognition of Need

Successful mitigation initiatives, for example, require a reconstitution of a population's environmental perception, but if the hazard has not been presented as a disaster, then those who advocate mitigation strategies are arguing about, essentially, a phantom menace, which a few recognize but which must be evident to others. When a disaster has occurred in a community, the lingering risk and hazard has been laid bare for the citizens. Often, the need is not as obvious to all stakeholders or, even if they are aware of the threat, they may not know what can be done about it. Innovation always requires a recognition of need, but that recognition may not always exist, especially across the various stakeholder groups in a community. And here we include public officials and government as stakeholders. For example, the need to develop innovative approaches to warning and evacuating a migrant segment of a city's population may be recognized by those in that particular community, while at the same time the need may not be recognized by public officials, those with a greater access to decision-making power, or

other communities of individuals not exposed to the same risk, even if the heightened vulnerability contributes to the city's overall vulnerability. What makes community innovation particularly challenging compared to organizational innovation is that individuals can be a part of multiple communities, each with different interests, priorities, abilities to mobilize others, and degrees of access to power.

A need must be both identified and clearly communicated. While some conception of need is always required for innovation, even those who understand the need are generally not able to implement innovations single-handedly. Rather, what is often required are persons who can build a constituency; a (growing) group of people who share that perception of a situation that change is needed. Daft (2004) refers to these people as *champions* - those who take on the job of fostering change in technology, procedures, or organizational structures.

In the mitigation or preparedness phases, the emergency manager virtually by definition is required to champion community change in the direction of reducing risk. The emergency manager's job is to identify the existing "need" - the sources of potential emergencies that remain in the community (or communities) and to develop programs to reduce them. This is, often, a highly evangelical activity, in which the emergency manager must continually work to make the community aware of lingering risks and what can be done about them. Other ideal champions include citizens who are members of community-based organizations who have a keen relationship with their constituents, private sector leaders who have a visible role in the community, or members of environmental advocacy groups, which often focus their attention on hazards (particularly industrial hazards). In some cases, a champion may be appointed, but often a champion emerges, someone who perceives a need and is inspired and inspiring to others. Lois Gibbs, who founded the Love Canal Homeowners' Association, was one such champion who emerged following discovery of toxic waste leaks at Love Canal and who campaigned for financial assistance for nearby homeowners.

Groups who are not traditionally emergency response organizations can make a substantial contribution to the development of innovative emergency management approaches within the community. For example, some non-governmental organizations are better able to act as watchdogs and enact political pressure on governments and the private sector; some groups adopt a neutral stance and run education campaigns; still others are successful in attracting funding from sponsoring agencies. For example, after the 2015 Nepal earthquake a many health INGO's and Nepalese-based NGO's were able to obtain a substantial amount of funding from donors after the earthquake. This group then use funds not only for mitigation but for long-term activities that make communities healthier and more resilient (Penta et al., 2016). Even more interesting, the boost in funding could propel these groups into a new capacity level for raising awareness and meeting needs for urgent issues such as mental health, which is more heavily stigmatized in the Nepali context (Seale-Feldman & Updahaya, 2015). Just as non-governmental organizations vary in their functions, perspectives, and what they can achieve, so too do public and private sector organizations differ from each other and from groups within the same sector. By bringing together organizations that can offer a variety of resources, ideas, perspectives, and sources of knowledge, the collaboration can result in innovative broad-based mitigation strategies that could not be achieved if one sector or group were to work in isolation.

Again, the activities in some Project Impact communities provide excellent examples. The most successful Project Impact initiatives at the local level included not only traditional disaster planning partners, but brought to the table leaders of such groups as senior citizen organizations, those organizations that work with people with disabilities or with immigrant communities, and organizations such as Habitat for Humanity, the Boy Scouts, the Sierra Club, the Humane Society, and Neighborhood Watch. These are just a few examples of the types of groups that provided a clearer understanding of the needs of different segments of the populations but that

also had their own resources, skills, and expertise to add to the tool chest of the community's capacity.

19.3.2 Excessive Focus on Costs

Costs are usually mentioned among the challenges impeding innovation and available financing is so often a limit to action that it hardly seems necessary to mention. Nearly the entire hazards field is devoted to assessing risk; communicating risk; and persuading or forcing people to take steps to avoid risk. Expenses are generally cited as impediments to the adoption of new strategies for reducing hazards in a place. For example, acquiring land in a floodplain is one way that communities have been able to lessen hazards, by simply not allowing dwellings to remain in flood-prone areas. There are, however, a number of financial implications to consider in such a strategy. Platt (1996, p. 333–335) noted several, such as initial purchase prices or loss of tax revenue when property becomes publicly-owned.

The post-disaster period is often described as a "window of opportunity" in which a community, alerted to the particular dangers of its setting, might try to mitigate some of the hazards that are prevalent there (Birkland, 2006). Mitigation grants that are included in association with a Federal disaster declaration can help communities lessen their risk, and communities are now required to have mitigation plans (Schwab, 2010). In this sense, innovation is mandatory after a disaster, and moreover, *thinking about innovation* has to occur before disaster strikes. Of course, Project Impact also showed that some innovative steps do not have to cost money, or may require only relatively small sums of public funds or can be supplemented through donations or other sources. Classes on hurricane-proofing one's home, taught at a hardware or building-supplies store, require just a bit of goodwill from the company (which will benefit when people purchase their materials there). While financial considerations undeniably present limits on what a community can accomplish,

an excessive focus on cost can stifle the imaginative consideration of novel approaches for which funding from novel sources can later be acquired (Simmons, Kruse, & Smith, 2002; Simmons & Sutter, 2011). Indeed, sometimes imagination and merely a willingness to start somewhere are key attributes in launching new risk-reducing initiatives.

19.3.3 Avoiding Uncertainty and Fear of Loss

In the community context, avoiding uncertainty and fear of loss are related to longstanding social and cultural norms and expectations. Ownership of property is a cherished principle of liberty in the United States, and ownership of land and homes is a principal means of securing wealth, especially for intergenerational transfer, at several income strata. Buy-out programs provide an example of cultural challenges, confronting residents both with uncertainties and the loss of cherished community patterns. Some are undertaken via the eminent domain power, but those that are sponsored under the Federal Emergency Management Agency (FEMA) post-disaster Hazard Mitigation Grant Program must be voluntary; FEMA will not extend the program to facilitate the exercise of eminent domain. As a consequence, public officials must engage in a substantial process of persuasion and negotiation. Even so, some homeowners occasionally hold out. The town of Valmeyer, Illinois, for example, voted to move away from the floodplain. Mitigation funds through FEMA enabled the buy-out of properties. However, some landowners resisted the program, criticizing the sums offered them for their properties. The strength of that attachment is often underestimated. Indeed, the symbolic value of property is a strong determinant in decisions to remain in hazardous areas for homeowners as well as those with a more fragile hold on physical place. Veness (1993) found that "homeless" people become very attached to their dwellings, however rudimentary, and find moving to be quite personally disruptive regardless of the paucity of their possessions. This has also

been found to be true in the context of sense of place for both disaster relocation (Cox & Perry, 2011) and preparedness (DeYoung & Peters, 2016). Therefore, the ability to implement innovative strategies requires confronting existing social norms and may demand further innovations that allow for more appropriate, or accepted, solutions.

There is an extreme and very politically charged cultural element of resistance to change and the uncertainly that change brings. Other elements might lie in certain expectations of who is responsible for disaster management—a belief that "the government" is both responsible for and able to provide a complete restoration of community life. This is always impossible. Indeed, counteracting a persistent sense that a higher level of government will continually provide assistance has become a project in policy-oriented hazards research. Scholars such as Platt (1999), Mileti (1999), and Cutter (2001) have argued that local communities have become far too dependent on Federal disaster assistance and should take on more responsibility for lessening the hazards. From this perspective, local communities are the principal sites for identifying the climatological, geophysical, or industrial hazard agents and ensuring that human activities take these into account. What these researchers are calling for is essentially a large-scale social change, a shift in *national* disaster policy to be realized at the *local* level and involving a sizable shift of expectations and substantial new norms of accountability. To the extent that communities have not attended to their local circumstances, innovation will be necessary.

The discussion of innovation adoption and implementation extends internationally. Several initiatives proposed following the Indian Ocean tsunami are likely to be extremely difficult to implement. Both India and Sri Lanka governments announced an intention to enforce existing regulations that prohibit construction in the coastal zone or to establish new ones. These regulations were originally intended both for hazard mitigation and as conservation measures,

but they will now conflict with the post-tsunami recovery ambitions of dozens of coastal communities. These residents desire reconstruction of their communities in their existing locations, even though such reconstruction will reproduce the locational component of their overall vulnerability. At the heart of their vision is the maintenance of long-established patterns of community life, closely associated with fishing and proximity to the water. There is thus the potential for two competing goods: reducing vulnerability to hazard and preserving traditional practices. Clearly, innovative thinking will be required, though it is not clear what direction that might take.

The fundamental conflict transcends international boundaries: What changes should communities make in order to lessen their risk, and what degree of change should communities be expected to make so that they don't require assistance from other communities or from larger scales of social organization? What is the acceptable risk? In Valmeyer, much of the community moved, and there was significant transformation of community life. In India and Sri Lanka, there would also be significant upheaval. There, however, the recurrence interval will probably be much longer than that of floods in Valmeyer, though without warning systems the danger to life is greater. Balancing the economic advantages of a place, the desirability of preserving established rhythms of social life, and reducing hazard are difficult in any setting. Concerted community action will require a consensus on the acceptable collective risk of living there. At a minimum, in areas impacted by the tsunami, mitigation should begin with a new awareness of the environment, and it is likely that large-scale social changes will be required to lessen the risk of future such events. Innovations do not always lead to positive changes for a community, or certain segments of a community. The uncertainty of whether or not those new approaches or large-scale social changes will better or worsen community life can work to impede any innovation at all.

19.4 Conclusions and Future Research

The act or process of collective innovation would seem to be a useful line of inquiry. Virtually from the founding of the hazards field, in the human ecological tradition, the emphasis was on understanding how communities got themselves into trouble and suggesting what had to be done about it. These suggestions were for innovations – changes in how communities understood and acted in their natural surroundings. Yet the dynamics of human-environment interactions, in the US and worldwide, have hardly been static. The world's population has increased dramatically; economies have grown and faltered; new dependencies have emerged; new needs have evolved; and resources of energy and space have been strained. Innovation is needed to meet change but it also sparks the need for innovation elsewhere. Innovation in the entire disaster milieu is rarely, maybe never, carried out by a single person. Even when one person has a flash of creative insight, other people modify it during implementation. In our research on the interorganizational response to the World Trade Center, we encountered several officials who each claimed to have initiated a particular action. Were all but one of them wrong? Maybe. But maybe they were *all right*, so that collective innovation can emerge from multiple individual thoughts directed toward a shared goal. Research taking this approach would then come into view of the growing body of work on sensemaking, thereby contributing to several fields and advancing our understanding of the collective innovation process.

In this chapter we have taken a fairly positive stance toward innovation, emphasizing the virtues of change when confronting environmental hazard. Such a stance follows from the meaning of hazard - "a threat to people and what they value" (Harriss et al., 1978) - and the normative requirement that the situation be rectified. Yet innovations can go awry. The project of controlling flooding along the Western rivers, study of which was the subject of much of Gilbert White's (1973) work, was relatively

mal-adaptive. The National Flood Insurance Program has earned criticism for encouraging settlement in dangerous areas (Platt, 1999) and for payouts for repetitively-damaged properties. Note that these were not innovations *in* communities, but innovations *for* communities, but still there were unintended negative spin-off effects. The principal challenge to innovation, even those that are salutary to begin with, is that they are set in a particular social and economic context. The context may change, faster than that which was innovative can be adjusted, so that in later years the innovation can actually become detrimental. Clearly more research is required for better anticipation, and also for understanding innovations as part of larger systems of social and economic activity.

In examining Tangshan, Mitchell (2004, p. 15) indicates that it is necessary for recovery planners "to hone their capacities for managing surprising contingencies." He further suggests (2004, p. 2) that the emphasis of recovery has changed over the last decades, "from the compassable goal of retrieving a known world that *was*, towards the much more uncertain task of achieving a projected, predicted or imagined world that is *yet to be*." Such a statement suggests that innovation is "squared" – that it is necessary to be able to innovate over innovations to take account of changing circumstances. Even with the apparent success of the recovery in Tangshan, Mitchell (2004) notes certain complicating factors. First, he argues that the city's recovery plan emphasized structural and economic concerns but subordinated more social needs of the community, the consideration of survivors with disabilities being, perhaps, an exception. Moreover, he suggests that an important element of successful recovery was not anticipated – the simultaneous opening and expansion of the Chinese economy. Meeting unanticipated developments will thus become a necessary capacity of officials who are managing recovery as well as those working in other disaster phases. In the case of Tangshan, shifts in circumstances were beneficial; with the National Flood Insurance Program they were not. While emergency managers have to be alert for

unexpected transformations that affect their plans, is it possible to plan for innovation? In some sense, yes. It is clearly possible to plan attempts to innovate, by setting up in advance the necessary preconditions (Daft, 2004) that facilitate the exchange of information and risk-taking, and by enacting policies that limit the conditions that stifle creativity (Amabile, 1997; Woodman, Sawyer, & Griffin, 1993).

Project Impact demonstrates something else about the effect of unexpected changes on innovation: it can be quite transient. Project Impact was dismantled at the national level by the George W. Bush administration when they assumed office, to be replaced by a competitive grant program. Just as communities are split by conflict, so too do they fit within a larger political universe where there are many different views about the proper relationship of local and national scales of economic and political activity. In certain places, Project Impact lives on among some dedicated devotees who advance its principles in their communities and have worked to institutionalize these innovations in their local practices. Of course, the flow of federal funding would not have lasted indefinitely; the program's durability in spite of the early termination of funding points even more strongly to its larger success. Nevertheless, the transience of Project Impact shows that we need ways of decoupling innovative programs from their political provenance, and we need ways of sustaining interest in initiatives over many years. In the US there is very little track record for sustained large-scale ambitions. The space program might be one example, though its fortunes, too, have been quite variable. Even innovative national initiatives related to climate change and reducing carbon emissions can come under threat with administration changes, undermining – or demanding – local innovations in such areas. Future research that examines the processes that better enable innovation in dynamic or uncertain conditions would greatly advance the field. Modern case studies, such as community innovation in coastal areas after the 2012 Japan triple disaster or – in the American context – the impact of the United States withdrawing from the December 2015 United Nations Framework Convention on Climate Change Paris Agreement on industry and state or city innovation regarding emission reduction.

Outside of the scholarship sphere, the intersection between community and innovation is often linked explicitly or implicitly to technological advances. For example, following Hurricane Sandy's impact on the eastern United States, the federal government launched the White House Innovation for Disaster Response and Recovery Initiative, a program that emphasized the potential of technological innovation to assist a wide range of stakeholders. Much of the early efforts focused on maps, apps, and data sharing (Lee et al., 2014). Greater emphasis needs to be placed on the innovative human process associated with such technologies. Indeed, Hurricane Sandy demonstrated a particularly innovative use, by the Occupy Wall Street movement, of an existing technology and practice. Occupy Wall Street was an emergent protest effort, situated primarily in New York City, developed to speak out against concentrated wealth in the United States. When Hurricane Sandy struck areas in and around New York City, the movement used its collective mobilization strategies to engage in a disaster relief effort. One innovative strategy they used was the Amazon.com wedding registry function. The existing online ordering system was one many potential donors were familiar with. Rather than soliciting material goods, donors could identify current needs and place an order on behalf of the relief effort. The technology was not an innovation, but the way the organization utilized the technology was.

Likewise, relatively recent discourse has centered on innovative uses of unmanned aerial vehicles – or done technology – in disaster response or relief efforts. Such efforts, though often top down in their development, could provide some space for communities to potentially utilize new technologies in innovative ways. Take a similar advance a few years ago. Geographic information systems (GIS) may be more closely identified with corporate or government top-down mapping efforts, but following

the 2010 Haiti earthquake, efforts emerged to, in an extremely innovative way, bring to bear the resources and technological skills of hundreds of volunteer mappers. As Soden and Palen (2014) describe, the "volunteer technology communities" (3) were able to leverage considerable innovations in social media and mapping efforts, as well as ideas of open access and participation through digital volunteerism to innovate in a more conceptual way what is today often referred to as crisis mapping. Significant dialogue had emerged around the crisis mapping concept the year prior to the earthquake, and when the disaster struck, the segment of the OpenStreepMap (OSM) community who had considered the potential for crisis response was able to mobilize additional digital volunteers whose attention was directed towards the unfolding events. Using existing databases and emerging imagery and information uploaded to social media by those on the ground, OSM was able to quickly document damage and emergent relief efforts. Even more impressive, the OSM effort gave way for a more comprehensive Humanitarian OSM Team (see Soden and Palen (2014) for a more detailed discussion of this effort). Here we see a very different conception of community – not one that is geographically or politically bounded but rather bounded by skill, expertise, and interest despite global participation. We also see how innovations outside the disaster sphere were utilized during a disaster event, both in the resources themselves but also through innovated activities and roles. Future research should explore if the boundaries of community impact the ways in which innovation occurs, as well as the shifting positive and negative consequences of various technological innovations in light of norms or values that may remain static or prove dynamic at a pace that differs from the innovation itself.

Similarly, community-based organizing was crucial for major NGO's engaging in rescue, relief, and recovery following the 2015 Nepal earthquake. For example, Kathmandu Living Labs, an organization the operated before the earthquake as development tech firm, mobilized quickly to create maps and critical information

for first responders (Wolbers et al., in press). Now with the reconstruction and recovery underway in Nepal, community innovation may play also key role in the effectiveness of retrofitting and sound construction programs (Paci-Green & Pandey, 2016). Collective choice and cohesion have been important in community coordination and recovery in more recent disasters such as the 2011 earthquakes in Japan and New Zealand (Elliot, 2012).

Finally, we may need to fully reconsider what is meant by community in the context of hazards and emergency planning (Buckle, 1999). Aguirre et al. (2005) argued that such diffuse hazards as bioterrorism or cyber terrorism disrupt the accustomed scale of viewing community and that it may, for some hazards, be more useful to look at institutions that might be under threat, such as hospitals or schools. Such hazards may spread quickly and surreptitiously and appear very far from their point of origin. Increasing travel and globalized economies also disrupt socio-spatial connections. Owing to the growth of the South Asia tourist industry, European countries became stakeholders in the recovery and identification of victims following the 2004 Indian Ocean tsunami. And many of the victims of the 2001 World Trade Center attack lived in other cities; their relatives' desire for memorialization clashed with the more proximate resident's desire for a return to normal neighborhood rhythms. What is considered "community" can truly transcend physical linkages and create a demand for community innovation that mirrors the social rather than physical connectivity of its members.

It is impossible in a single chapter to account for all aspects of innovation in communities. Innovation is, as noted earlier, a vast area filled with conflicting theories on initiating and being successful at, change in various types of organizations. The purpose in this chapter, rather, was to highlight a number of points that seem relevant to community innovation for reducing risk and for responding to disaster. Money is certainly at issue, as is recognizing a need, though what "need" really means depends on the community's environment and the particular imperatives that it must respond to. A challenge facing

communities is when the need for action is a response to a threat that is distant, speculative, unlikely, or of unknown magnitude. Prior to such an event, coordination and cooperation may be impeded because all of the required participants in the change do not see the same necessity. Even with an organizational entity such as city government (itself composed of many organizational units) disagreements can erupt over interpretations of needs, possibilities, action, and consequences. Information technology has provided an example of such discord, as city agencies have clashed over software type and specifications. The possibilities for discord become even more numerous as one looks beyond local government to the diverse organizations and interests that comprise a community. Yet at the same time, organizing against disaster requires alignment of these interests, either via their direct involvement and participations or via the action of legitimate intermediaries (e.g., elected officials).

One of the greatest needs for innovative thinking is in establishing consensus, even if merely a grudging, functional agreement, across multiple community interest groups. Often such a consensus emerges upon a disaster event, as observed, for example, by Barton (1969). Many innovative strategies and uses of resources occur in the response phase whose implementation in non-disaster times would be slowed or precluded. Urgent need, which is plainly evident, overcomes most objections. This period, however, is short-lived and, moreover, though many important innovations may occur, others will prove to be maladaptive. In the urgent environment of disaster, some sub-optimum innovations are an acceptable risk, and generally everyone agrees on the need for action. Such need is much less obvious in other disaster phases, and the need is not merely for innovation, but just in establishing a sense that there is a need at all. Even then, certain irreconcilable interests may be at issue.

Innovation in communities occur at multiple scales of social activity; individual organizations in the community can be innovative, so if their innovation is realized to the benefit of the community as a bounded socio-economic and political entity, then in a sense the whole community receives the "credit" for that innovation. The reverse is also possible. Silicon Valley innovations don't make the local communities innovative, though obviously innovative and very successful people live there. A community innovation has to emerge from the same social-political ecology that creates the collective that is known as the community, from entities that are participating in that ecology. One of the principal requirements for successful innovation in communities, either before or after disaster, is coordination amongst various member groups. The waterborne evacuation of Manhattan, for example, involved public agencies such as the United States Coast Guard, commercial organizations such as the various tour boat and ferry companies, and private individuals acting together in a shared interpretation of the best interests of the city at that time. As Comfort (1999) emphasized, a sense of shared risk is essential. But as Peacock et al. (2000) argued, our communities are anything but coherent groups of like-minded people. It is an axiom in the hazards research field that hazards are "mismatches" of natural and social systems (Mitchell, 1990), but devastating events such as the Kobe earthquake, the Indian Ocean tsunami, and more recently Hurricane Katrina demonstrated all too ably that communities do not "share" the risk that natural forces and social systems combine to create. Innovations to benefit the community must transcend the fractures in community relationships at all scales; the most successful ones will be those that can re-engineer those relationships as well as their precarious interactions with the natural environment.

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