Elements of Resilience After the World Trade Center Disaster: Reconstituting New York City's Emergency Operations Centre

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In this paper we examine the reconstitution of the Emergency Operations Centre (EOC) after its destruction in the World Trade Center attack, using that event to highlight several features of resilience. The paper summarises basic EOC functions, and then presents conceptions of resilience as understood from several disciplinary perspectives, noting that work in these fields has sought to understand how a natural or social system that experiences disturbance sustains its functional processes. We observe that, although the physical EOC facility was destroyed, the organisation that had been established to manage crises in New York City continued, enabling a response that drew on the resources of New York City and neighbouring communities, states and the federal government. Availability of resources — which substituted for redundancy of personnel, equipment and space — pre-existing relationships that eased communication challenges as the emergency developed and the continuation of organisational patterns of response integration and role assignments were among the factors that contributed to resilience following the attack.

Keywords: resilience, emergency operations centres, World Trade Center.

Introduction

In this paper, we examine organisational resilience in the response to the World Trade Center disaster in September 2001, using as a case study the re-establishment of the Emergency Operations Centre after the destruction of the primary facility. The Emergency Operations Centre (EOC) on the 23rd floor of 7 World Trade Center (7WTC), one of the most sophisticated centres of its type in the world, was the designated coordination site for the various organisations that were expected to respond to any major emergency affecting the city. It contained computer-equipped workstations for organisational representatives, a communications suite, a conference room, a press briefing room and a large number of staff offices. On 11 September 2001, the EOC was evacuated shortly after the attacks on the twin towers. At 5:20 pm, the entire 7WTC structure collapsed as a result of fires that are thought to have been ignited by the collapse of WTC Tower 1. The destruction of 7WTC was the only recorded case of the collapse of a large steel-frame building as the result of fire (Federal Emergency Management Agency, 2002). Following the evacuation of the

EOC, emergency management personnel moved to intermediate facilities, and finally relocated it to a semi-permanent location at Pier 92 on the Hudson River. Less than three days after the attack, emergency management personnel had established a site that in many respects mirrored the destroyed facility and that, although lacking in elegance, preserved and magnified many of the functional attributes of the original EOC complex.

An EOC is both a place and a social system (Quarantelli, 1997). It is comprised of representatives from various public, private and non-profit organisations. Although those representatives answer to their respective organisations, when functioning within the EOC they comply with additional requirements. The resilience of a functioning EOC is related to features of each organisation as well as to features of the operational environment, such as suitability of equipment and furnishings, and of the set of participating organisations as an integrated socio-technical system. Because the Mayor's Office of Emergency Management (OEM) permanently staffs the EOC space and plays an instrumental role in its activation, the resilience of the EOC as an organisation during an emergency is possibly more closely related to OEM's organisational robustness than it is to that of other departments within the city. At the same time, the instrumental role each department plays in the EOC organisation cannot be overstated. Re-establishing the EOC demanded multi-organisational coordination (including among organisations that were new to disaster response), access to resources, identification of new resources and the intelligent maintenance of familiar operational patterns as well as the incorporation of new ones.

Methods

Findings in this paper result from inductive analysis and are based on qualitative data gathered during exploratory fieldwork that commenced within two days of the attack and continued for two months thereafter. During that time the field team conducted over 750 collective hours of systematic field observations. These included close observation of key planning meetings at secure facilities, including the EOC, the Federal Emergency Management Agency's (FEMA) Disaster Field Office and incident command posts near the 'Ground Zero' area. The field team spent extensive periods observing operations at Ground Zero; respite centres established for rescue workers; family-assistance centres established for victims' families; and sites for marshalling volunteers, supplies and food. The field team also observed activities at major security checkpoints in lower Manhattan and at other locations that were important in the emergency response. The team wrote voluminous notes that provide a rich description of observations and experiences; it took over 500 photographs; and sketched and collected floor plans of various facilities to chart the spatial and organisational changes over time. We were thus able to track the evolution of the reconstituted EOC, and other facilities, from very early stages. We were particularly interested in the activities of formal and informal organisations and the multi-organisational coordination of different aspects of the response: identifying which organisations were involved in particular functions of the response and early recovery, the effectiveness of inter-organisational interaction, the degree to which responders implemented planned emergency response activity and the extent to which alternative response strategies emerged. We sought, in general, to identify successes and challenges experienced by those responding to the disaster.

In addition to direct observation in New York City, we collected numerous documents produced by local, state and federal agencies as well as by individuals and organisations with less formal ties to response efforts. These documents included internal and public reports, requests for information or resources, informational handouts, internal memos, schedules, meeting minutes and agendas, maps and internal directives.

DRC also assembled an extensive electronic database of articles and web-based information. The database includes articles from major New York City newspapers for six months following the attack. The database includes articles from major periodicals, selected articles from newspapers worldwide and information from the many government, charity, community-based, individual and private Internet sites that emerged after the disaster. All of the information was later coded according to relevance to the response and early recovery as well as to the primary operational functions related to the response effort. The identification of these operational functions was informed by the literature on disasters and based in large part on the activities observed during the field component of the research.

The use of multiple data-gathering methods and sources, including direct observation, documents produced by New York City agencies, documents produced by victims of the disaster and by informal supporters of the official response, newspaper accounts, and Internet-based data, allowed us to triangulate the resulting data. That is, we were able to compare the information collected from one source with other sources as a means to check for accuracy and validity of the data (Denzin, 1998; see also McKendrick, 1999).

The Emergency Operations Centre

Quarantelli (1979) identifies six functions of EOCs: coordination, policymaking, operations management, information gathering, public information and hosting visitors (see also Wenger et al., 1987). Perry (1991: 204) has called the EOC 'the key to disaster response'. It centralises at a single location the personnel and equipment that are needed to manage a response to diverse types of emergencies. All EOCs are expected to have multi-hazard response capabilities; that is, response managers should be able to cope with a variety of disaster types (see Kreps, 1991). At the EOC, representatives from organisations crucial to response efforts interpret information gathered from the remote locations of the emergency site and from outside sources (using such means as maps, satellite data, weather reports, resource inventories, health and safety statistics and news accounts) in order to understand and coordinate the disparate, shifting elements of an evolving dynamic situation and to mount an effective response through mobilising the assets of many branches of government. EOCs are not fully staffed at all times; rather, they are activated only when an event crosses a certain magnitude threshold requiring a multi-agency response. EOCs differ in their design, equipment configurations and capacities, based on their community's resources, technical sophistication and risk exposures, but they all share the goal of coordinating the interactions of various agencies at different levels of government. EOCs serve as the headquarters for planning and response decision-making during a disaster event and support operational response implementation undertaken in the field. The EOC concept allows for interpersonal communication, technically supported information exchange, and decision-making among the representatives of different agencies, who

are in turn communicating with their personnel either at the scene of an emergency or elsewhere in their respective organisations.

The New York City EOC boasted an array of technological capabilities to support the generic functions that Quarantelli (1979) elaborated. The facility at 7WTC was outfitted with computer-equipped workstations for up to 68 agencies, arranged into groups called 'pods' (based on response functions such as health and medical, utilities, public safety, infrastructure, human services, transport, government and administration) with an ability to expand by another 40 workstations if the need arose (OEM, 2001). Workstations were equipped with software that made it possible to perform the specialised tasks of the various constituent agencies. The site was equipped with computer messaging systems for communication among staff, a phone system with provision for microwave back-up, separate systems for fire department, police department and EMS communications, coastguard-operated video monitoring of New York's waterways and traffic monitoring of the city's streets. A raised 'podium' provided selected staff an overview of the EOC and its operations and allowed for access to a variety of sources of weather information — including direct National Weather Service feeds — video conferencing and ARCVIEW and MAPINFO geographic information systems (GIS) packages. Podium staff could use databases and maps to view the location of critical systems and facilities, such as the electric grid, water system and hospitals (OEM, 2001).

In addition to its explicit, instrumental capabilities, the EOC at 7WTC fulfilled another more symbolic emergency management capability: the projection of the city's authority and influence. A large table dominated the mayor's conference room with a telephone for each person seated at the table. Projection screens along one wall facilitated the display of maps, charts and images. Windows enabled policy-level conferees to look out across the work floor of the EOC, where the representatives of the different agencies staffed the workstations. The mayor and staff from the mayor's office were clearly awarded a privileged space that symbolised and facilitated their leadership. At the opposite end of the EOC was the press briefing room; the wall behind the lectern was transparent and allowed for a view of the EOC work floor where dozens of personnel from various agencies would be working during a typical emergency. During news conferences or other broadcasts, cameras directed at the speaker would also look out at the work floor and project to the public images of response personnel as a backdrop to the messages being delivered by the mayor at the lectern. The focal point of the work floor was the podium, installed on a raised platform, staffed by officials of the mayor's Office of Emergency Management (OEM) whose job is to coordinate the interaction between the other agencies. For example, one feature of this process is calling agency representatives 'to the podium' to give or receive information. The OEM official thus was in a commanding position both physically (looking down on the agency representative) and organisationally (able to influence although not totally control the information flow). The visual impression from all directions was that of a busy, competent, technologically advanced emergency response in a well-designed, well-equipped facility.

The Destruction of 7 World Trade Center

The broad outlines of the events of 11 September 2001 are now widely known, featured as they have been on television and in other media. Because of the extreme hazard

caused by its close proximity to the towers, 7WTC was among the buildings evacuated after the second airplane strike. In addition, early reports of a possible third hijacked aircraft with an unknown destination contributed to the decision to evacuate.

The evacuation of the facility was very rapid, and little or no equipment or documentation was saved. Emergency managers, along with the Mayor and some agency representatives, kept falling back from the attack area to intermediate sites in order to set up a command post. Before long each of these alternative sites proved hazardous or otherwise untenable. During the initial period after the attack, the city made use of a mobile emergency operations unit that was able to provide a base for initial re-establishment of the EOC.

Preliminary accounts conflict regarding the nature of communications difficulties during this early time; most communications were down, but the 800Mhz capability remained and OEM personnel could communicate with other staff. Eventually OEM personnel reached the library of the Police Academy but they soon found its configuration and communications capability to be inadequate. Meanwhile, a parallel operations centre was established at a nearby high school to serve as a forward-staging area. This was an improvised arrangement, with cafeteria tables being used for meetings, wires running everywhere and very old telephones. Nevertheless, this site was set up to resemble the spatial organisation of the original EOC, with workstations and a command table. During the night of 13 September, approximately 60 hours after the attack, the operations at the Police Academy moved to a large cruise ship facility at Pier 92 on the Hudson River. This semi-permanent location housed the EOC until mid-February 2002, when OEM moved to a facility in Brooklyn.

Conceptions of resilience and their relevance to the World Trade Center response

Various conceptualisations of resilience, which can be found in several different literatures, suggest an ability to sustain a shock without completely deteriorating; that is, most conceptions of resilience involve some idea of adapting to and 'bouncing back' from a disruption. Wildavsky contrasts resilience with anticipation in this fashion:

> Anticipation is a mode of control by a central mind; efforts are made to predict and prevent potential dangers before damage is done… Resilience is the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back (1991: 77).

Elsewhere, he argues that dealing with unknown hazards 'as they declare themselves' is another expression for resilience (Wildavsky, 1991: 70). Others have defined resilience somewhat differently. For example: 'Resilience is the ability of an individual or organisation to expeditiously design and implement positive adaptive behaviors matched to the immediate situation, while enduring minimal stress' (Mallak, 1998a: 1); and 'Resilience is a fundamental quality of individuals, groups, organisations, and systems as a whole to respond productively to significant change that disrupts the expected pattern of events without engaging in an extended period of regressive behavior' (Horne and Orr, 1998: 31).

While defining resilience is clearly challenging, identifying the features of organisations and other social units that make them resilient is even more difficult.

Although researchers differ in the terms they use to describe various features of organisational resilience, they nevertheless orient their analyses around such features as redundancy, the capacity for resourcefulness, effective communication and the capacity for self-organisation in the face of extreme demands. Resilience appears to be as much a set of attitudes about desirable actions by organisational representatives as it is about developing new capabilities. Identifying resilience where it exists is less onerous than creating it where it does not. Nevertheless, the various literatures do appear to consider resilience as the ability to respond to singular or unique events.

Weick's (1993) analysis of events surrounding the deaths of firefighters at Mann Gulch offers one important approach to conceptualising resilience. In subjecting the account of that disaster in Norman Maclean's book *Young Men and Fire* (1992) to an organisational reanalysis, Weick identified four principles, tenets or features that allow for effective response in rapidly changing, ambiguous conditions. When in place, these principles facilitate the collective 'sensemaking' that is required for a group to comprehend and respond to crisis or sudden change. These principles include, first, 'bricolage' (following Levi-Strauss, 1962), which is the capacity to improvise and to apply creativity in problem-solving. Weick cites Bruner (1983: 183), who argues that creativity (which Weick sees as a component of resilience) is 'figuring out how to use what you already know in order to go beyond what you currently think'. Second, 'virtual role systems' preserve intact in each person's mind a conception of the system of which they are a part. Each person 'mentally takes all roles', so that even in situations of peril and disruption everyone is able to maintain a shared vision of risks, goals and possible actions. This allows people both to fill in for an absent member (one who is either physically or *cognitively* absent) and to refer to that conception in order to align their actions continually with the shared goals of the group. Third, 'wisdom' is the capacity to question what is known, to appreciate the limits of knowledge and to seek new information. Fourth, 'respectful interaction', following Campbell (1990), consists of respecting the reports of others and being willing to act on them; reporting honestly to others; and respecting one's own perceptions and trying to integrate them with others.

Weick et al. (1999) expand on these themes in their discussion of 'high reliability organisations' (HROs), adding to resilience a number of other qualities that engender the 'mindfulness' needed to 'discover and manage unexpected events'. This is an urgent requirement in the organisations generally studied in the HRO line of research — nuclear power, air-traffic control, aircraft carriers — because of their rigorous operational environments and the necessity of forestalling the interactive complexity and tight coupling (Perrow, 1984) that are conducive to 'normal accidents'.

For Weick et al. (1999), resilience is comprised of 'coping skills'. They further elaborate on the related idea of improvisation as 'the capability to recombine actions already in [the organisational] repertoire into novel combinations' (101). In addition, the ability of people or subunits of an organisation to self-organise (they cite Rochlin (1989) in calling these self-organising systems 'epistemic networks') spreads problems around to a greater scope and range of expertise, thus boosting the chance of finding successful options. Weick et al. (1999: 100) note that '[t]his form of resilience materializes when events get outside of normal operational boundaries and knowledgeable people self-organize into ad hoc networks to provide expert problem solving'.

'Ambivalence to past practice' is another aspect of resilience noted by Weick et al. (1999). Here, the organisation shows a willingness to overturn or bypass experience, knowing that the current troublesome situation, although similar to those

encountered previously, may in fact have quite novel features that require enquiry and ingenuity to address. They cite Ryle's (1979: 129) concept of response to the unexpected as 'a union of some Ad Hockery [sic] with some know-how … the pitting of an acquired competence or skill against unprogrammed opportunity, obstacle or hazard'.

Weick's research argues for the importance of virtual role systems, in which each member cognitively reproduces the organisation. Comfort's (1999) work suggests that such networks can be achieved by linking those cognitions via improved communications and imaging technology. Comfort urges the fostering of responsive, adaptive behaviour among organisations: to get them to create a shared vision of risk from their separate identities. In the same vein, Weick, Weick et al. and Horne and Orr (1998) want to enable an organisation to maintain a shared vision among its constituent parts during times of crisis.

Although Weick et al. (1999) deal with resilience as a feature of HROs, in their review article, they argue that the features of HROs that make them reliable need not be confined only to organisations that manage complex, dangerous technologies.

> High Reliability Organisations (HROs) have been treated as exotic outliers in mainstream organisational theory because of their unique potentials for catastrophic consequences and interactively complex technology. We argue that HROs are more central to the mainstream because they provide a unique window into organisational effectiveness under trying conditions (Weick et al., 1999: 81).

Mallak (1998a) has applied Weick's (1993) conception of resilience to hospital settings. He chose three dimensions of Weick's conception: 'bricolage', 'virtual role systems' and wisdom to explore resilience among health-care workers. While in the HROs that Weick et al. (1999) studied, resilience was a feature needed to help forestall catastrophe, Mallak suggests that resilient behaviours should help facilitate other welcome outcomes, such as shorter hospital stays, improved treatment results and lower costs. Mallak tested scales for measuring resilience through a survey of nursing executives. Factor analysis results from his survey yielded resilience factors different from, but still analogous to, those discussed in Weick's (1993) paper, and which are also broadly aligned with those reviewed in Weick et al. (1999). These include the following:

- 'goal-directed solution seeking', encompassing 'goals and a vision to guide creative processes in seeking solutions to problems', which is comparable to 'bricolage';
- 'avoidance', or 'approaching new situations with skepticism', which Mallak notes is related to wisdom, but somewhat contrary to the idea of 'bricolage';
- 'critical understanding' or 'effective use of information … to make sense of the situation when chaos ensues';
- 'role dependence' or 'the ability to fill in for a missing team member', which Mallak associates with Weick's virtual role systems;
- 'multiple source reliance', which is the use of multiple sources of information to develop a coherent understanding of changing conditions; and
- 'resource access', or the use of tools or supplies as needed, even without securing permission each time (Mallak, 1998a: 6–8).

Mallak (1998b) elaborated additional resilience-enhancing principles: 'perceive experiences constructively'; 'perform positive adaptive behaviours'; 'ensure adequate external resources'; 'expand decision-making boundaries' (a dimension analogous to the underspecified structures of Weick et al. (1999) or the application of Rochlin's epistemic networks); 'bricolage'; 'tolerance for uncertainty' (that is, an ability to make good decisions when complete information is lacking); and 'virtual role systems'. Mallak has interpreted this to mean that an organisation can function 'in the absence of one or more members'. While this is important, Weick envisages another meaning: a virtual role system isn't significant only when someone is missing, but at all times, enabling all members of an organisation to develop simultaneously a shared vision of emergent challenges and ranges of action.

One of the distinguishing features of HROs that appear repeatedly in the literature is their concern that novel, anomalous or surprising situations can develop; by their nature, these highly unusual and perhaps unique situations are not amenable to unvarying procedures, checklists or protocols. This is not to downplay the importance of procedures in this literature; rather, the character of the procedures is important. Some procedures stifle resilience while others facilitate it. A high-reliability organisation is one that exhibits resilience, among other qualities, in the face of unanticipated occurrences.

Researchers at the Disaster Research Center and the Multidisciplinary Center for Earthquake Engineering Research (Kendra, 2001; Bruneau et al., 2002) have identified several dimensions along which resilience can be measured. These are robustness, resourcefulness, redundancy and rapidity. Robustness is 'the ability of elements, systems, or other units of analysis to withstand a given level of stress or demand without suffering degradation or loss of function' (Bruneau et al., 2002: 6). Our analysis of resilience in this paper is concerned with the ability of a specific unit, the organisational network of the EOC, to withstand and rebound from stress. Alternatively, robustness is concerned with the ability of elements that support or comprise that specific unit to withstand or rebound from stress. Examples of elements supporting the organisational network of the EOC include the building housing the EOC and OEM. While the physical structure housing the EOC was not sufficiently robust to survive the 11 September attack, OEM did exhibit considerable robustness as an organisation, demonstrating an ability to continue to function even after losing its facility and a great deal of its communications and information technology infrastructure, the latter of which, when reconstituted, contributed to the resilience of the EOC as a functional and effective organisational network.

Redundancy is 'the extent to which elements, systems, or other units of analysis exist that are substitutable, i.e., capable [of] satisfying functional requirements in the event of disruption, degradation, or loss of functionality' (ibid.). Resourcefulness is the 'capacity to identify problems, establish priorities, and mobilize resources when conditions exist that threaten to disrupt some element, system, or other unit of analysis' (ibid.). Rapidity is the 'capacity to meet priorities and achieve goals in a timely manner in order to contain losses and avoid future disruption' (ibid.). As a performance indicator, the quality of rapidity perhaps comes closer to representing a more objective measure of resilience, while the others, especially resourcefulness and redundancy, are semi-subjective indicators. Bruneau et al. (2002: 1) note that the dimensions of redundancy and resourcefulness are the means toward the ends of robustness and rapidity. But these features may also be seen as having a telescoping relationship, wherein the robustness, redundancy, resourcefulness and capacity for rapidity of elements that constitute a socio-technical system contribute to the system's

overall resilience; that system further contributes to the resilience of any larger system of which it is a constituent.

An interpretation of the literature discussed above suggests that resilience should be seen not merely as the application of scientific knowledge and techniques, but also as an art. Weinberg (1985: 60), for example, argues that 'Science deals with regularities in our experience; art deals with singularities.' Although Weinberg's statement suggests a too-rigid distinction between the work of art and of science, it illustrates what emerges from recent writing on resilience: a concept of resilience as the product of a kind of craft skill, or an artistic interpretation and response to singular, unexpected, anomalous events as opposed to a rationalised predetermined response to what is regular or expected. Achieving resilience thus requires:

- a high degree of organisational craftsmanship, comprised in turn of individually exercised craftsmanship;
- the ability to respond to the singularities in the interactions of social, technological and natural systems, which requires artistry; and
- a sense for what is the same and what is different from prior experience in every new experience, so that responses are continually adjusted, anomalies are sensed, and learning occurs and is incorporated into the next incremental unit of response.

Indeed, the theme of 'same yet different' is common throughout our interviewees' comments. Meeting the vagaries of the operating environment and being prepared for sudden discontinuities require vigilance and the capacity for combining experience with new learning.

Resilience in New York City

We do not argue that all of the aspects of resilience summarised in the foregoing section apply to the organised response to the 11 September attacks in New York City. Some of those conceptions are, if not contradictory, then at least poorly aligned with each other. Rather, we have tried to show links, similarities and points of departure for recent thinking about resilience. We do argue that the emergency management organisation in New York City evinced many qualities of resilience and that, to the extent that those qualities can be reproduced elsewhere, other emergency managers might be able to enhance their capacity to respond to catastrophic events.

One key aspect of the response to the 11 September attack is that, although the EOC was destroyed, the emergency management organisation was not. Rather, the organisation itself exhibited robust, adaptive behaviour, demonstrating considerable improvisation, evidence of goal-directed solution-seeking and incorporating resources from diverse sources. A pier on the Hudson River, which had been scheduled to be used for a bio-terrorism drill on 12 September, was leased for long-term use. OEM staff, working closely with the Department of Citywide Administrative Services and other departments, then arranged for the delivery of office equipment and other supplies and hundreds of computers; these were installed within 36 hours, with more arriving thereafter.

When we arrived at the new EOC, some 96 hours after the attack, we found not a makeshift facility, but a two-city-block-long space already half-filled with an expanding number of people, worktables, copy machines, maps, charts and over 200

computers, all networked and functioning — a number which was to grow during the period of our observations. The number of workstations alone was nearly twice that possible at 7WTC, with spaces laid out for meetings, press briefings and offices: sometimes merely demarcated by seclusion from ongoing activity, sometimes by curtains, but soon evolving in the formality and semi-permanence afforded by modular partitions. The facility did lack the well-appointed furnishings and finished touches of 7WTC and it did bear abundant evidence of its rapid assembly, but it was nevertheless a functioning, continually-maturing site for the performance of all necessary emergency management functions.

Mirroring the pods in the original EOC, staff established comparable pods at the new EOC. It is important to stress, particularly in terms of the resilience dimension of rapidity, that the improvised EOC that was set up over a period of 48 to 72 hours of the attack was already twice the size of the original, both in size and in terms of the number of organisations represented and computers involved. By September 15, an additional pod for logistics was established, as was one for debris, with at least eight computers assigned to it, demonstrating rapid organisational adaptation to the particular needs of this event. Over 250 computers and a comparable number of organisations were eventually present in the EOC, and some 700 people worked there or passed through during the day. The features of redundancy, resourcefulness and rapidity are well-illustrated in the re-establishment of the EOC, though the significance of redundancy was to a large extent illustrated by its absence. These events, however, show the qualities of redundancy and resourcefulness to be strongly interrelated. Resources, and resourcefulness, can create redundancies that did not exist previously. The redundancy exists in a latent form as a set of possibilities to be enacted through the creative efforts of responders.

There was no pre-established back-up facility at which OEM staff and other responding departments could conduct operations even on an interim basis. Any back-up facility should also have been geographically removed from the primary centre, and this might have increased the rapidity with which the city could orchestrate the multi-organisational response. Instead, OEM staff had to seek space at several intermediate locations, eventually settling on the Police Academy for two to three days. Nevertheless, events would later demonstrate that any back-up facility would probably have been inadequate given the wide-ranging demands of this disaster. Improvisation on a large scale would still have been necessary, as was seen at the site that became the EOC for the next five months. One senior OEM official said, in fact, that the city would have been unable to manage the event entirely from 7WTC even if it had not been destroyed.

OEM compensated for the EOC's lack of physical robustness and physical redundancy through strategies that not only succeeded in mobilising resources but also created an alternative physical facility where none had existed before, which in turn contributed to the overall resiliency of the EOC organisation. With space as well as computing and communications equipment, OEM staff were able to establish a functioning replica of the old facility. There was no pre-existing redundancy for the EOC, but with access to resources from within the city and relationships with the private sector, OEM substituted for redundancy. Obviously, one source of this enormous capacity for resilience inheres in the city itself. New York City alone, even without recourse to external sources of assistance, possesses immense capacity, with emergency services departments equalling the population of a small city, and a resident citizenry possessing every art and talent.

New York was also the focus of an outpouring of support that further enhanced its response capacity. Resources of nearly every description arrived, with convergence becoming at times a management problem in itself. This convergence of volunteers and equipment is well-documented in reports of other disasters as well (see, for example, Neal, 1992, 1994. See Kendra and Wachtendorf, 2001 for a discussion of convergence in New York City). In terms of the community aspect of resilience, there was a network of personal contacts between the emergency managers in OEM and their colleagues in other nearby communities. They knew each other and often attended meetings and conferences together, and thus were able to ask for and give assistance more readily. For example, personnel from nearby Nassau and Suffolk counties worked at the logistics station, augmenting the existing staff. Police officers from New York State Police staffed barricades and checkpoints. National Guard personnel and police from well beyond the city's borders — and ultimately from across the country — also arrived to provide help in a similar capacity. The role these assisting officers and military personnel played enabled New York City's officers to work at tasks requiring more local knowledge. Such emergent redundancy was not limited to the police force but also seen in a variety of areas such as logistics offices and fire departments.

Another large source of personnel were the Red Cross volunteers who served hot meals (prepared by a commercial caterer) in the EOC and in respite facilities established close to Ground Zero — at first near forward-staging areas in outdoor tents and then later at the Marriott Financial Hotel and St John's University. In these respite centres established at the latter two facilities were cots, easy chairs, showers, dining halls, televisions and computers with Internet and e-mail access. They also provided such services as massage therapy and chiropractic care, counselling and first aid. Urban search-and-rescue teams arrived from across the US. Nextel supplied thousands of radio-telephones. Other Hudson River piers were pressed into service for FEMA office space and the establishment of the Family Service Center, where relatives of victims and survivors displaced from their homes or jobs could find assistance with the many administrative processes. New York City and Company, the visitors' bureau, helped volunteer and other relief workers find accommodation. Responding to the urgent and ongoing need for maps and spatial analysis, Hewlett Packard, ESRI and professors and graduate students from local colleges were among those who supplied GIS support and equipment to the EOC, in addition to GIS specialists from within the city government. The development of the map production and distribution capability, much greater than existed at 7WTC and amounting essentially to a mapmaking factory, was an emergent function, a self-organised 'ad hoc network to provide expert problem solving' (Weick, 1999: 100) and a key indicator of resilience (discussed further in Kendra and Wachtendorf (forthcoming)).

A complete listing of supplies and services donated to or purchased by New York City would fill many pages, but other resources included: large quantities of office supplies, clothing, medical supplies and personal-care products (toothbrushes, toothpaste, combs, socks, underwear, contact-lens solution, tissues), many of which were laid out for the taking in the EOC. At first only snack foods and donated baked goods were available, but the food service component evolved to the provision of hot meals (with two entrees). A dining area was contrived, first with simple folding tables but soon expanding to include café tables, tablecloths, floral centerpieces and later holiday decorations, cold-drink coolers and other restaurant accoutrements. Outside the EOC, trucks and barges laden with sand provided security against unauthorised

landward and seaward approaches to the pier. As these examples suggest, a large influx of materials can, at least in some instances, counteract a lack of redundancy.

While none of OEM's regular staff was killed, its members were dispersed and out of regular contact with each other for several hours after the attack. Other departments lost personnel, some of whom occupied key positions in these departments. Nevertheless, the EOC as a functioning entity was able to preserve its organisation, even though it had to reconstitute that organisation in an entirely new location. The creativity of the facilitating agency — OEM — lay not so much in creating something new, but rather in reproducing what it had lost: the familiar socio-technical system in which personnel had worked and trained in previously. Physical elements of the EOC, such as the workgroup pods, the podium, the raised platform for the watch officers, were replicated and expanded in size and scope. The ability to re-establish that level of familiarity with respect to physical facilities and arrangements helped to maintain the shared vision that most researchers agree is important to a resilient organisation and, in this case, a resilient community. OEM staff and EOC representatives from other departments did not merely use what they already knew; they drew upon resources in order to duplicate familiar operational patterns, patterns that were expressed in the spatial arrangement of their facility. When existing procedures were destabilised in the face of unexpected catastrophe, OEM staff and other members of the EOC organisation created the operational context for maintaining them. This was possible because, through training, frequent drills and exercises that often involved the mayor, OEM and departmental representatives in the EOC organisation had developed a capacity for adaptive behaviour that was not dependent on either specific physical facilities or specific technological systems. As one senior OEM official said, 'It [the organisation] was in my head.' OEM thus helped create, not a new 'shared vision', but the means of preserving the vision that had guided its activities prior to 11 September.

Resilience continued

This paper has highlighted the close relationship that typically exists between community and organisational resilience. For example, resilient communities provide the context in which organisations themselves become more resilient. An economically strong community is better able to respond to disastrous events than one that is economically troubled. At the same time, organisations provide the infrastructure for a community's resilience, in that organisational resources, networks and overall capacity are what make coordinated community-wide response possible. In turn, organisations draw their strength from their human and material resources and knowledge and also, importantly, through the creativity and initiative of their members. Resources are of little use if the relevant organisations are unable to innovate, create and respond appropriately under extreme conditions. The relationship is iterative and telescoping, played out across multiple scales within organisations, between organisations and between organisations and the community.

The argument here is not that the response of OEM, or of New York City in general, was flawless in this case. The absence of an auxiliary facility was a noteworthy shortcoming: one which was recognised by OEM staff but which they felt unable to influence. Not having sufficient redundancy in the form of an auxiliary EOC profoundly affected the response, especially early on. A comprehensive multi-

organisational analysis of events in the first few hours has yet to be developed, but it seems likely that initially there was considerable confusion among responders caused by the sheer magnitude and suddenness of the event and exacerbated by the damage to communications. Some officials have stated that OEM was too distracted by the loss of the EOC to perform much coordination, and that the response suffered in this respect. A high-ranking fire official criticised OEM for not being more effective, over a long period of time, in mitigating the long-standing tensions between the police and fire departments. Responding agencies continued to experience intra- and inter-organisational problems in the days following the attack. For example, we spoke with a high-ranking fire official who expressed fairly bitter criticism of OEM's handling of at least one critical resource request, naming three OEM officials as particularly obstructive. One logistics officer in the EOC was very dissatisfied with the functioning of the organisation, while another logistics officer said that this emergency was a bad time to introduce E-Team, a planning software which no one had used before and which required practice and training. Indeed, police cadets were assigned as E-Team operators, though some of its functions, as well as requirements for interpreting and prioritising information, assumed more knowledge of emergency management principles and organisation than the cadets possessed. However, it should be noted that some other officials have insisted that OEM has not received enough credit for its accomplishments in the disaster, and others, when describing their roles in the response, were quite deferential to OEM's authority.

Our findings with respect to the response to the World Trade Center attack support conceptions of resilience that are found in the existing literature, but we also find some divergences, especially with regard to the anticipation-resilience dichotomy presented by Wildavsky (1991). Anticipation is the perspective he prefers only for situations in which there is 'considerable knowledge' and change is 'predictable' (1991: 123); these are the minority. In other situations, he argues, problems are addressed through actions that demonstrate resilience. We argue, however, that resilience and anticipation are not polar opposites or mutually exclusive characteristics or states. Indeed, Wildavsky himself often conflated resilience and anticipation, probably because they are so closely related. Resilience is achieved by preparing, not for a particular event, but rather for the maintenance of a range of capabilities or functions that will be needed after any kind of event. 'The organisation was in my head', the statement made by the OEM official, is a key phrase in this respect, because the organisational outline or template 'in his head' was a schematic of tasks to be performed and the interorganisational relationships that would accomplish them. Anticipation lay in the design of an organisation that would focus on the dimensions of the response — what, how, where, who — and that would be able to 'think' about needs and then fulfil them.

The case of New York demonstrates that, rather than being conceptually distinct, anticipation is an integral dimension of resilience. The distinguishing feature concerns what is to be anticipated. NYC certainly devoted attention to anticipating, and preparing against, a certain range of expected hazards, biological attack among them. Researchers from DRC attended a bio-warfare exercise just a few months prior to the attack and were again scheduled to observe another bio-terrorism exercise on 12 September. There is a strong measure of anticipation evident in NYC's resilience: in its previous training and drills, and in the organisation itself, which was able to expand dramatically to cope with new demands. There was no rigidity that excluded new agencies from participating.

The relationship is perhaps more like that of the centralisation-decentralisation pattern described by Weick (1987, citing Perrow, 1977): effective decentralised operations are first preceded by some kind of centralising influence, such as prior military service or other kinds of common training.   Just as, under certain circumstances, there is no decentralisation without centralisation, there is no effective resilient response without anticipation.   Stated differently, anticipation and resilience are related and mutually reinforcing activities, knowledge and skill sets that are operationalised at different times.   As Kreps (1991) has observed, preparedness and improvisation are both required in emergency response.   The emergency response in New York was as tied to previous planning as it was to rapid creativity.   Some aspects of that creativity, in turn, were founded in pre-existing organisational attributes: a willingness, for example, to bring in outsiders to help, even going beyond existing mutual aid agreements.   This latter action is not a universally-shared organisational attribute by any means (and it is not consistent within OEM, either).   The organisation showed considerable flexibility in size, as well: substantially increasing numbers of departments and agencies and almost doubling the number of personnel present from those respective agencies actually involved over those possible at 7WTC.

The example of the loss and reconstitution of the EOC also sheds light on the concepts of EOCs as organisations and as places.   Perry (1991: 204) has characterised the EOC as 'a function, a place, and a structure', while Quarantelli (1979) has looked at EOCs explicitly in terms of fundamental questions of who is working, what they do and where they do it.   In later work, though, Quarantelli has somewhat downplayed the significance of the place dimension, highlighting the importance of the EOC as a social entity (1997; see also Wenger et al., 1987).   He states:

> At one level, the place — particularly the physical facilities — is of relative importance.   As a minimum, adequate communication provision, computers, sufficient work   space and certain resources, such as maps and equipment inventories, are required.   However, the physical facilities in themselves cannot make up for social factors (1997: 52).

He later observes (ibid.): 'An EOC is a social system; if relevant and generic functions are carried out, its location and the physical facilities are relatively unimportant.'   The key phrase is 'if … carried out'.   If the functions are carried out adequately, one might conclude that the place, however configured, was adequate.   While the relative location may be of less significance (and Quarantelli (1979) outlined important considerations for location), activities occur in a place, leaving place as a still-significant dimension.   We suggest that it is not easy to separate structure, function and place, and that a resilient response requires the maintenance of this triad.   *The* place may not be important, but *a* place is.   Quarantelli (1979) observed that even in situations where there is no pre-planned EOC, one or more EOCs, or less-developed command posts, very often emerge anyway, an observation reinforced by Scanlon (1994).   In one case, Wenger et al. (1987) noted an impaired emergency response when no EOC, but rather multiple command posts, existed.   Scanlon (1994) also reports coordination difficulties when there is no EOC.   Therefore, place-seeking/place-making could be added to the list of six functions that Quarantelli identified: a function that closely parallels the existence of structure, and the rapidity of which bears directly on the resilience of the organisation.   Stated differently, if the structure does not have or make a place, the emergency response falters.

Certainly the importance of a designated, well-equipped place was demonstrated in the WTC attack: the loss of 7WTC occasioned the immediate search for substitute places: initially as basic as the mobile communications van and then evolving in sophistication. We can see that the functions of both OEM (the custodian of the EOC) and the EOC as an organisation were disrupted by the loss of the EOC as a place. The organisational structure persisted, though, as a latent force or set of potentials across the different organisations as the members dispersed. But though dispersed, they did not remain so; rather, they sought to regroup, a goal that was identical to relocating: to searching for a new place. For OEM, the communications van served as a marshalling point; other organisations actively sought information on a temporary EOC. One high-placed official could not remember how he learned that the EOC was being set up at the police academy, but that information spread throughout the responding organisations. That searching for and discovery of information suggests that the structure persisted; it was robust, though clearly under stress. The EOC structure and concomitant function continued when there was no place, preserved or coded in the ongoing relationships between the constituent organisations of the EOC and extending across space, but the structure and function immediately became directed to place-seeking activities. The spatial arrangements at Pier 92 ultimately reflected the structure. Other spheres of activity show why the place dimension of an EOC should not be discounted; for example, Alexander (1993: 439) observed that post-disaster temporary housing may gain 'trappings of permanence', while Veness (1993: 319) has observed that 'homeless' people 'define and interpret their own versions of home'. Pier 92 took on many trappings of permanence and even domesticity, although it was only a transient facility. What a facility lacks at the outset, even its very existence, people will work to create. Seen within the lexicon of resilience that we have elucidated, 'robust' means not just strong and durable, but suitable in all particulars. From a planning or policy perspective, a resilient EOC will devote exquisite attention to detail in the establishment of its place.

Conclusion

Given the foregoing, we return to what the case of New York City can tell us about resilience or, stated more generally, about socially constituted adaptability to unpredictable ambient forces. Clearly, an organisation involved in emergency response wants to maintain established and known aspects: policies, procedures, practices or tools. Yet, as illustrated by the World Trade Center disaster, these aspects of an organisation and its response can fail or prove inadequate to deal with the emerging disaster situation. It is at these times that resilience proves instrumental for bolstering effective response efforts.

The example of New York shows that craftsmanship with respect to problem-solving — almost an artisanal quality — allows people to deploy rapidly adaptive strategies. Like any craftsmanship, that associated with emergency response derives from training, experience and the ability to become inspired by features in the surrounding environment, and to translate those inspirations into creative and innovative actions. Inspiration here is not meant in an ephemeral sense. Instead, it implies that the craftsman has taken note of a feature or features in the surrounding environment, engaged in a cognitive process of interpretation of that feature to produce a vision of a new goal or a previously unthought-of way to achieve an existing goal and

redirected his or her actions. Just as an artist may employ a new tool, new material or new strategies, so too do decision-makers in a resilient organisation invoke new tools, materials and strategies to rebound when established methods fail or when unanticipated circumstances arise. In both cases, training and preparation remain fundamental, but creative thinking, flexibility and the ability to improvise in newly emergent situations are vital.

Acknowledgement

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