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Abstract

This study employs the perspective of organizational resilience to examine how information and communication technologies (ICTs) were used by organizations to aid in their recovery after Hurricane Katrina. In-depth interviews enabled longitudinal analysis of ICT use. Results showed that organizations enacted a variety of resilient behaviors through adaptive ICT use, including information sharing, (re)connection, and resource acquisition. Findings emphasize the transition of ICT use across different stages of recovery, including an *anticipated stage*. Key findings advance organizational resilience theory with an additional source of resilience, *external availability*. Implications and contributions to the literature of ICTs in disaster contexts and organizational resilience are discussed.

Keywords

organizational communication, organizational structures, computer mediated communication, organizational change

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When natural disaster strikes, all levels of the regional infrastructure are affected. When Hurricane Katrina struck in 2005, New Orleans was home to a thriving arts industry, one of the busiest ports in the United States, the country's second-largest fishing industry, and one of the top ten largest producers of cotton, sugarcane, and rice in the United States (New Orleans Marketing Tourism Council, n.d.). These industries created jobs crucial to New Orleans residents, and residents, in turn, were crucial to these industries. After Hurricane Katrina, however, each of these industries was devastated. While much research focuses on how *individuals* recover following disaster and how public agencies coordinate during disaster, less research has looked at *organizational* recovery following disaster. Yet organizations are an important part of the regional infrastructure, as they provide employment and financial stability to inhabitants. Without viable organizations, communities can dry up, as was the case in Detroit, Michigan, when General Motors' plant shut down. Unlike a closing or other crisis focused on a particular organization, organizations affected by natural disaster often have a desire to return and reopen, but they face obstacles, from extensive physical damage, missing or dislocated personnel and missing community members and customers to failed communication and technological infrastructures. In the process of rebuilding, organizations endeavor to obtain resources through, for example, the use of technology and tapping into their social networks.

Previous research has demonstrated the utility of information and communication technologies (ICTs) for coordinating among emergency relief efforts (Arnold et al., 2004), contacting disparate family members and friends (Katz & Rice, 2002), obtaining emotional support (Dutton & Nainoa, 2003), and information sharing (Carey, 2003). A growing body of evidence shows that ICTs are used to bridge communication gaps during and following crises (e.g., Macias, Hilyard, & Freimuth, 2009; Procopio & Procopio, 2007; see also Veil, Buehner, & Palenchar, 2011 for a review). Disaster may also provide opportunity for businesses, such as making new contacts and reaching new stakeholders (Doerfel, Lai, & Chewing, 2010; Ulmer, Seeger, & Sellnow, 2007). This trend suggests that technology can be used strategically in critical situations, particularly by organizational leaders, to help organizations function well in the moment and in the long run. Simply put, technology use in crisis is an additional communication strategy for organizational leaders with long- and short-term implications.

Crises can vary along a spectrum of intentionality, predictability, and the degree to which they were manufactured or caused by nature. We study natural disaster as a catalyst for organizations enacting resilient behavior using ICTs. Specifically, we focus on the temporal aspect of ICT use following the evacuation of New Orleans as a result of Hurricane Katrina by analyzing how

organizations utilized ICTs across phases of disaster recovery. This case provides an extreme example along the crisis spectrum, or what may be viewed as a catastrophe, as there was a mandatory evacuation, leaving organizational contacts far-flung and often inaccessible (Quarantelli, 2006). As with many catastrophes, communication and coordination problems existed on the individual, organizational, community, and even societal levels, which in some ways also reflected disparities of resources across different levels (Quarantelli, 2006). Thus it provides a stark backdrop against which to study organizational recovery and has the potential to highlight both the advantages and disadvantages of relying on technology for recovery.

We employ technology-in-practice (Orlikowski, 2000) to examine organizational resilience and, in doing so, emphasize the role of human agency in technology use. According to this view, an ICT's utility does not rest in the technology itself, but rather in the way it is used. Viewing technology use in this way acknowledges innovation, context, and user ability. Such a perspective is especially useful when tracking disaster recovery longitudinally, as user needs and motivations are likely to change as postdisaster conditions change. Although traditionally separate domains of study, both organizational resilience and technology-in-practice emphasize adaptability and change. We therefore integrate the two theoretical perspectives to show how both human and environmental influences on ICT use impact organizational resilience, which can lead to both positive and negative postdisaster outcomes over phases of disaster recovery.

Organizational Resilience

Although conceptualizations and measures of resilience vary across studies, common to them is the idea that resilience rests in the ability of the affected parties to communicate and reorganize across periods of rapid change or chaos. It involves the ability to respond to situations as well as to adapt in terms of creating new solutions. For example, Weick (1993) discusses resilience in terms of "coping skills" aided by "improvisation," and Kendra and Wachtendorf (2003) frame resilience as being as much "a set of attitudes about desirable actions by organizational representatives" as about "developing new capabilities" (p. 42). In organizations, resilience is about "the ability to repair old practices and develop new practices when the old ones are no longer possible" (Mark, Al-Ani, & Semaan, 2009, p. 690). Organizational resilience can be enacted in response to a crisis or something that organizations learn over time and put into use when they are faced with new challenges (Sutcliffe & Vogus, 2003).

Organizational resilience is also viewed as a cross-level concept. Horne and Orr (1998) argue that resilience should be viewed as a “whole-system” response to change, where individuals, groups, organizations, and systems *as a whole* respond “productively to significant change that disrupts the expected pattern of events without engaging in an extended period of regressive behavior” (Horne & Orr, 1998, p. 31). As part of their whole-system perspective, while resilient individuals within the organization can make a difference, it is the collective actions that create a resilient response (Horne & Orr, 1998). Therefore, when we talk about resilient organizations, we are essentially talking about the directed actions of the organization as a whole as enacted by its members working in concert with each other.

Organizational resilience entails different dimensions of ability and adaptability enacted by organizations. Several studies have identified the ways in which this adaptability can be achieved (e.g., Bruneau et al., 2002; Kendra, 2001; Mark & Semaan, 2008). Essentially, enacting resilience means that organizations need to exhibit continuing ability and adaptability to use resources successfully to resolve issues whenever they arise (Sutcliffe & Vogus, 2003). The way an organization leverages resources of different types, such as financial, relational, structural, and technological can thus differentiate resilient organizations from less resilient ones.

Compared with previous crises, people and institutions now rely on person-to-person technology to gain access to more information from more people than ever before (Carey, 2003). ICTs not only foster links between individuals and groups but also connect organizations to entire populations of stakeholders. As people increasingly turn to official organizational websites for information, organizations have expanded the communication options on their websites to include press releases, interactive chat, threaded dialogue, and real-time video to communicate with publics (Perry, Taylor, & Doerfel, 2003). As ICTs blur the lines between levels of communication (e.g., interpersonal; mass), it makes sense that organizations and individuals involved can find ways to use ICTs to connect to resources that help resilience after disaster. Yet, few studies address how ICTs can be used as resources by organizations and their leaders in response to critical situations such as natural disaster. While there are many ways that an organization can adapt to changing conditions, we assert that adapting the technological structure through ICT use is one key to enacting organizational resilience.

ICTs and Resilience

Adapting existing routines, including ICT use, which may in turn lead to modifications or even creation of new routines, is one way organizations

may enact resilience during crisis. Technology-in-practice (Orlikowski, 2000)—the idea that the utility of a technology lies in the way that it is used rather than the technology itself—can illuminate why an ICT that had no real role in an organization before crisis might become the backbone of its technological structure following crisis. Technology-in-practice “focuses on emergent technology structures enacted in practice rather than embodied structures fixed in technologies” (Orlikowski, 2000, p. 408). According to this view, users do not *appropriate* technologies, but *enact* them. They “repeatedly enact a set of rules and resources which structures their ongoing interactions with that technology” (Orlikowski, 2000, p. 407). So, using ICTs in context can result in a reinforced sense of traditional communication patterns, or the creation of new organizational communication and technological structures. As people respond to the altered conditions created by disaster, they constitute and reconstitute both their communication and technological structures by adapting ICTs to access the resources and contacts necessary for recovery (e.g., Carey, 2003; Sutton, Palen, & Shklovski, 2008).

There is also evidence that using not only one, but multiple, technologies together can help people enact recovery following disaster. Katz and Rice (2002) found that in a crisis, people develop *ad hoc* solutions using a variety of media in order to maintain contact with their network. During the events of September 11, a mother who was vacationing out of the country used a combination of phone and email at an Internet café to ascertain that her daughter and extended family were safe (Katz & Rice, 2002). This combination of technologies allowed her to span international boundaries to make sure that her network was intact. People were able to inform loved ones trapped in the World Trade Center based on what they saw on television, and vice versa (Dutton & Nainoa, 2003). This “interdependence” of technology use in a disaster situation implies that using multiple ICTs is more beneficial than using a single device (Dutton & Nainoa, 2003). By adapting their ICT use to fit the circumstances of use, individuals are constituting emergent technological structures.

These studies jointly emphasize ICT use in adapting to disaster related circumstances. Reconnecting and sharing information, support, and other resources were key to individual recovery following disaster. However, the question of whether and how ICTs can aid organizational resilience following a disaster has been less explored. Organizational resilience emphasizes innovation, creativity, and adaptability. This study brings resilience to the organizational level and provides a framework for understanding *what* elements of technology work as well as *how* they can help in organization recovery. Therefore, we ask the following research question (RQ):

RQ1a: How do organizations use ICTs to enact resilience following disaster?

The technology-in-practice framework suggests how organizations can use already existing technological resources to achieve the flexibility considered necessary for resilience. Flexibility has the potential to help organizations recover and offers the opportunity for positive change and new enactment of technological structures in the organization. To explore if and how ICT use in the postdisaster context leads to new or altered technological structures, we ask the following RQ:

RQ1b: What impact does post-disaster ICT use have on organizations' technological structures?

Because disaster conditions vary in severity, there may be situations in which technology is unavailable. While such technological breakdowns are likely to be temporary, they are also likely to happen immediately following disaster. In other cases, organizations may not already rely on technology and therefore may not have a technological infrastructure in place when crisis hits. To illuminate if and how organizations enact resilience without ICT, we ask the following RQ:

RQ2: How do organizations enact resilience in the absence of ICTs?

Multiphase Disaster Recovery

According to the concept of technology-in-practice, technology users are the ones constituting the structure, often according to the customs of the organization or context at hand. Thus, the structure, while created by the users, is often representative of the boundary conditions of the organization. When these boundary conditions change, for example, from times of stability to times of rapid change, enactment of technological structure will change as well. This evolution echoes the conceptualization of multiphase disaster recovery in previous research (Doerfel et al., 2010; Heifetz, Grashow, & Linsky, 2009), which posits that postdisaster recovery evolves in stages. It is possible that the level of urgency might be highest immediately following disaster as individuals strive to obtain necessary information under dire circumstances. But later on, needs for and approaches to obtaining resources, including technology use, vary.

Research has identified organizational recovery in terms of phases. Heifetz et al. (2009) propose two phases of crisis leadership: An emergency phase

and an adaptive phase. In the emergency phase, the leader assesses the underlying causes and builds capacity to thrive in the new reality. The adaptive phase is a time when organizational leaders can revisit and redesign organizational operating rules and bring closure to the past. Studies on community-level response to disaster conceptualize postdisaster recovery stages that consider community “well-being” and infrastructure management. Such models include recognizing that the problem is imminent, mitigating possible effects, clean up and healing, and long term correction of problems that could not be quickly fixed (Faulkner, 2001; Fink, 1986). Similarly, organizational disaster recovery following Hurricane Katrina can be characterized in terms of communication phases (Doerfel et al., 2010; Heifetz et al., 2009).

Doerfel et al. (2010) identified the following sequential phases: (a) *personal emergency*, in which organizational leaders’ communicate to secure resources necessary to personal survival and rely on personal contacts to do so; (b) *professional emergency phase*, in which leaders ascertain employees’ safety and status; (c) *transitional phase*, which involves a move to organization-level communication with incoming and outgoing communication distinguished in terms of media and content; and (d) *rebuilding phase*, in which organizations resume their core work and focus on nurturing relationships (both old and new) that could aid in sustaining work. In this rebuilding phase, communication resembles “normal” network communication in which open, two-way lines of communication are utilized to access work-related resources and engage in work-related functions (see also Heifetz et al., 2009). While some research looks at individuals’ long-term adoption of ICT use (Hughes & Palen, 2009; Shklovski, Burke, Kiesler, & Kraut, 2008) following recovery, little research has been done in untangling the temporal change of ICT use throughout the process of disaster recovery. Even less considers the organizational perspective. In light of this, we ask the following RQ:

RQ3: How does post-disaster organizational ICT use reflect the phases of recovery?

It is worth noting that adaptive techniques evidenced in post-disaster communication may not become part of an organization’s long-term communication strategy. Shklovski et al (2008) observed that during a post-disaster recovery stage, people switched back to conventional, land-based technologies from mobile technologies that they started using in the response stage. Once the initial, immediate and urgent needs following the disaster are fulfilled, people may change their technology use back to the more familiar ones. This use suggests that technology that helps people obtain information during

earlier stages of recovery may lose its advantage in the latter recovery stage since people's focus changes to a broader goal of rebuilding normalcy.

Just as Orlikowski's (2000) idea of technology-in-practice implies that technology use in context will (re)create technological structures, the findings of Shklovski et al. (2008) imply that these structures will again have to change once the crisis has passed. Since it is unlikely that following a natural disaster, "normal" operating procedures would completely mimic predisaster work conditions, organizations are likely to retain elements of their recovery-based ICT use to succeed in their "new" normal environment. Therefore, we ask the following RQ:

RQ4: To what extent do organizations retain patterns of ICT use enacted during disaster recovery?

To answer these questions and explore the theme of ICT use following disaster, we look to the experiences of New Orleans business owners and organizational leaders in the years following Hurricane Katrina.

Method

Data come from a larger project that examines interorganizational network communication after disaster. Convenience and snowball sampling generated open-ended interviews from organizational leaders and decision makers. Initial contact was made with a professional business-networking club located in New Orleans during their first meeting back after the storm. Field visits ($n = 16$) enabled further recruitment during various public events and when visiting shops, restaurants, and businesses. Participants ($n = 53$) included business owners and key decision makers from a variety of industries found in New Orleans: restaurants and bars; art galleries; media outlets; nonprofit agencies; bed-and-breakfast inns; cultural venues; banks; professional firms (e.g., law, accounting, consulting, and insurance firms); and retail establishments. Organizations ranged from small (fewer than 20 employees) to medium (21-100 employees) and large entities (greater than 100 employees). Interviews ranged from 12 min to 105 min and were conducted both in person and over the telephone. There were no significant differences in length between face-to-face (FtF; $M = 53.82$, $SD = 17.65$ min) interviews and those conducted over the telephone ($M = 54.29$, $SD = 15.77$ min) and none in terms of number of communication partners named while interviewed FtF ($M = 20$, $SD = 9$) versus by phone ($M = 18.18$, $SD = 11.93$).

Data Analysis

As part of the larger project, the constant comparative technique was applied to interviews to create inductively a coding scheme for multiple coders to apply. Over 1,500 pages of interviews were assessed over a 2-year period by a team of seven people. Once the coding scheme was developed, it was applied to all of the interviews in AtlasTi, a data analysis program that allows for review of data in a variety of ways, including as whole documents, chunks, by code, or by quotation. Being able to view the data in such a way allows for comparison of emergent themes. Dissection of documents in these ways was used to compare how codes were used within and among documents, including by quantity, association with other codes, and similarity and differences among stories. Treatment of the text using constant comparison allows for analysis, rather than description, of the phenomenon being studied. Each transcript was coded by two coders, but to avoid intrateam biases, coding partners varied.

ICT use was operationalized by combining the following codes¹ to create a supercode, ICT-Use: landline phone; mobile texting; mobile talking; email; blog/website; phone; one-way (e.g., bulletin or some mass communication announcement that has no feedback loop to support reciprocation); and media. By using these codes as search terms, quotations associated with these codes were culled from the entire corpus and assessed for themes. As existing definitions of resilience vary in scope and focus (Bruneau et al., 2002; Horne & Orr, 1998; Kendra, 2001; Weick, 1993), we focused on the element of adaptability, as that is an overlapping theme among all studies for resilience. Accordingly, text associated with the ICT-Use supercode was first studied for instances of ICT use that enabled adaptability. Once general themes had been derived, the ICT-Use supercode was combined with other codes from the coding scheme in order to examine specific research questions. Table 1 details the codes associated with each RQ.

Results

ICT use was mentioned 520 times across 53 interviews. Those uses mentioned include blog/website ($n = 129$), followed by email ($n = 121$), phone (because it was unclear if landline or mobile, this category is general; $n = 104$), mobile phone talking ($n = 65$), one-way ($n = 43$), landline ($n = 30$) and mobile phone texting ($n = 28$). All interviews contained direct mentions of ICT use, but allusions to ICT use were also made, such as “we tracked down our employees,” that did not make it into the count. We thus view explicit

Table 1. Codes Used

Research question	Codes
RQ1a: How do organizations use ICTs to enact organizational resilience following disaster?	ICT Use, 2.3.1 functioned at a distance
RQ1b: What impact does postdisaster ICT use have on organizations' technological structures?	ICT Use, 5.2 new disaster, 14 creativity, 5.7 predisaster
RQ2: How do organizations enact resilience in the absence of ICTs?	ICT Use, 2.3.2 functioned only locally, not useful, FtF, 6.0 Tie activation prior to return, immediately upon return, after settled in
RQ3: How does postdisaster organizational ICT use reflect the phases of recovery?	ICT Use, 28 evacuation tales, 24 initial renetworking, 26.3 recovery plan, 6.0 Tie activation prior to return, immediately upon return, after settled in
RQ4: To what extent do organizations retain patterns of ICT use enacted during disaster recovery?	ICT Use, 26.3 recovery plan

Note: RQ = research question; ICT = information and communication technology; ICTs = information and communication technologies.

ICT-use comments to be instances that stood out in participants' minds as truly aiding recovery but predict that the actual incidence of ICT use was even greater. Blocks of text were also coded for face-to-face (FtF; $n = 179$), in which participants explicitly mentioned using FtF communication, not an ICT (e.g., when running into clients or other network members during evacuation, or when ICT use failed). These quotations illustrate patterns of how organizations enacted resilience without ICT or how FtF communication was used to supplement ICT use (or vice versa). Emergent themes are presented below and are paired with tables that report representative quotations across interviews. The quotations listed in the tables were selected for inclusion after discussion among the authors about which particular quotations from the corpus of interviews were most illustrative of the emergent themes across interviews.

ICT Use and Resilience

RQ1a asked how organizations used ICTs to enact resilience. Three themes emerged: Coordinating contacts; coordinating resources; and enacting work routines.

Coordinating contacts. ICTs were crucial to establishing first contact, as well as for maintaining an open line of communication as recovery continued. While reestablishing contact one-on-one was often accomplished through texting, a series of connections with both new and old network members took place on a mass-communication level when organizations used

their websites as a place for internal and external stakeholders to check-in and communicate (Table 2, FamEntertain-16) and used both their own and others' email address books to establish connections (Table 2, Nonprofit-29[a]). Essentially, ICTs allowed organizations to reconnect across distance and with many stakeholders at once. In the case of mass outreach via websites or blogs, ICTs even allowed people to (re)connect and expand networks with network members whose location was unknown. That is, as long as network members or other audiences were checking the Internet, they could reconnect with the business, or connect for the first time, despite the fact that each other's location, email address, and telephone number were unknown.

Coordinating resources. Access to information and material resources was obtained using ICTs, which enabled organizations to begin recovery. Uses covered a range of resource acquisition, from updates about New Orleans and places to carry on operations during evacuation and repair of damaged infrastructure (Table 2, Prof/Legal-62) to finding new vendors for work (Table 2, Prof/Legal-13). For example, a performing arts organization was able to secure a place to perform by connecting with other performing arts organizations via email and telephone. Essentially, they coordinated the use of a new facility and a joint performance across eight states via ICTs. Additionally, with the aid of ICTs, many participants ended up receiving "surprises" in the forms of financial resources or emotional support from their existing contacts, strong and weak ties alike, as well as from new contacts (Table 2, Association-3).

With the aid of ICT use, support from external contacts, including personal or indirect contacts, provided impetus for organizations to return (Table 2, Prof/Legal-6, Nonprofit-40). Keeping communication channels open with key social contacts inside the affected area was beneficial for people who were displaced (Table 2, Prof/Consult-56). For example, participants described countless emails from customers and clients who reassured organizational leaders that when the organization was ready, they were anxious to do business with them again. Such email communiqués provided leaders the confidence that their rebuilding efforts were purposeful. The gift of ICT access or technical assistance for participants was especially important to connect effectively and efficiently with business contacts (Table 2, Nonprofit-29[b]), thus facilitating more efficiency and effectiveness in connections upon returning.

Enacting work routines. Organizations relied on ICTs to enact work routines across geographic space. While this worked best for jobs that already relied largely on computers to accomplish work, other organizations, such as retail stores, also used ICTs to accomplish business tasks. These tasks often included using the Internet or telephone to conduct meetings that would have normally taken place FtF, including information exchange and weekly meetings (Table 2,

Table 2. Resilience Through Information and Communication Technology Use.

Organizations	Quotations
FamEntertain-16	The website and the chat room was open. Some portion of the chat room was open to anyone, and we had lots of people that did contact, that went onto the site that were familiar with us, that wanted to find out if we were okay, or they could do anything for us or whatever. But then we had other sections that were just for the employees, where the employees could go in to get information and we could get information from them.
Nonprofit-29(a)	Now, of course, at the time when I emailed, we were all over the map because we were evacuated. That was in November. And asked that they email to everyone in their address book. And so I got a lot of responses from people that I didn't know who they were and wanted to join in.
Prof/Legal-13	Considering that you can get just about anything on the Internet, I've already replaced some things via the Internet from places that I had no idea would have supplied that sort of thing. So it works, it's just that it takes longer to get here.
Prof/Legal-62	I learned through email and voice mail that most of my employees had scattered, literally, to the four corners of the country—Florida, New York, one person went up to Seattle, and a lot of people went to Texas. So really not knowing, and I was at the time in Tennessee, we evacuated to Tennessee, and then made plans, knowing we couldn't return home any time soon, to go to Atlanta where we lived with a brother and I was able to set up a place to work in his office.
Association-3	I communicate on a couple of online chat groups of innkeepers nationwide and one of those, a group . . . because it was a month before we could come back, one of the people on one of those groups took up a collection amongst her state association and just sent us a check. I think it ended being like US\$1800.
Prof/Consult-56	And it was amazing the people you found on the Internet that, again, you've never met before, but that would drop by your house, some policeman or whatever. We did use nola.com, but a lot of cases I was just emailing people I knew or things like that.
Nonprofit-29(b)	The first time I went on the radio . . . a local photographer heard me announcing, "Look, I'm doing this out of my personal email address. I don't have a website." He set up the website, And then it was regular, I needed to add new information regularly, and he had his own job and he wasn't doing it. I was like, "We have to figure something else out." So my brother-in-law set up [the website] and I do the text.
Prof/Legal-6	. . . my children's school started a blog, and that helped tremendously because then we knew what was going to happen. My husband's company finally reached him by text messaging his phone, his cell phone, because text messaging worked. Cell phones didn't. You couldn't talk to anybody, but you could text message . . . my husband's company, and those were the biggest factors for us in terms of coming back.

(continued)

Table 2. (continued)

Organizations	Quotations
Nonprofit-40	[My husband] emailed everybody in his address book. And a lot of my friends and some of the prime members and people in the organization would get his address book. So then I started getting emails from them, because I didn't have people's cell phones. . . . Once the word started getting around the network in DC and all the agencies that we deal with that they could get in touch with us, they started calling my house to see how we were and what we were doing and where we were going to go and. . . .
Corp/LgProfit-23	And we would have meetings twice a day. And [work contacts] would call down at 10 o'clock and at 3 o'clock every day. We set up a hotline and [employees] from all across our footprint, Alabama, Pensacola, would call in and we would go through a checklist, just like a pilot's checklist flying an F-18. What's working? What could be better? What problems are we having? You know, so and so.
FamEntertain-30	But we normally have Wednesday morning meets here, and so I asked people to consider Wednesday morning as our meeting time and to email each other reports on what they'd been doing, because they were getting paid, to share what path they were working on and what they'd been doing, any updates they had personally.
Prof/Consult-15	R: I wrote [the proposal] while I was in Houston, [colleague A] was in Atlanta, [colleague B] was in Atlanta, [colleague C] was in Baton Rouge, so we wrote it. All the Internet . . . back and forth. I: Track changes. R: That's exactly right. And that's how we did it. And then we, this was in October, and then we were awarded it at the end of October.

Corp/LgProfit-23, FamEntertain-30). Similarly, a business consultant reported being able to coordinate work with colleagues to the extent that his organization was awarded a grant while they were still evacuated (Table 2, Prof/Consult-15). Additionally, the Internet was used as a way to sell to a customer base outside of New Orleans.

Rebuilding Technological Structure

RQ1b asked about the impact of postdisaster ICT use on organizations' technological structures. When segmenting the ICT supercode by the code "creativity," three subthemes emerged: adopting texting for business use; utilizing websites and blogs for two-way communication; and piggybacking ICT use. Additionally, email, while not a new or creative use of ICT, was a staple in communication following Katrina. These four subthemes represented the

ways in which organizations enacted the three main themes (coordinating contacts, coordinating resources, and enacting work routines) using ICT.

Text messaging for business use. Texting was not one of the most frequently mentioned media for communicating, but it was a useful way to communicate when other ICTs were not working. Therefore, the counts associated with the ICT do not reflect the importance imparted on it by the participants who utilized it. Participants reported never having used texting before, not being familiar with it, or figuring it out because someone sent them a text (something they had never received before; Table 3, FamEntertain-12, Advocacy-24). Despite the learning curve, texting was lauded as the primary form of communicating when landline and mobile phones were not working.

Utilizing websites and blogs for two-way communication. Organizational leaders reported using their websites, some with blog or chat room features, in order to communicate with both internal and external stakeholders (Table 3, Restaurant/Bar-28, Nonprofit-35, FamEntertain-12). This subtheme emerged most frequently as part of the larger themes of enacting work routines and coordinating contacts. Websites went from primarily one-way communication with external stakeholders to a way to make contact and coordinate with individuals within and outside the organization on a mass communication level.

Piggybacking ICT use. ICTs were combined in unique or novel ways in order to communicate postdisaster. For example, when the Internet alone was not enough, people reported using the Internet in combination with the telephone, email in conjunction with conference call, and email in combination with fax, among others (Table 3, Business-4, Shipping/Freight/Storage-52). Because the communication obstacles created by the hurricane were sometimes too great to overcome with singular ICT use, organizations creatively used them in conjunction with each other to accomplish their tasks.

Emailing. While neither new nor novel, email played a large role in rebuilding technological structures. It was used to enact all three of the main themes, coordinating contacts, coordinating resources, and enacting work routines. Email provided flexibility because it allowed for participants to reach out on a mass level to all participants in their address books or one-on-one with specific clients. It was also more useful than phone (either landline or mobile) because phone service was spotty, and participants reported not having personal contact, such as mobile phone numbers, for clients. While email was generally used for the same tasks that it was pre-Katrina, participants reported relying on it more frequently than they had in the past, as it supplanted much of the FtF communication and phone-based communication that they typically used (Table 3, Prof/Legal-6, Restaurant/Bar-25).

Table 3. Rebuilding Technological Structures

Organizations	Quotations
FamEntertain-12	We used cell phones, which were basically ineffective initially and then . . . the thing that was working was the text messages. They worked throughout and we were able to use some of those. The challenge there was that a lot of people were not familiar with using text messages to communicate, so we just had a capacity issue there.
Advocacy-24	I actually got a 901 number in Memphis because the 504 numbers were down or not working. . . . So text messaging was actually the only way you could connect. A lot of people didn't have access to the Internet, so email wasn't really the best.
Restaurant/Bar-28	In the early days, when it first happened, my Internet website went down. Now the fellow who was handling it, he got me a temporary site, and on the temporary site it said [the business' name] would never die. Contact [owner's name] at [business' name.com.] . . . Well I mean that helped a lot, because when people were trying to get in touch with me, they were able to reach me that way.
Nonprofit-35	We assembled this bulletin board, so people could sign in and say, "Hey, I'm okay," and we began to use that as a conversation tool for shoppers and producers to find one another; and then eventually vote within the next couple of weeks of which market do we reopen, because we had 4 and one was in flooded territory.
FamEntertain-12	We had a website, of course. We always had a website. And then we made changes to the website from where we were in Dallas, where I was in Dallas, and there were a couple of us that were in Dallas and scattered, so we made changes there to keep it updated, because we thought, well, maybe our employees will try to contact us through the website, they'll try to find us through the website. So we were always pretty up to date on that website
Shipping/Freight/ Storage-52	And he could get Internet service at his girlfriend's mother's house, so he would take his laptop over there. I could get fax service from a friend's house down on Bourbon Street, so we were, he'd get something on the email, tell me . . . fax, I'd . . . Bourbon Street . . .
Business-4	I got up at three o'clock in the morning—I get up early anyway—so got online, got halfway through and lost the connection. So I called up. They had a number that I had written down, so I called me and they did the entire application at about five a.m. for me on the cell phone, and my cell phone almost ran out of juice, it was so long. But they had my telephone number to call me back.
Prof/Legal-6	And then customers were like that as well. They were scattered. You might have some of them at this branch office in Dallas, and some of them in Houston, some of them wherever. And everyone was scattered, so that practically the only way you could communicate was email, from a business perspective, unless you happened to have their cell phone numbers before. But like cell phones, they didn't work for a while, and so you'd end up having to get another cell phone with a different area code because the 504 area code just didn't work. So there was most of the contact, especially initially, was by email.
Restaurant/Bar-25	So in mid-October, I mean our main marketing tool was an email list. We had this email program. At the time we were using Constant Contact, which is a well-known email program, had about 4,000 people on my email database. This is the mail way we stayed in touch with our customers and done marketing the entire time.

Resilience Without ICTs

RQ2 asked about how organizations enact resilience without the aid of ICTs. In the immediate aftermath of the hurricane, ICTs were only of sporadic use because of overloaded systems or physically damaged servers and cell towers. One family entertainment center described this situation as a sort of communication vacuum following the hurricane (Table 4, FamEntertain-1). In the absence of geographically close network partners or working ICT, participants reported turning to proximate others, on both organizational and personal levels, for assistance and support. For example, a bar reported pooling resources with any other businesses open on their street in order to survive (Table 4, Restaurant/Bar-42); a culinary education-focused organization expanded to be a more conventional restaurant, thus opening its doors to anyone after the storm. At this point, the owner reported, they were not open for profit, but rather were just using their physical space to build a community (Table 4, Restaurant/Bar-25).

Others started to branch out and work with new clients or partners who were proximate during evacuation. For example, a communication consultant described supplementing her consulting business with clients from Houston (Table 4, Prof/Legal-6). A bank described having an evacuation plan in place through which employees were relocated to existing bank offices in alternate locations. In many cases, businesses that engaged with proximate others during evacuation also relied on ICTs to accomplish their work. However, they were working around the disruption in New Orleans by relocating and rebuilding networks in their evacuated space.

Some early efforts at resilience without ICT were buoyed by a feeling of community camaraderie, but that was quickly supplemented with ICT use when it was available. For example, the restaurant that used its space to throw a community party quickly implemented mass email lists and offered free Internet service at their restaurant as a way to reconnect and rebuild their business. While there were organizations that were not able to begin business operations until people started to return to New Orleans, or until ICT was back up and running (Table 4, Business-27), even organizations that did not rely heavily on ICT for day-to-day operations did use ICT to coordinate clean-up efforts and to locate employees. Therefore, even though their use of ICT was more limited, it was still used in the initial stages of recovery.

ICT Use in Stages

RQ3 asked how post-disaster ICT use reflected phases of recovery. Though the purpose and frequency of ICT use evolved through the stages, the primary

Table 4. Resilience Without Information and Communication Technologies

Organizations	Quotations
FamEntertain-1	The lack of communication, that was really, really hard. You're functioning in a modern world, but you can't talk to anybody. You can't communicate. You can't let anybody know how you're doing. That was really, really hard. . . Other than that, there's nobody to talk to. There's nobody to communicate with, so that was a big problem. . . There were no phones. There was no anything.
Restaurant/Bar-42	And we were there every afternoon, and a lot of people in the neighborhood were working on their houses, who would come in like we did, and we just had our doors open. We had a generator running. We had some ice that we'd bring in every day and ice down some cold drinks, and people would come by, we'd just give it to them.
Restaurant/Bar-25	So we'd jam out, and we'd jam out music, and just have people come, and people would just come by and drink, whatever, get some food. So that was one thing we kind of did is kind of create a community. And you've got to understand that everyone had been gone from the city for like 6 weeks, 8 weeks. Cell phones worked horribly. People's phones were still down. So I mean the ability to come on a Saturday night and see all your friends was huge. I mean it was a really like, I mean I can't tell you how many tearful hugging reunions I witnessed in our space.
Prof/Legal-6	But because I was in Houston, I started like calling on new potential customers there, and so I ended up actually developing more business there, as did my business partner.
Business-27	No, no. I would say, I'd say 60% of them do not have Internet, because being a store you've got seamstresses and stuff like that. They don't have a computer or have Internet. Those are the ones we were having trouble with.

utilization reflected the three overall emergent themes: coordinating contacts, coordinating resources, and enacting work routines. Noteworthy was that, at the time of the interviews, a few of the struggling organizations seemed stuck in the professional emergency or beginnings of the transitional phase.

Personal emergency. Directly after the hurricane, organizational leaders reported dealing with limitations in technology (Table 5, Restaurant/Bar-18). Cell towers and local servers were down, and landline phones were inoperable. Business leaders primarily reported communicating FtF, or via email.

Table 5. Information and Communication Technology Integration at Short, Medium, and Long-term Intervals.

Organizations	Quotations
FamEntertain-30	On the Internet. Actually, the Times Picayune, our newspaper, published them. There was a link and that was a way people found out what they were coming home to. It was a full blocked grid coverage of the city. It was like a map of New Orleans and then there was like a bingo game, D7.
Restaurant/Bar- 18	Yeah. So, well right after, yeah, I mean nothing was working. So, you know, I mean for a while after. I heard from. I actually had two. I had a manager here and a manager at the other store before the storm. And they. The Saturday before the storm, I had to come to both stores and close up and make sure everything was done and whatever. But soon after I talked to them. At that point I did not know what was going on. In fact, I said, look, I have no idea what's going on. I don't know the status of the stores at this point. Just give me a week after
FamEntertain- 14	Our website becomes a very important place . . . actually we did have a blog on our website . . . briefly that we took down after it wasn't really needed.
Prof/Legal-6	But I think email was really the biggest factor. And then afterwards, even once we were, like probably for at least the first 6 months of 2006, like our reports that we generate for our referral sources, you know, our customers, they were all sent on email and many of them were sent by email.
Corp/LgProfit-23	I think our plan, I think most business' plans were good, generally speaking. Now there were lessons learned. . . . Telecommunications was a big challenge and that's where much of our focus will be this next time, to make sure that people have cell phones and laptops when they leave.
Nonprofit-35	But everything of importance, that keeps us afloat and running, will be uploaded onto our website as a document, a digital document that sits in, I don't know, Australia—I don't know where the server is—to ensure that we have it saved someplace digitally.
Business-7	So now we have a 1-800 emergency hotline and these little cards for people to carry with them at all times because we evacuate sometimes two or three times a year. So now we have a backup website now a little distance so we can get in touch with each other.

It was during this stage that texting also began to emerge, although participants also reported being unfamiliar with the technology. During this stage, most communication was directed to personal contacts, as business leaders relied on family outside of New Orleans to provide both shelter and working technology. Participants reported that the local radio station WWL TV and radio, as well as the website for the local newspaper, noaa.com, were invaluable sources of information (Table 5, FamEntertain-30).

Professional emergency. Once business leaders had established a place to work outside of New Orleans, they began the process of reconnecting with employees. For some, this occurred the next day; for others it took longer. Texting and email emerged as the primary ICTs during the professional emergency phase. In this phase, business and organizational leaders contacted employees by texting, through second-hand information, and with FtF serendipity (e.g., bumping into someone on the street in Houston; meeting during a brief return to the city; seeing a colleague, etc.).

Transitional and rebuilding phases. Though treated separately in previous literature, the transitional and recovery phases were not as distinct in terms of ICT use. The transitional phase has been classified as a time of repair and stabilization for organizations, while the rebuilding stage marks the process of returning to a state of normalcy (Dorefel et al., 2010). Again in the transitional stage, coordinating contacts was key. However, instead of connecting with personal contacts or employees, contacts in this stage were primarily strangers offering help, external stakeholders, or professional contacts outside the realm of employees. To that end, using ICTs to coordinate resources, as discussed previously, became a main function of the transitional stage. In the transitional stage, using ICT for work functions became more prevalent, although business owners were still connecting with others whom they had yet been able to reconnect with, as well as coordinating resources. During the rebuilding stage, organizations were using technology to begin enacting work routines, whether still evacuated or newly returned. As organizations moved through the rebuilding phase and toward routine work, they started to pick and choose which types of ICT use were still relevant (Table 5, FamEntertain-14). Despite the innovative use of ICTs in the earlier stages of recovery (Table 5, Prof/Legal-6), most long-term integration of ICTs included a return to pre-Katrina usage patterns with the inclusion of lessons learned for future disasters.

Retaining Patterns of Use

RQ4 asked if organizations retained patterns of ICT use that were enacted during recovery. While most patterns of use went back to predisaster conditions,

a theme that emerged was the incorporation of lessons learned into preparation for future emergencies.

Recovery plan. Organizations recognized both the limitations and potential of ICT use following the disaster and often reported making provisions to their disaster plans so that they could use ICTs to their fullest potential in case of future disasters (Table 5, Corp/LgProfit-23, Nonprofit-35). Participants reported that in the future, the critical ICT resources that they should consider include satellite phones and/or mobile phones with services that are not physically in New Orleans, Internet servers located elsewhere, 800-numbers for employees to use to report their status, as well as “laptops for everyone” (Table 5, Business-7).

Discussion

This article combined two separate areas of organizational study, organizational resilience and technology-in-practice, to investigate how organizational leaders use ICTs to recover from disaster. Results showed that technology use in practice has implications for organizational resiliency in that organizations were able to adapt their ICT use effectively to overcome obstacles presented by the hurricane. New contributions to literature on ICT use include an extension of organizational resilience theories to include the element of *external availability*, the importance of sequential use of ICTs in a crisis situation, and the addition of a fifth stage of disaster recovery labeled an *anticipated stage*. Additionally, findings support and build on existing literature that emphasizes the importance of redundancy, shared context, and mass communication-based ICT to organizational resilience.

Technology-in-Practice and Organizational Resilience

Arguably, resilience for any organization rests on its capacity to carry on work operations regardless of circumstance. The flexibility afforded by ICTs enabled organizations in this study to rebuild and extend communication networks, gather resources, and enact work routines from a distance. Taken together, the emergent themes suggest that *connection*, *coordination*, and *creating context* were the cornerstones of resilience for organizations. While connecting, coordinating, and creating context were often accomplished with conventional uses of existing technology, such as email and phone, consistent with Orlikowski's concept of technology-in-practice, organizational leaders also adopted their ICT use to the context at hand, creating new patterns of ICT use that were incorporated into overall ICT usage. This pattern was evidenced in three main

ways: The adoption of text-messaging for work communication; the use of websites to initiate and maintain contact with both internal and external stakeholders; and the use of ICTs in conjunction with other ICTs. Connecting was the integral first step. Finding personal and professional contacts were the necessary conditions for enacting organizational resilience. Once that was accomplished, coordination of material, emotional, and informational resources was key to getting an approximation of work up and running. Finally, creating context, or intersubjectivity (Weick, 1993), allowed organizations to carry on work routines and move towards recovery. By connecting with employees across distance via ICTs, organizations created a shared vision of moving forward with leaders communicating goals, priorities, and progress to employees. Other research shows that postcrisis coordinating across distance can be hampered by a lack of context or shared understanding of the environment in which each team is acting (Reddy et al., 2009). Yet the communication facilitated by the ICTs enabled leaders to overcome this situation by creating a shared context for employees to work together despite geographic distance.

The data suggest that ICT use, specifically incoming emails and blog posts from external stakeholders, empowered organizational leaders to act. A particular decision-making challenge that leaders faced after Katrina was whether they should return and when. The emails and blog posts of support received about how customers were “ready and waiting” to do business provided some impetus for organizations to return. ICTs being used as a way to coordinate two-way communication echoes the importance of open organizational boundaries. Others (Taylor & Perry, 2005; Taylor & Kent, 2007) have shown the importance of using the Internet to open boundaries and enable two-way, interactive communication following crisis as well as to provide real-time status updates and connect visitors to other relevant information. While these studies focused more on a public relations approach to reputation management, our findings support this idea and extend it to the area of organizational recovery. Perhaps a fifth source of resilience (Weick, 1993) and adding to ways to measure resilience (Kendra, 2001; Bruneau et al., 2002) is *external availability* through the use of ICTs to open up boundaries to the public. The findings presented here highlight future considerations about the extent to which a disaster event might transform the way organizations make their communication systems symmetric with their stakeholders.

Mass communication, both one-way and two-way, is important during a crisis. While some respondents reported using websites or blogs specifically to contact missing employees, others left the forums open to give and receive updates. Participants also cited the importance of both public and personal blogs for status updates, emotional support, and decisions about when to

return to New Orleans. Previous research has supported the idea that public message boards are more useful than one-on-one technology during crisis, as it enables emergency workers who are passing through or checking in to ascertain both status of patients and command structure (Reddy et al., 2009). Although the public message boards in Reddy et al. (2009) were for colocated teams, the idea of information being made available via an easy-to-update, mass communication platform (rather than one-on-one level) is the same.

Technologies like blogs and texting are more resilient in times of crisis because of the infrastructure that powers them and because both functions can be accomplished using a mobile device (Macias et al., 2009). Both the technological platforms and their uses allowed those affected to check in when they could and organize on the fly. The durability of the technology is important during crisis, *and* the nature of the information being ready and waiting when people have the access to check in is key for the users. Organizations, emergency response teams, and individuals can benefit from mass communication like blogs and bulletin boards during recovery.

In line with the research on sequential ICT use (Stephens, 2007), results also showed that participants tend to make successive use of different media modalities when accomplishing tasks, such as filling out a grant application online, getting city permits, or searching contact information of existing ties. But in expanding this work to the disaster context, findings indicate that certain social contacts play a key role in the process of modality switching. That is, a social contact serves as the “hub” so that information or resources can be transmitted and received by the organizations through different media. Taken together, the ways in which organizations adapted their technological structures to their communication needs emphasize the importance of redundancy, creativity, and user ability in organizational resilience. The findings reflecting adaptive ICT use show that following Hurricane Katrina, technology became more than interchangeable; it became innovative, echoing Weick’s (1993) assertion that *improvisation* and an *attitude of wisdom* are key elements in resilient behavior. This finding suggests that in an emergency, multiple ICTs used in multiple ways are key to organizational resilience. Organizational leaders and emergency planners should incorporate redundancy into communication plans in order to overcome obstacles created by crisis.

However, ICTs were not always useful or available to organizations attempting to regroup and recover. While some did not rely heavily on ICTs before the hurricane and therefore did not have the knowledge or resources to adapt technology to the issues at hand, others simply could not overcome the challenges posed by the hurricane. Shortcomings of technology have been cited as a problem in the coordination of emergency efforts among different

agencies (Reddy et al., 2009), with emergency department and emergency medical teams citing the utility of paper records transferred with patients in a crisis over the utility of tracking records via ICT. However, findings support the idea that organizations were able to find temporary solutions, including pooling resources and lending assistance to others who were stranded. These findings are relevant in two ways. First, they are consistent with Katz and Rice (2002), in that results showed that in the absence of ICTs in an emergency situation, organizations will come together with proximate others to share resources and promote goodwill. While Katz and Rice (2002) evidenced this finding on an individual level, this study shows the same trend present on the organizational level. Future research should look at whether this goodwill lasts or relationships return to predisaster status as organizations move out of crisis mode. Additionally, this finding points to a potential digital divide between organizations that can and do utilize technology regularly, and those that do not. While the main focus of this study was on organizations that were able to leverage ICTs successfully for resilience, future research should consider the implications of this digital divide in organizational recovery.

Temporal ICT Use

Considering the data in terms of sequential stages underscores the facts that (a) ICTs can be used to serve a variety of purposes, depending on how they are used, and that (b) how ICTs are used will change as the environment changes. While Orlikowski (2000) focused on recurrent use of technology by users, this study shows that technology can also be contingently adapted to move an organization through a period of change successfully. This contingency acceptance of ICTs can be extended to a fifth stage of disaster recovery labeled an *anticipated stage*. While the anticipated stage is not one that organizations enact as part of their recovery cycle, it is a stage that could serve as the first stage in organizational recovery strategies. Because the anticipated stage is based on lessons learned from previous disasters, it has the potential to alter and improve future communicative response to crisis.

Limitations

This study used in-depth interviews to draw conclusions about post-disaster ICT use and interorganizational network building. A combination of snowball and convenience sampling were used to recruit participants in the study; therefore, results may not completely reflect the experiences of the New Orleans businesses community. While a search of the city's web site,

www.neworleans.com, reveals that the spectrum of businesses in the study sample does not represent the spectrum of businesses and industries found in New Orleans, because random sampling techniques were not used, estimates of the findings' representativeness are impossible to make. Additionally, organizations that were available and willing to participate in this study represent those organizations that were experiencing varying levels of success in returning to New Orleans. Thus, the sample is possibly biased towards exceptionally driven leaders and/or successful businesses. Finally, this study examines organizational resilience in the face of natural disaster. As organizational crises can vary in areas such as intentionality and predictability, crisis response and management will vary. The results from this study represent ICT use in response to one type of crisis that affected many organizations simultaneously; other crises may generate different responses. Despite these limitations, this study offers important insights into the role of ICTs in organizational resilience following disaster.

Conclusion

Findings from this study underscore both the utility and limitations of ICT use to support interorganizational recovery efforts following disaster. These findings support and extend previous research examining postdisaster ICT use, highlighting the importance of connectivity, adaptability, and redundancy while positing a new dimension of resilience labeled *external availability*. Findings also emphasize the transition of ICT use across recovery stages and extend the idea of recovery phases into a fifth, *anticipated stage*. Suggestions for responders, survivors, and rebuilders include the importance of creative ICT use, including the creation of more "mass" communication resources, such as websites, blogs, and forums, to allow people to reconnect. Additionally, rebuilders should consider the incorporation of redundant ICT use in future recovery plans, including the acquisition of backup servers and phone capabilities outside of the local area and providing multiple ways for network members to reconnect. Future research should consider multiplexity of media use in disaster recovery as well as the role of external stakeholders in supporting organizational resilience.

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Note

1. See Doerfel, Lai, and Chewning, (2010) for a comprehensive list of codes and procedures.

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