INFORMATION MANAGEMENT AND ANIMAL WELFARE IN CRISIS:

THE ROLE OF COLLABORATIVE TECHNOLOGIES AND COOPERATIVE WORK IN

EMERGENCY RESPONSE

by

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ABSTRACT OF THE DISSERTATION

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Information Management and Animal Welfare in Crisis: The Role of Collaborative Technologies and Cooperative Work in Emergency Response

Thesis directed by Associate Professor Leysia Palen

When making decisions about what to do in a disaster, people consider the welfare of their animals. Most people consider their pets to be "part of the family." There are more than 144 million pet dogs and cats in homes around the US, and Colorado is home to a $3 billion livestock industry. In emergency response, supporting the human-animal bond is one important way we can assist people in making good decisions about evacuation, and improve their ability to recover after the emergency period is over.

There is an opportunity to leverage social computing tools to support the information needs of people concerned with animals in disasters. This research uses three major studies to examine the information management and cooperative work done around animals in this domain: First, an online study of the response of animal advocates in the 2012 Hurricane Sandy event; second, a study bridging the online and offline response of equine experts following the 2013 Colorado floods; and third, an extended 22-month ethnographic study of the work done at animal evacuation sites, beginning with on-the-ground participant observation at two fairground evacuation sites during the Black Forest Fire in Southern Colorado in 2013, and including the design of two information support tools.

The research provides lessons about how information online, information offline, and the bridging of information in those arenas both supports and limits the potential for innovation in addressing the unusual and emergent ill-structured problems that are hallmarks of disaster response. The role of expertise as a vital resource in emergency response, and recommendations for policy improvements that appreciate the conscious inclusion of spontaneous volunteers are two contributions from this work.

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I think now of my home and of my four children. They have eaten a lot of take-out, and coped as I attended conferences and often wrote into the night. Rebecca, Maxim, Forest and Charles, thank you for your support, love, humor and understanding. My husband, Jed, reminds me often that I can do anything I set my heart on, and his desire for me to succeed makes me love him even more. He believes in me. It's both powerful and humbling.

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CHAPTER 1. Introduction: Animals as a Vital Consideration in Emergency Response

Social computing technologies such as blogs, wikis, discussion boards and chat or instant messaging tools have become pervasive inclusions to communications around the world. Where once only a small number of people had access and interest in these kinds of social media technologies, today social computing tools such as Facebook are embraced by a wide range of people all around the world.

This broad access provides like-minded people with an infrastructure upon and through which they can come together and work in unprecedented ways. These media have moved beyond being sites of personal connectivity and information sharing (though they certainly still fulfill that role). They are now used in innovative ways to raise the profile of, and address, myriad societal problems.

The collaborations these tools support can be aimed at social change. For example, Facebook and Twitter were credited with being sites where communication, affirmation and decisions to take action were articulated and reinforced during the 2011 Egyptian uprising and other Arab Spring revolutions (Starbird & Palen, 2012; Tufekci & Wilson, 2012). Apart from political concerns, other social issues that have received attention through social media include society's struggle with racism (Carr, 2014; Stelter, 2014) through to activist collaborations such as those asking large corporations to report on food production issues (Stanford, 2014). Social computing tools are also increasingly being used in response to disaster events.

Disasters include natural hazards such as hurricanes, tornadoes, earthquakes, etc., as well as human-caused events such as bombings and mass shootings. By definition, disasters disrupt normative societal infrastructures, behaviors and routines (Fritz, 1961). The disruption caused by disaster creates needs for human innovation and collaboration. People both *di*verge from an affected location in the process of evacuation, and *con*verge upon it, using whatever resources they can access to try and help (Dynes, 1970).

These sites of convergence can be identified physically through a geographic location such as the area of impact and centers of evacuation where people gather, typically at a perimeter of an affected area. They are also seen online, as people pivot their attention in social media to the effect of the disaster

(Starbird & Palen, 2011). Studies have focused on one site or the other (i.e., at the physical location or online), but rarely on both. Social collective behavior in geographic locations has been the site of study for sociology of disaster scholars, while online collective behaviors have found attention in the growing field of crisis informatics. Crisis informatics is a young area within the field of Human Computer Interaction that has focused on the computational aspects of disaster.

The disruption wrought by disasters brings attention to the most primary of human concerns such as provision of food, shelter and warmth. While these are always vital for individuals and society, in normal times they are attended to as part of everyday social routine. In disaster response, victims' and responders' ability to adapt, innovate and collaborate in sometimes the most unimaginable circumstances provides an opportunity to observe and study cooperative work not evident in normal times.

One important area in the cooperative work engagement of emergency response is how people respond and react to the welfare of animals. Animals are a core part of society. The human-animal bond has proved to be important to the ways people navigate their lives in many ways. For example, the presence of pets in the lives of children helps teach them empathy and how to nurture (Melson & Melson, 2009). Pets are important in reducing stress (Allen, Blascovich, Tomaka & Kelsey, 1991), and trained service animals are tasked with the noble duty of helping people with disabilities in day-to-day living, with the added benefit of providing a "social lubricant" as they go about their tasks (Hart, Hart & Bergin, 1987). Furthermore, most people consider their pets to be "part of the family" (Serpell, 1996; Carmack, 1985). However, animals do not only fulfill companion and service roles. Farmers rely on livestock for their financial livelihood.

The way animals are accommodated—or not—in emergency response has been shown to affect human decision-making (Heath, Beck, Kass & Glickman, 2001; Heath, Kass, Beck & Glickman, 2001). However, until recently including animals in evacuations has been a secondary concern—a situation that does not reflect their important presence in the lives of humans. In the time- and safety-critical environment of emergency response, supporting the human-animal bond is an important consideration if

we are to improve the ways we can assist people in making good decisions about evacuation, and improve their ability to recover after the emergency period is over.

1.1 Animal Identification: A Complex Problem

At first glance, evacuating animals with their owners might seem to be a very practical problem. Unfortunately, the problem is deceptively complex. In the US there is no single, standardized way of knowing how many households own animals, nor what species and number of animals are owned, and by whom. Each state has different laws related to the registration of animals, and some states still even allow personal ownership of exotic animals such as wild cats, wolves and bears (Nyhus, Tilson & Tomlinson, 2003). The US's most reliable statistics on pet ownership are through the American Veterinary Medical Association's (AVMA's) Pet Ownership and Demographics Sourcebook. The Sourcebook contains a survey of more than 50,000 households across the US. It is updated every five years, with the most recent data, collected in 2011, claiming there were 70 million pet dogs and 74.1 million pet cats in households around the US (American Veterinary Medical Association, 2012).

Not knowing the species, number and locations of animals in society makes it difficult to adequately prepare for evacuations. It is hard to tailor preparedness communications to owners, and difficult to prepare animal evacuation locations with information about what to expect if an evacuation were to happen. All we can reliably know is that there are a *lot* of animals.

1.1.1. Microchipping: A limited technical solution to a socio-technical problem

With so many millions of pets in households around the US, how might we begin to know which pets belong to whom? For small animals, a microchip is touted as the most reliable way of identifying an animal and its owner. A microchip is a small implant, about the size of a grain of rice, which is a Radio Frequency Identification (RFI) transponder held within a shell of bioglass. Microchips are a form of proprietary technology, and those made by different companies operate at different frequencies. This used to be problematic, but today most veterinarians and shelters have a "universal reader" which can scan all frequencies, enabling the chip to be read. Each microchip holds a unique identification number. When a

microchip reader is held above the microchip, the ID number is "read" and displayed on the reader, along with the name of the registry the pet is registered with. The vet or shelter can then call that registry to find the owner's details (Petfinder, n.d.). This appears to be a straightforward process, however research on the number of animals that have been displaced and reunited through the information in microchip registries is disappointing.

While the technology and the systematic method to identify animals with microchips are reliable in concept, the reality of successful pet-to-owner identification and reunion is flawed. Even if a pet is "chipped," the chance an owner will be reunited with their pet remains around the 50% mark. In a study conducted by Lord, Ingwersen, Gray & Wintz (2009) of 7,700 stray animals at shelters, just 52.2% of dogs with microchips were reunited (compared with 21.9% of dogs without microchips). The numbers were even less impressive for cats, with just 38.5% of microchipped cats being reunited (compared with 1.8% without microchips).

Why isn't microchipping producing better outcomes? In most cases where a pet is microchipped and is not reunited with its owner, information at the registry is out of date or has not been entered correctly. *In fact, in many cases the information has simply not been entered at the registry at all.* In plain terms, the chip technology works, but information on owner and contact details—which is supposed to be connected to the chip—often does not exist.

Reasons commonly given by registries on why this occurs relate to *the public's misunderstanding of the technology* rather than a failing of the technology itself. First, many people do not understand how a microchip works. Owners may hear that they need to microchip their pet and do so, believing the chip itself acts as a GPS, allowing the pet to be tracked through the chip (D. Schnackenberg, personal communication, July 8, 2013). They do not understand that owner information must be manually entered into a registry. This misconception is so common that most pet microchip registries feature it on the FAQ section of their websites (e.g. The HomeAgain and PetLink registry sites both feature this GPS question). Second, once the pet is microchipped, owners neglect to check that their information has been entered correctly into the registry, and/or they do not update it when they move house, change phone numbers, or

when the pet's ownership is transferred. Third, microchip-related limitations stem from the proprietary nature of both the software and the organizations that hold chip data in their registries. This information holds commercial value for companies interested in selling pet-related products and services, and the data are fiercely protected by the companies that retain it. Each of these companies charge owners to enter and/or update the information held in their database, creating a financial barrier to keeping information current. Finally, owners may not even realize there *are* different microchip registries, let alone with which one their pet is registered. In fact, some research recognizes these limitations and has said that while microchipping is a good idea, it does not replace the need for tags and other identification (Lord, Wittum, Ferketich, Funk & Rajala-Schultz, 2007; Lord, Grifin, Slater & Levy, 2010).

1.1.2 The role of brand inspections in identifying livestock

Microchipping is possible for livestock too, although it is more common for farmers and ranchers to use small plastic markers known as ear tags to identify the animals they own. Colorado is home to a $3 billion livestock industry, and is known as a "brand state." That is, it is mandatory for livestock owners in Colorado to register their animals with the state. The State of Colorado classifies livestock as: "cattle, horses, mules, burros, sheep, poultry, swine, llama, cervids, bison and goats, regardless of use. Livestock includes any animal that is used for working purposes on a farm or ranch, excluding dogs; or is raised for food or fiber production; and any other animal designated by the Commissioner" (Colorado Department of Agriculture, 2008).

The days of having to physically brand livestock to prove ownership in Colorado have passed, although it is still usually done. There are more than 35,000 registered brands in Colorado, and the job of Brand Inspector still plays a vital role. State brand inspectors annually check more than 4 million head of livestock, using brands, registration papers, veterinarian bills and other documentation to prove ownership. This mandatory process assists in tracking cattle, horses, mules and donkeys if they are to change ownership (by being sold or given away), or if they are being transported to other locations (75 miles or more within Colorado, out of state, or into the state) (Colorado Department of Agriculture, n.d.).

Brand inspections provide more than proof of ownership. The collected data helps in the tracking of animals for disease traceability—vital for the success of the industry (Colorado Department of Agriculture, 2014). However, just as not all small animals are microchipped, not all livestock have had brand inspections. Animals that were born and raised on family farms, and/or whose owners believe will never leave the property, may not be considered to need brand inspection. In these cases, if the animal is displaced from its owner, the only owner identification support may be through photographs and veterinarian bills.

Clearly, while animals may be "one of the family" and/or key to an owner's livelihood, human inaction creates information gaps that result in additional stress if the animal is displaced.

1.1.3 The socio-behavioral management of animals

In normal times, animal owners create environments and routines to help keep their animals secure. Owners keep pets safe with the use of leashes and crates, and contained at home with fencing. Other coordinated protective behavioral measures, such as remembering to close doors and gates, prevent animals' escape. The location of livestock is managed in pens and pastures, often on expansive areas of land with little disruption to the animals' environment. In addition to these spatial constructs, owners adapt their behaviors to accommodate animals, such as maintaining routines to which animals become familiar. Familiar people, standard locations for food and water, and routine exercise and care provide both animals and humans a level of security which likely masks the larger issue of a need for animal identification—until a pet is displaced from its owner, and the reality of our deficient system of information management becomes evident.

1.2 Animal Advocacy and Social Computing

In non-disaster times, animals and issues surrounding their care receive attention from advocates who want to raise awareness and influence policy (Beers, 2006). Today, interested groups and individuals use collaborative technologies to connect and provide information on issues such as breed-specific legislation (BSL), animal hoarding, spaying and neutering, and animal abuse.

In non-disaster situations, pet advocates connect online in what Golbeck (2011) calls "passion-based networks." These networks are created through message boards and forums that are highly frequented by pet advocates. Over time, as the social web has become more accessible and integrated into everyday life, these animal advocates have begun to connect in other, less pet-centric online spaces such as twitter and Facebook. These platforms allow advocacy messages to reach beyond the siloed confines of like-minded people to raise general awareness. On the whole, animal advocates remain loosely connected, sharing similar practices that identify them and the advocacy work they do. They might name their social media accounts using words that reflect their pet advocacy interests, e.g. "Mary Crossposter Williams" and "AnnieAntiBSL." They also "like" Pages and belong to groups that reflect their animal advocacy interests, especially those that some feel are of pressing importance.

One area of concern for many pet advocates is rescuing abandoned animals from shelters, and finding them new homes. According to the ASPCA, between 5 and 7 million pets enter animal shelters nationwide annually, with 60% of those dogs and 70% of cats euthanized (ASPCA, n.d.). The Animal Care and Control group and the Humane Society make counter claims to the ways pets are cared for in shelters, and scholarship adds further to this conflicted space, describing the "neat and tidy" picture offered to the public as obscuring the issues that arise with the enormous number of unwanted and stray pets. A 72-hour period is the minimum legally required time that an animal can be sheltered before being euthanized, though this time frame is flexible if an animal is judged by the shelter to have health or behavioral problems—the measure of which are not standardized or regulated, and as a result, many advocates feel is too easily granted.

With so many abandoned animals entering shelters, advocates seek to draw the attention of rescue groups who may be able to "pull" animals before euthanasia is considered. Social media helps advocates' communications as many shelters have an online presence, making information about abandoned and lost pets quickly available, and easy to share. Even so, rescue organizations' own resources, as well as time and attention may be limited.

Understanding that these limitations exist, individual advocates "crosspost" information about animals in shelters across the wider social media landscape, hoping for an intervention that will save the animal's life. The advocates who do this work self-identify as "crossposters." I will now describe in more detail the ways that social media have been used to help facilitate this work.

1.2.1 Crossposting: A network of change agents

A survey of pet advocates conducted over a six-month period during 2014 on *Examiner.com* (Todd, 2014) invited 100 crossposters to share their experiences. Of the respondents, 94% were female, with 87% over the age of 35. 64% of respondents reported crossposting more than 13 animals every day, with some reporting they post hundreds. Prior to the rise of social media, crossposters used email to share information about animals in shelters needing rescue, and this is still prevalent with 27% of crossposters using that method. However Facebook has taken over as the site of attention for most people, with 53% reporting they focus their efforts there. Demonstrating their connection, crossposters reported having a network built around and through flows of information about time-sensitive animal-related data. One respondent in the study reported, "I have over four thousand Facebook cross-posting friends, so it is impossible for me to cross-post everything I see, but I do manage to cross-post a lot."

Interestingly, crossposters in the survey saw their work as doing more than the practical outcome of getting animals "pulled" from shelters. They reported they believed the sharing across social media helps educate the public and raises awareness of the plight of abandoned animals, creating social change. As one respondent said, "I am not only trying to help (mostly) dogs in my area, but I'm also trying to educate people about the responsibility that they have. I'm trying to break a chain of beliefs that "it's just a dog" (Todd, 2014).

Crossposters are often involved in animal advocacy work beyond their online-focused activities. Many reported being part of other activities such as animal rescue, Breed-Specific Legislation (BSL), animal transportation for rescue organizations and other volunteer work in both online and offline sites. With such passionate engagement from intrinsically motivated people who seek to help animals through

collaborative technologies, it is timely to consider ways in which animal advocates—who are already actively engaged in social computing—might be able to help address some of the existing information collection and management deficiencies, particularly as those deficiencies become realized in disaster and emergency response.

1.3 How Animal Information Deficiencies are Unveiled in Emergencies

The deficient information collection and management practices surrounding animals in normal times become suddenly unveiled in emergencies when the socio-behavioral parameters are removed. The destruction of built infrastructure and quick changes in behavior and environment subject animals more easily to displacement. Owners and caretakers who want to be reunited with their animals are confronted with the realization that they might not have the identification information they need to enable a reunion.

Owners may not know how to begin the process of reuniting with pets or livestock. The practical aspects of reuniting owners with animals are difficult due to the pre-existing information deficit compounded by the upheaval to normal processes wrought by the emergency. Actions and behaviors that make sense in normal times such as posting flyers and contacting local animal control may be less effective in a disrupted environment. If evacuations have taken place there will be fewer local people to see flyers. Family members and rescue squads (among others) may be searching for humans, which would understandably take precedence. Additionally, those caught in a disaster event may be coping with other significant losses and injuries, which adversely impact their ability to find and claim displaced pets.

1.4 The Opportunity for Investigation

Given this complex information problem, this dissertation aims to find out how we can support people who have concern for animals with better information in disasters and evacuations. It identifies what kinds of information is needed to support the needs of people who own and work with animals in evacuations, and investigates what might be appropriate formats for the information's collection, organization and dissemination to support decision-making and cooperative work in emergency response. In particular, the dissertation considers what kinds of information related to animals in disaster appears in

the online and offline arenas. It considers ways in which that information intersects across those arenas, who uses the information, how they use it, and to what effect. In exploring these areas, the dissertation aims to find out whether social collaborative tools might be able to improve information flows around animals in disaster, and furthermore, what these findings reveal about information management across disaster response, generally speaking.

The rise of collaborative efforts through social computing technologies provides an opportunity to improve information collection and management about animals in emergency response situations, in a way that does not rely on information gathering and management systems used during normal times.

The opportunity to improve upon information deficiencies during disaster events initially requires the identification of people who are interested and motivated to help in the area of animals, and who are already active users of collaborative technologies.

CHAPTER 2. Background Literature: Animals and Emergency Response

In this review of literature, I will consider some common traits experienced around the world before narrowing my focus to the ways in which animals have been included in emergency response in the US.

2.1 The Social Impact of Animal Loss in Disaster

The grief of losing an animal in normal times can be just as intense as losing a human (Carmack, 1985), with the impact of the loss felt most acutely by children, the elderly and families (Sharkin & Knox, 2003). When that loss occurs during a disaster, it negatively affects the ability of people to recover, particularly for the most vulnerable in society, such as the elderly, children, and the disabled who rely on service animals for day-to-day living (Kilijanek & Drabek, 1979; Hunt, Al-Awadi & Johnson 2008; Lowe, Rhodes, Zwiebach & Chan, 2009; Zotarelli, 2010).

The social impact of losing animals also extends beyond these already vulnerable groups. When a disaster leads to the death of livestock, the livelihoods of people who own them are also destroyed, negatively affecting their ability to recover both emotionally and practically. For example, during the foot-and-mouth disease epidemic that afflicted the farming industry in the UK in 2001, the death of more than a million animals and the subsequent loss of farmers' livelihoods had a devastating effect on farmers and farming communities. Heightened recorded levels of depression and even suicide were sad realities that were correlated with the disaster (Hagar & Haythornthwaite, 2005). Clearly, the wellbeing of animals of *all* species is important to society's recovery after a hazard event.

Unfortunately, the effect of animal loss in disaster is not one that receives much focus. To better appreciate and address the social impact of animal loss in disaster we must raise social awareness of this issue. Media can play an important role. After the US hurricane season of 2005, media focused on the plight of animals left behind or forcibly separated from their owners, leading to changes in how animals were accommodated in US emergency response. However, media in other countries have not been as responsive. For example, in the aftermath of an earthquake in Christchurch, New Zealand in September

2010, media reported there were "no deaths," however researchers determined that more than 3,000 animals had been killed (Glassey & Wilson, 2011). The disparity between the importance of human lives and animal lives has been highlighted through work that questions humans' willingness to dismiss animals as 'property' in emergencies, placing animals on a "sociozoologic scale" that values some species over others, depending on their role in society and the situational context (Irvine, 2009).

In any case, one over-arching aim is certain: Ensuring that the human-animal bond is supported by assisting families to stay together with their animals in evacuations will help reduce the time it takes communities to recover.

2.2 The Effect Animal Welfare has on Human Evacuation

The majority of people feel their pet is a member of the family, so it is not surprising that many people refuse to evacuate their homes without their animals, or that they will disobey officials' directives and cross exclusion zones to retrieve them (Edmonds & Cutter, 2008; Heath, Kass, Beck & Glickman, 2001; Mitchell, Cutter & Edmonds, 2007; Mitchell, Edmonds, Cutter, Schmidtlein, McCarn, Hodgson & Duhé, 2005). Evacuation of people with their animals has only recently been formally recognized as an important inclusion in emergency response in the US, through the establishment of the 2006 Pets Evacuation and Transportation Standards (PETS) Act. The PETS Act is an amendment to the Robert T. Stafford Disaster Relief and Emergency Assistance Act, with authorizes the President to issue federal aid to state and local governments that have been overwhelmed by the effects of a disaster (Bea, 2010). I will now outline the events leading to the introduction of the PETS Act, and its effect.

2.2.1 Events leading to the 2006 Pets Evacuation and Transportation Standards (PETS) Act

The impact of hurricanes Katrina and Rita in 2005 gave media an opportunity to publicize the devastation of animal loss.

In Hurricane Katrina, approximately 70,000 pets were left behind or displaced from their owners because of damage to property, rapid human evacuation, and the lack of formal support for pets in evacuation procedures and human shelters. Many evacuees were instructed to leave their animals behind.

Of these, only 15,000 pets were ultimately rescued and just 2,300 were reunited with their families—a mere 3% of the total. Many animals were euthanized or simply left behind to die (Lowe, Rhodes, Zwiebach & Chan, 2009).

Mainstream media attention on the emotional devastation wrought by animal displacement helped focus public attention on the issue and contributed to a call for change. One dog and his young boy owner, in particular, became the "faces" of the forced pet abandonment issue in Hurricane Katrina. As the young owner was being evacuated, an official took his dog from his arms and threw him aside. The child yelled "Snowball" numerous times and became so distraught he threw up. Snowball was never located. Mainstream media reporting of this heart-wrenching event brought into focus the plight of the human-animal bond in a disaster. Even those who were not animal lovers were moved by the story of the child and his cute, fluffy pet. The public pressured the government to ensure this scenario was not revisited in later disasters (Beaver, Gros, Bailey & Lovern, 2006; Irvine, 2009). The government acted swiftly, passing the Pets Evacuation and Transportation Standards (PETS) Act in 2006, one of the fastest bills to pass through the legislative process in US history.

The PETS Act stipulates that people can take their companion and service animals with them on public transport in an evacuation. It also provides financial reimbursements to state and local governments that help co-locate animal sheltering alongside human shelters. However it does not provide support to reunite pets with owners if they become displaced. The Act is clear in the type of animals it covers: "'Household Pet' means "[a] domesticated animal, such as a dog, cat, bird, rabbit, rodent, or turtle that is traditionally kept in the home for pleasure rather than for commercial purposes, can travel in commercial carriers, and be housed in temporary facilities. Household pets do not include reptiles (except turtles), amphibians, fish, insects/arachnids, farm animals (including horses), and animals kept for racing purposes. 'Service animal' means "[a]ny guide dog, signal dog, or other animal individually trained to provide assistance to an individual with a disability including, but not limited to guiding individuals with impaired vision, alerting individuals with impaired hearing to intruders or sounds, providing minimal

protection or rescue work, pulling a wheelchair, or fetching dropped items" (Mike, M., Mike, R. & Lee, 2011).

2.2.2 How effective has the PETS Act been?

Even though the PETS Act has been in place for nearly eight years, just one study has sought to investigate its effectiveness (Hunt, Bogue & Rohrbaugh, 2012). The (albeit small) study, conducted after 2011's Hurricane Irene, discovered that pet ownership was not statistically aligned with evacuation failure. *However* researchers discovered some people still reported difficulties with evacuating their pets, which they said had an impact on their decision to stay. The disconnect between official support for pet evacuation and the refusal to access that help by some pet owners who fail to evacuate is curious, and I will address it later in this section.

The lack of research literature on this subject leads me to look for other ways to identify the impact of PETS Act. One useful indicator is the change in the reported numbers of pets evacuated in disaster events. During 2008's Hurricane Gustav, three years after Katrina and two years after the passing of the PETS Act, animal-focused responders converged onto the affected areas and assisted with evacuating and caring for displaced pets. The American Humane Association and its Red Star team worked with other national animal organizations in affected areas They successfully cared for 1,200 pets, ultimately sending them home with their owners (American Humane Association, n.d.). Members of the Red Star team reported they achieved a 99% reunification rate (PetAid Colorado Disaster Services, n.d.).

More recently, and closer to home, in the September 2013 Colorado flash floods, the National Guard operationalized what was reported to be the largest airborne evacuation of people in a water hazard event since Katrina, and the largest airborne evacuation of pets and companion animals to date in the US (Coffman, 2013). In this evacuation, with the motto of "No pets left behind," the National Guard conducted the evacuation of more than 800 companion and service animals by helicopter, with hundreds more evacuated by land (CBS News, 2013; National Guard, 2013).

These numbers are encouraging. However, as Hunt, Bogue & Rohrbaugh (2012) found, even with official support, not all people evacuate with their animals in an emergency.

Examination of post-disaster surveys of people who did not evacuate during a disaster reveals that some still claim that their animals were the reason they did not leave (Edmonds & Cutter, 2008; Gibbs & Hollaway, 2013). One would expect this claim would be made less often following the implementation of the PETS Act in 2006, but "a concern for the welfare of their animals" was still the reason given by a small, yet persistent number of people. For example, 2% of respondents in one Hurricane Sandy exploratory study (Baker & Downs, 2013), and 4% of respondents in the New York City After Action Report (Gibbs & Holloway, 2013), made this claim. It is curious at face value, but how *significant* is this issue? To put the numbers in perspective, these small percentages fall within the same range as people who cite "lack of transportation," and that they "didn't believe they were under an evacuation area" as reasons they did not leave.

Therefore, while a small proportion of the public still identify their non-human family members as being the reason for their failure to evacuate in a disaster, we may instead be witnessing indications of a persistent failure of human awareness and preparation rather than a lack of support being provided to them.

Why might people continue to report that their animals are the reason they do not evacuate? One contributing factor may be the design of post-event questionnaires used to gather this information. When people who did not evacuate are presented with a checklist of options as to why they chose to stay behind, they likely want to give a reason that would seem reasonable to an outsider, whether it is the truth or not.

In any case, there *does* appear to be an overall reduction in the number of people who cite their non-human family members as the reason they do not evacuate.

Given the promising numbers of animals joining their owners in evacuations, it would seem that people are more ready to evacuate with their pets rather than leave them behind, or even stay behind in an evacuation to care for them.

Having addressed the history and likely effect of the PETS Act, I will now turn to other ways response in emergency supports the needs of people and animals when they are experiencing a disaster event and are under evacuation.

2.3 Official, Organized Animal Assistance in Disaster Response

When people are evacuated with their animals, they often have limitations on where they can go. Many hotels will not allow animals, and if people are staying with family or friends, their homes may not be pet-friendly. In these situations, it may be necessary for people to shelter their animals at a designated animal evacuation site. These evacuation sites are pre-determined and managed by trained volunteers who are often aligned with different animal advocacy organizations, and with the Sheriff's office for that local county.

US states manage their official disaster animal response in various ways. The State Animal Response Team model (SART) was initiated in response to Hurricane Floyd in 1999. SARTs are interagency state organizations resulting from public private partnerships that are organized under the direction of state and local emergency management and the principles of the Incident Command System (Animal and Agriculture Response Teams, 2013; SandyCityUT, 2013).

SARTs often oversee smaller units, called Community Animal Response Teams (CARTs), which work alongside official responders to assist with the needs of evacuating animals in smaller community areas within the state. These may be county or city-based, or created in other ways as directed through the SART (S. Tate, personal communication, August 28, 2014). Response works in the same way as other emergency response efforts, with local mobilization the first step. If the hazard's demands become larger than the capability of the local team, the SART will direct services from other areas in the state to assist if required.

2.3.1 Colorado's state and community animal response teams (CARTs)

Colorado's SART began in 2003 and is managed through PetAid, Colorado's Disaster Services division (PetAid Colorado Disaster Services, n.d.). PetAid conducts training and assists each county in

establishing CARTs. Some counties (such as Boulder County) are still in the early stages of developing a CART, while other counties (such as Douglas and Elbert County) have chosen to combine their efforts to create one CART that would respond in both areas. The Jefferson County CART has been operational for over a decade. It features volunteer representatives from 12 different animal advocacy groups, and is led by the director for animal control at the Jefferson County Sheriff's office.

2.3.2 CART resources in Colorado: Material and human

2.3.2.1 Material resources

CARTs in Colorado have memoranda of understanding with facilities such as county local fairgrounds, animal shelters and equine centers, that they will be mobilized as an animal evacuation site in a disaster. Under the direction of PetAid Disaster Services, the state of Colorado also has 12 CART trailers, fully equipped with animal-related resources such as equine halters and wire crates for small animals. These trailers are under the management of the SART and are stationed in different counties, but can be directed to a specific location depending upon need.

2.3.2.2 Human resources

The volunteers who work in CARTs already have knowledge and expertise gained through their non-emergency animal-related work. In addition to that experience, CART members are also officially trained through FEMA certifications, and in animal care in disaster response with full day trainings through PetAid Colorado. CART members from any county may attend these training days, and there is often a mix of affiliations present. The range of trainings available covers everything from basic operations through to assisting at the State Emergency Operations Center at the Emergency Support Function (ESF) desk concerned with animal and agricultural response. CART members have pre-defined roles at an evacuation site, depending upon their ability, training and the needs of the site at the time, however CART volunteers may also be called upon by the SART to assist a CART that has identified a

lack of resources. Therefore, CART members must also be flexible and able to work with different people in multiple locations.

2.3.3 Colorado's CART mobilization procedures

In the event of an evacuation, the Director of Emergency Management for the affected county telephones the CART lead and directs them to mobilize an evacuation site. The CART then uses a "call tree" to bring onto the site the necessary team members needed to set up the location and prepare it for the expected incoming animals for both small and large animal divisions.

Fairground locations in Colorado often receive high numbers of many different animal species in an evacuation. For example, in the June 2013 Black Forest Fire, Kiowa Fairgrounds was managed by the Douglas-Elbert County CART. Those Fairgrounds received more than 600 animals, with species ranging from dogs and cats, to horses, goats, fowl and even yaks. Similarly, Jefferson County experienced three major evacuations in 2013, with the September flood evacuation resulting in more than 100 horses being brought to the Fairgrounds over the course of six days (A. Raschke, personal communication, October 28, 2013).

An evacuation may last hours, days or weeks, depending upon the hazard. Animal evacuation sites may receive hundreds of animals, or none at all. Members of the CART, therefore, must be as well prepared as possible for any demands.

When an evacuation event is over and the animal evacuation site has been demobilized, CART members meet to debrief and review their activity. Depending upon the size and duration of an evacuation response, the CART may meet as an individual team, or be part of a bigger meeting with other official responders such as County Directors of Emergency Management, Fairgrounds Managers and state-level representatives.

2.4 Spontaneous Volunteers in Disaster Response

The spontaneous convergence of volunteers onto disaster sites is not a new development. Sociology of disaster literature shows that a substantial spontaneous volunteer response is common

(Drabek & McEntire, 2002; Dynes, Quarantelli & Wenger, 1990; O'Brien & Mileti, 1992). When disasters happen, it is human nature to want to help. For example, the aftermath of September 11 in heavily populated urban New York City raised the profile of unaffiliated volunteers, where more than 40,000 unsolicited volunteers arrived at Ground Zero (Illinois Terrorism Task Force Committee on Volunteers and Donations, 2005). This led to officials beginning to conceive of ways to work with spontaneous volunteers, reflecting the adage that planning must be based on the likely actions people take in disasters (Dynes, 1994a).

In the incident command emergency management structure it is difficult to recruit, train and monitor these spontaneous volunteers in an immediate way. It is also difficult to identify and recruit uniquely skilled volunteers when a disaster calls for specific expertise. Officials have struggled with this issue, identifying both the potential positive input these volunteers contribute, especially during the earliest stages of a response, at the same time as despairing over the possibility they may overwhelm the capacity of officials to manage them, or worse, ignore their directions (Fernandez, Barbera & Van Dorp, 2006).

2.4.1 Animal advocates as spontaneous volunteers

Just as officially recognized and prepared organizations come to the aid of animals in disaster, so too do animal advocates who arrive as spontaneous volunteers. Sometimes animal-focused spontaneous volunteers go to animal evacuation sites to volunteer, but these well-intentioned efforts may be considered unwelcome by officials if the spontaneous volunteer has not had recognized training relevant to animal evacuation in emergency. I have already outlined that the tenet of emergency management is to orientate around the behaviors of people in emergency, so it is therefore interesting to note the difficulty officials have had in engaging and working with spontaneous volunteers.

Spontaneous volunteers wanting to help with animal welfare in disaster are often considered a *problem* by officials (Irvine, 2006). One module in Colorado's basic CART training includes a section called "Unaffiliated Volunteer Management" (PetAid Colorado Disaster Services, 2015, p.17), referring

to spontaneous volunteers as Spontaneous Unaffiliated Volunteers, or SUVs. The training recommends that one CART member be tasked with managing SUV registrations, noting whether the SUV has particular skills that might be needed. The training also says that these SUVs can be tasked with the more mundane but time-consuming low-skilled jobs such as cleaning crates, and the training recommends that CARTs create checklist directions on the proper procedure for bleaching and cleaning so they may be easily followed. Most often, however, the high demands of work and the animal-focused team members do not embrace the arrival of spontaneous volunteers. It is usual for officials to thank people for their interest and sometimes take a phone number, but ultimately refuse their entry to the site.

Being turned away does not improve the relationship between pet advocate spontaneous volunteers and officials. In non-disaster times many pet advocates are distrustful of established organizations and shelters, and believe there is a lack of transparency in the way those organizations report on pet welfare issues (White, J.I., Palen, L. & Anderson, K., 2014). These feelings are amplified if spontaneous volunteers are treated as unwelcome helpers in disaster.

This problem is not only a public relations issue. The physical and mental demands on volunteers working with animals in emergency response can be overwhelming. The decision to turn away assistance from people who want to help may result in an utterly exhausted cohort of volunteers who have no relief. While PetAid Disaster Services recommends that teams record telephone numbers and follow up after an event to offer training and an opportunity to join the CART, over the course of this research, it did not seem to happen.

2.5 The Role of Collaborative Technologies in Emergency Response

Computer Supported Cooperative Work (CSCW) research often aims to identify ways in which technologies may facilitate work processes, the design and implementation of those technologies, and their effect (Schmidt & Bannon, 2013). It is timely to look at how the use of collaborative technologies might leverage the skills of animal-focused spontaneous volunteers in ways that are helpful and

complementary to the official response effort, and how spontaneous volunteers might provide better support to other areas of animal management in disasters.

CSCW researchers have long been interested in work done in safety-critical environments such as commercial airlines and air traffic control (Juhlin & Weilenmann, 2002; Nomura, Hutchins & Holder, 2006); in train coordination such as the London Underground (Heath & Luff, 1991; Heath & Luff, 1992); and in ambulance dispatch centers (Bowers & Martin, 1999, Normark & Randall, 2005). These high-pressure environments, where fast decision-making and communications are integral to the work being done, has informed research focused on both the temporal and spatial aspects of work, and the ways coordination happens in situ.

One important part of this body of research focuses on the role social technologies play in emergency response. This literature falls into a category of Human Computer Interaction (HCI) called Crisis Informatics (Palen, Vieweg, Liu & Hughes, 2009; Palen 2014). Research in this area has considered the impact of social collaborative technologies on situational awareness (Laituri & Kodrich, 2008; Bruns, Burgess, Crawford & Shaw, 2012; Hiltz & Gonzalez, 2012; Dashti, Palen, Heris, Anderson, K.M., Anderson, S. & Anderson, S., 2014); how to verify information in social media (e.g. Tapia, Pajpai, Jansen, Yen & Giles, 2011; Imran, Elbassuoni, Castillo, Diaz & Meier, 2013; Imran, Castillo, Lucas, Meier, & Vieweg, 2014); and the ways in which these tools may assist with event detection (Cameron, Power, Robinson & Yin, 2012; Gupta & Kumaraguru, 2011; Pohl, Bouchachia & Hellwagner, 2012), data filtering (Sakaki, Okazaki & Matsuo, 2010; Tyshchuk, Hui, Grabowski & Wallace, 2012; Inoue, Toriumi, Shirai & Minato, 2011; Starbird & Stamberger, 2012; Hughes, 2014), and data visualization (Kayen, Steele, Collins & Walker, 2008; Soden & Palen, 2014; Shueh, 2014. Finally, the corpus of literature on collaboration and innovation in emergency response has included studies of both official *and* public action (Kendra & Wachtendorf, 2006; Denis, Palen & Anderson, 2014; Starbird & Palen, 2011; Sarcevic, Palen, White, Starbird, Bagdouri & Anderson, 2012; Starbird & Palen, 2013).

A range of foundational literature from both crisis informatics and the broader field of HCI will be referenced in the exploration and analysis sections in each study, contained within Chapters Four, Five and Six. It will also be foundational to the Conclusions outlined in Chapter Seven.

CHAPTER 3. Research Design

3.1 Primary Research Question

How can we support people who have concern for animals with better information in disasters and evacuations? What information is needed, and what are appropriate ways to collect, organize and disseminate it?

I have broken this large question into six smaller questions, as follows:

RQ1 What kind of information gets collected about animals; how is it gathered, managed and used?

RQ2 What kind of information about animals affected by emergency appears in online and offline arenas?

RQ3 Does the information identified gathered and shared in both online and offline spaces intersect, and what effect does that have?

RQ4 Who uses the information gathered, and how?

RQ5 In what ways does the information flow impact the work done in animal-centered emergency response?

RQ6 Is it possible to use social collaborative tools to improve information flows around animals affected by disasters?

Ultimately, what does learning about this particular problem in disaster response reveal about the challenges of information management in disaster generally speaking?

These questions are answered through three major studies that explore online, online-and-offline, and offline experiences of information and cooperative work.

3.2 Overview of Studies Used to Answer the Research Questions

3.2.1 Overview of Study One

Study One, an online study of a grassroots emergent organization formed around the needs of pets displaced from their owners in Hurricane Sandy, addresses RQ1, RQ2, RQ3, RQ4 and RQ6. In this study we saw the presence of "digital volunteers" in the form of pet advocates. These advocates turned their pre-existing strong identities to the needs of pets in the disaster. They mobilized online, using the

Hurricane Sandy Lost and Found Pets Page on Facebook as the technological infrastructure that supported their coordinated work. The ways the advocates adapted the Page to support their work, how they articulated the work to be done and organized the information on the Page provided a clear tie between the work many advocates do in an ad hoc way in normal times, that of "crossposting," and how it was adjusted to suit the needs of pets in this disaster.

3.2.2 Overview of Study Two

Study Two, a study of the intersection of information online and offline and its role in supporting the evacuation of horses following the Colorado Floods, addresses RQ1, RQ2, RQ3, RQ4 and RQ5. This study reveals how expertise was sought, articulated and actuated across online and offline worlds to enable the evacuation of 38 horses from an isolated ranch in the mountainous region of Northern Colorado following a series of devastating flash floods in September 2013. The shared expertise within a loosely connected community of practice bridged spatial-temporal limitations and afforded opportunities for practical assistance and response, both virtually and on the ground. Interaction via social media articulated the parameters of the emergent problem to be solved, and "cast a net" to find the expertise necessary to address different aspects of the perceived problem. Eventually, more than 60 people with equine expertise converged onto the ranch, bringing their materials to execute a single-day evacuation and relocation of the herd.

3.2.3 Overview of Study Three

Study Three, an offline investigation of the ways information is collected and managed at animal evacuation sites, answers research questions RQ1, RQ4, RQ5 and RQ6. By working alongside volunteers and officials in animal-focused emergency response I was able to observe the impact that onsite information and the sharing of that information offsite had on the ways in which work was done. The focus on paper-based information collection and management, with that information being transferred to others via telephone, limited the ability for responders who are not onsite to access information held by those working directly with animals.

While each of these studies individually contribute answers to the research questions, an overall analysis of what these findings can contribute in answering the primary research question form the basis of the Conclusions (Chapter Seven).

3.3 Methods and Reporting

The foundation of this research is ethnographic inquiry in the interpretivist tradition (Geertz, 1973). I used ethnographic methods to collect data across three different disaster events, as well as to record my engagement with responders through early 2015. Data gathered comprise extensive field notes, online and audio interviews, and hundreds of photographs.

I have undertaken an inductive analysis (Thomas, 2006) of these data to inform the research questions posited, using an ethnomethodological frame for analysis (Dourish, 2001). Chapter Six presents the Third and most comprehensive study. Part of the study reports on the creation of two interventions using collaborative social technologies, and the experiences these projects provided. The two projects address RQ6, on whether it is possible to use collaborative technologies to improve information collection and animal management in emergency response.

3.4 Reflections on Methodology

The use of ethnographic methods in the time- and safety-critical domain of emergency response and disaster is delicate. Gaining access can be problematic, as officials and volunteers must focus on the response rather than monitoring a researcher. The in-the-moment decisions around data collection are also sensitive, and must be made quickly. The researcher must endeavor to remain true to the ethos of "do no harm," but what this means can change moment to moment in the environment of emergency response, where problems are emergent and ill-structured, resources are few, and emotions may be high.

Of course, these are also reasons why ethnographic methods are a perfect choice for studying emergency response. Successfully navigating the selection and implementation of these methods can capture nuanced aspects of emergency work that are not easily identified through other means. In

employing ethnographic methods to study the ways information flows impact cooperative work across online and offline spaces in emergencies, I took on different roles for each of the three studies.

In the first study (Chapter Four), examining the information flows and cooperative work of pet advocates on a Facebook Page following 2012's Hurricane Sandy, I used non-participant observation to watch the actions of people on the Page, taking field notes daily. The Page acted as both a site of study, as well as a chronological repository for the data. This meant I was able to revisit and trace the ways people engaged with the information on the Page, and with each other, without having to watch in realtime. With this wealth of rich data as a source, I could then identify key administrators and users of the Page, and outline instances and activities to ask them about in interviews. Observing the Page as an online public arena meant I was invisible until I made the Page users who would be interviewees aware of my presence through my individual messages to them. This study showed how a network of animal advocates saw and worked with each other. This understanding informed my approach for the other studies.

In the second study (Chapter Five) I acted as a participant observer from a very early stage. Collecting data about behaviors of equine-focused volunteers within and across online and offline arenas called for self-identification early in the response. Not having any equine expertise, I hoped the evacuation organizer would be supportive of my research agenda and would grant me access to the evacuation day. After seeing the post on the Back Country Horsemen's site, I emailed the contact on the post saying that I was a student researcher interested in work around animals in disaster, and that I hoped to be able to attend the evacuation to take photographs, talk with people, and perhaps do interviews afterwards, as opportunities came up. I assured him that I would not want to make my presence a problem for the people doing the work, and that while I didn't have experience with horses, I would be happy to pitch in to help in any ways that were needed, and which I was capable of. Thankfully, the spontaneous volunteers and ranch owners were happy to engage me in layperson activities such as opening and closing gates, and even used my inexperience for a relaxing moment near the end of the evacuation, by convincing me to be led around a paddock on the back of one of the volunteer's horses. It was

remarkable, as all the volunteers suddenly took out their phones to take photographs of me on a horse, contrasting my activities to then, which had included photographing them as they did the work.

Gaining access to the onsite evacuation sites for the 2013 Black Forest Fire was also carefully sought. The upheaval of the early hours of an emergency response change emergency responders' usual desk-based activities to focused and often urgent activity across multiple spaces. This means emails asking for access are unlikely to be answered quickly. Instead, I called and spoke directly to the Director of Emergency Management who invited me to join him onsite. Being clear and friendly, and ready to adapt to the environment saw the start of relationship building with officials and key volunteers across the evacuation. I used my initiative to look for ways of helping. This included asking regularly for jobs, cleaning crates, washing food bowls, and staging pens for animals yet to arrive. While doing these jobs, I was often working alongside other volunteers, and had many informal conversations that helped my understanding. I audio recorded my own in-process memos (Emerson, Fretz & Shaw, 1995, p.123) as I walked around the fairgrounds, attending to tasks. The evacuation had many opportunities for photographs, and I stayed onsite each day at each fairgrounds location until the evening began, and work wound down.

I believe the key factor in each of these cases was my willingness to be flexible, and to be immersed for as long as the work took. I held no presumption on how each engagement would go. This is an important point. Any of the studies could have been derailed at any point if a key participant no longer wanted to speak with me, or if access to a site was denied. I ensured I was conciliatory and helpful, even though at times I, like other volunteers, was tired, dirty and subject to information gaps.

It is difficult to put down the clipboard and other tools, and "get dirty" with the needs of the evacuation response, especially in a constantly changing environment where an end point is not known, and misinformation and miscommunication affects the researcher as well as volunteers when the researcher takes on a participatory role. For example, I was asked to take on the role of Shelter Manager at the El Paso County site for a midnight to dawn shift. When I arrived late at night, after driving for nearly three hours, the fairgrounds were locked down, and I was unable to contact the Emergency

Operations Center, or find anyone at that hour to let me know what to do. I checked in at a small motel close by, and returned to the fairgrounds site at 7am, concerned I might have missed a message and neglected to take on my role. Instead, it turned out someone had forgotten to call and inform me that I was not needed after all. While tired, I remained onsite for the day, and adjusted to the role of researcher, which afforded access to talk with and shadow an Animal Control officer who arrived that afternoon to gather information about "left over" animals.

Relationship building with responders, both official and volunteer, was vital for the research to proceed. In numerous cases I needed to contact people multiple times, and sometimes needed to ask clarifying, detailed questions that I'm sure would have been cumbersome to the respondent. Immersing myself with the community of practice of CART teams in Colorado over 22 months helped show my interest in the teams and their work was sincere. It has been an honor to work alongside these people, as they attend to the needs of animals. My intent has been to authentically convey the work they do, and the use of ethnographic methods enabled this.

3.5 Collaborative Research and Inclusion of Published Work

This dissertation includes previously published research: The research and analysis for Studies One and Two, and one of the projects conducted and outlined in the Third study. In all cases, I was the lead author of these publications. My co-authors are as follows:

- Study One, which is in Chapter Four, is a reprint of White, J.I., Palen, L. & Anderson, K. (2014). Digital Mobilization in Disaster Response: The Work & Self-Organization of Online Pet Advocates in Response to Hurricane Sandy. In *Proceedings of CSCW 2014,* 866-876, with additional material at the end.

- Study Two, which is in Chapter Five, is a reprint of White, J. I. & Palen, L. (2015). Expertise in the Wired Wild West. In *Proceedings of CSCW 2015,* with additional material at the end.

- Study Three, which is Chapter Six, includes reporting on The Mapping Project, which is the first information support tool. This work appears here as Section 6.7.1.1.1 through 6.7.1.5.2.2, and is a

reprint of White, J. I. & Palen, L. (2015). Participatory Mapping for Disaster Preparedness: The Development & Standardization of Animal Evacuation Maps. *In Proceedings of ISCRAM 2015*. Additional material has been added at the end, combining its findings with the discussions and conclusion of the rest of Chapter Six. The rest of Chapter Six is previously unpublished work.

All reprinted, previously published research appears in this dissertation with the permission of my co-authors, Leysia Palen and Ken Anderson.

CHAPTER 4. Study One. Information Online: The Self-Organization of Volunteer Responders Concerned with Reuniting Pets with Owners Following Hurricane Sandy

4.1 Study One Summary

Study One, presented in this chapter, answers research questions RQ1, RQ2, RQ3, RQ4 and RQ6. Existing literature has already established that people come together online in disasters, just as they do physically at sites affected by disaster events. In Study One, we see the presence of these digital volunteers in the form of pet advocates. These advocates turned their pre-existing strong identities to the needs of pets in the disaster. They mobilized online, using the *Hurricane Sandy Lost and Found Pets Page* on Facebook as the technological infrastructure that supported their coordinated work. The ways the advocates adapted the Page to support their work, how they articulated the work to be done and organized the information on the Page provides a clear tie between the work many advocates do in an ad hoc way in normal times, that of "crossposting," and how it was adjusted to suit the needs of pets in this disaster.

The text contained within Sections 4.2 through 4.8 is a reprint of White, J.I., Palen, L. & Anderson, K. (2014). Digital Mobilization in Disaster Response: The Work & Self-Organization of Online Pet Advocates in Response to Hurricane Sandy. In *Proceedings of CSCW 2014,* 866-876. This reprint appears here with the permission of my co-authors, Leysia Palen and Ken Anderson. I will now present this study and then conclude the chapter with reflections on how this study answers the research questions.

4.2 Study One Introduction

Much attention has been paid to the possibilities of "crowd computing" (Kittur, Nickerson, Bernstein, Gerber, Shaw, Zimmerman, Lease & Horton, 2013; Rotman, Vieweg, Yardi, Chi, Preece, Shneiderman & Glaisyer, 2011), including how it might be used effectively in disaster response (Barrenechea, Barron & White, 2012; Starbird & Palen, 2011; Starbird & Palen, 2013; Vieweg, Palen, Liu, Hughes & Sutton, 2008). This study examines how crowd work emerged naturalistically in the 2012 Hurricane Sandy event. In the domain of pet advocacy, the latent potential for crowd interaction comes from intrinsic and extrinsic motivations. In this study, we focus on how that potential was transformed

into a viable form of distributed, decentralized cooperative work. We combine practice-and structurational-based understandings of human action (Orlikowski, 2000) to show how work practice and mechanisms of self-organizing interact with one another. In this space we see where the features of the environment, the varying skills of the convergent crowd, and the problem of pet displacement created by the event come together to articulate a socio-technical cooperative work environment.

4.2.1 Pets & disaster

Pets and their "owners" are unheralded sufferers in disasters. For example, in 2005's Hurricane Katrina, approximately 70,000 pets were separated from their owners due to property damage, rapid human evacuation, and lack of formal support for pets in evacuation procedures. Of these, only 15,000 pets were rescued and just 2,300 were reunited—3% of the total. Many were euthanized or left to die at great emotional cost to families and financial cost to the state (Irvine 2007; Lewis, 2006; McCully, 2007).

4.2.2 Pet advocacy

Like other "convergers" onto a disaster (Fritz & Mathewson, 1957; Hughes, Palen, Sutton, Liu, & Vieweg, 2008; Kendra & Wachtendorf, 2003; Starbird & Palen, 2011) pet advocates are present in both the physical and digital disaster scene. They bring their existing knowledge and very strong identities as advocates to assist in the disaster cause (Barrenechea et al, 2012). In non-disaster situations, pet advocates have taken to online activities in what Golbeck calls "passion-based networks" (Golbeck, 2011). Message boards and forums were early internet destinations that remain highly frequented locations for pet advocates. However, like other topical groups that organize online, how they might mobilize into action is of great interest to researchers, particularly with respect to today's social media use where the differences between activism and "slacktivism" are in debate. "Slacktivism" (Gladwell, 2010) refers to the observation that online advocacy in its simplest forms (such as collective profile changes and the simple passing on of information to show support for a cause, which happens frequently in pet advocacy) has unclear benefits to the causes themselves (Lee, Y-H & Hsieh, 2013; Obar, Zube & Lampe, 2012; Rotman et al, 2011). However, the conditions of disaster response call upon advocacy in temporally accelerated

and constrained ways that allow examination of how loose coalitions reorganize to engage in coordinated work—an important element of mobilization.

We examine a central online site for pet activism during and after Hurricane Sandy, which made US landfall on 29 October 2012 in New Jersey, exacting its worst damage there and in New York. How people's online advocacy is reshaped and restructured within a digital environment (Atkinson & Ayers, 2010) to support both centralized and decentralized forms of distributed, cooperative work is the topic of this study.

4.3 The Pet Problem in Disasters

The impact of a disaster greatly increases the number of pets that enter shelters. The hazard event itself can disrupt the physical environment—fences are compromised and windows are broken. Pets might be scared by the hazard and run away. Their owners may not be able to return home, or perhaps assume temporary accommodations where pets are not allowed. Rebuilding efforts can further compromise the built environment because the usual security measures are looser. For areas in great distress, people might simply be unable to care for their pets.

The loss of a pet from a disaster may increase the risk for mental health issues (Irvine 2007; Kilijanek & Drabek, 1979; Lowe et al, 2009; Mileti, 1999). A study of pet-owning survivors of Hurricane Katrina found significantly higher levels of acute stress, depression, and post-traumatic stress disorder in those who lost their pets than those who did not, even when controlling for the other effects of the disaster (Hunt et al, 2008). In addition to devastating emotional loss, the logistical consequences of lost pets to the region can be high: Animals must be gathered, transported, sheltered, fed, fostered, and re-homed if possible. Following the 2005 Hurricane Katrina event, the US government passed the PETS Act (Mike, M., Mike, R., & Lee, 2011) to help address the multi-faceted problems of pets in disasters. The Act has spurred improvements in the treatment and logistical management of animals although it has not been a panacea for large disasters where the problems are vast. The most reliable method of pet-family matching during non-disaster situations—microchipping—depends on proprietary software, and on owners to

update phone and address details, which are major obstacles to seamless reunions in the aftermath of disasters.

The effects on pet welfare during Hurricane Sandy were far less than in Katrina, but nonetheless were still significant. One of the difficulties faced by both pet advocates and emergency managers is that so little comprehensive information is available about the pet population after disasters (Gibbs & Holloway, 2013). At the time of writing, nine months after Sandy made US landfall, partial data helps explain the magnitude of the disaster's impact on pets and their families. The Humane Society deployed more than 140 paid and volunteer staff, assisted with the rescue of more than 350 animals, and cared for more than 700 total animals in their shelters—400 of which were reclaimed by owners. In the initial days of Sandy, The Humane Society's 24-hour hotline received more than 900 calls (Humane Society of the US, 2013). The American Society for Prevention of Cruelty to Animals (ASPCA) reports that its combined response helped more than 30,000 pets in NY and NJ alone (ASPCA, 2013). Usually, distrust of established organizations pervades grassroots pet activism even during times of normalcy. This distrust interacts with the disaster response in ways that influence advocates' behavior. In particular, some advocates distrust how sheltering organizations manage pets. According to ASPCA, 5-7 million pets enter animal shelters nationwide annually, and 60% of dogs and 70% of cats are euthanized. The Animal Care and Control group and the Humane Society promote positive stories around their pet management practices, and scholarship adds further to this conflicted space, describing the "neat and tidy" picture offered to the public as obscuring the issues that arise with the enormous number of unwanted and stray pets (Irvine, 2003; 2004a). A 72-hour stay is the minimum required time that an animal be sheltered before euthanasia, although some are euthanized earlier if they are judged to have health or behavioral problems. During disasters, however, a large number of pets—who are otherwise wanted—are newly subjected to emergency shelters. Pet advocates therefore feel that it is urgent to alert rescue organizations to "pull" the pet from the shelter and help it find a "forever home" during what is perceived as the critical 72-hour window.

4.4 Objective & Theoretical Approach

With respect to the online response to Hurricane Sandy, the pet advocacy community participated in ways that echoed earlier events, such as the appearance of social media accounts, Facebook Pages and Groups. However, the nature of the volunteer response to disaster is changing in often observable ways with each event, and *The Hurricane Sandy Lost and Found Pets Page* on Facebook, a central place of convergence, captured an important state change in pet advocacy response that is worth investigating from cooperative work and self-organizing points of view.

The decisions made—even when seemingly small—on this Page to organize the information about lost pets interacted powerfully with the existing, but ad hoc, work of online pet advocates ("crossposting"). The yield of this combination articulated a new form of work for pet advocates, which helped to realize the potential of organized collective behavior through volunteerism in disaster response.

Following Orlikowski (2000), this analysis unites both practice-based (Suchman, 1987) and structurational-based interpretations of coordination and social organization (Giddens, 1984) to understand the nature of collective work in large, distributed, and emergent groups—groups that have some existing common motivation to help but have little prior precedent for how that work might be conducted (Kreps & Bosworth, 1994). By examining work practices, and tracing how those practices are reified in the social-technical organization of a group that is forming and stabilizing *as they do the work*, we learn not just what this particular group did, but also how the mechanisms by which collective action in digital environments are organized bottom-up. We also learn how those lessons are graduated into prescriptive top-down direction to sustain and direct future action.

4.5 Methods

Data collection primarily took place in the form of ethnographic, non-participant observation of the Hurricane Sandy Lost and Found Pets Page over seven months from October 2012 to May 2013. In keeping with the ethnographic method of both collection and analysis, we digitally captured interactions and took extensive field notes about user and administrator behavior, including features of their

communication, collaboration, and organization (Harper, 2000). To supplement, we collected basic statistics about the Page using Facebook's Graph API to pull available data into a relational database. The data collected are specific to Timeline Posts, Album Photos, Likes, and Comments for the same seven-month period.

To ascertain reasons for behaviors that we could not directly observe, we followed up with an "email interview" to informants who, based on their observed activity on the Page, could speak to decisions that were made by members and administrators of the Page individually and collectively. These open-ended questions queried issues common across all participants, including elements about their pet advocacy as well as their disaster response backgrounds. In addition, a second section was tailored to each participant to deeply inquire about their observed role on the Page. We initially contacted Page administrators and active non-admins for a total of 38 people. Twelve people (three administrators and nine non-administrators) followed up with first-round responses to the email interview. Most respondents offered extensive responses, which supported the ethnographic quality of the investigation. Additional questions were sent after initial responses came in to clarify and elaborate points, just as in an offline interview. In one case, follow-up came in the form of a telephone interview per the participant's request. Finally, one of the administrators made critical measures from the Page analytics available. As an ethnographic investigation, the analysis uses a grounded, immersive, data-driven, triangulated approach in the interpretivist tradition (Denzin & Lincoln, 2011).

4.6 The Hurricane Sandy Lost & Found Pets Page

4.6.1 Origins

The Hurricane Sandy Lost and Found Pets Page was launched on 28 October 2012 (Figure 1). Sandy was expected to cause a great deal of damage on the US eastern seaboard; landfall was known to be imminent by the storm that a day earlier had made landfall in Jamaica and Cuba. By 28 October, Sandy was already the largest Atlantic storm on record. After making landfall in New Jersey on 29 October, the storm exacted the worst of its damage there and in coastal areas of New York, with total

damage estimated at more than $50 billon by the time it dissipated on 31 October (FEMA 2013; Sullivan & Uccellini, 2013).

Figure 1: Cover of the Hurricane Sandy Lost & Found Pets Page.

As Hurricane Sandy approached on 28 October, the founder of the Hurricane Isaac Lost and Found Pets page appealed there for "someone to create a page similar to this one but for Sandy" with a request to "…please comment here so we don't have a million different pages…so that it can be organized and people can add each other." Within a few minutes of the first share of this post, the newly created Hurricane Sandy Lost and Found Pets Page added a comment saying, "Done."

The Sandy Page founder lives well outside the affected region, but had experienced Hurricane Katrina and the pet loss in the aftermath of that event. She is also connected to numerous animal rescue and advocacy groups online. The Page About section states:

Posting photos of lost or found pets in the areas affected by Sandy, as well as posting animal shelters in need and temporary shelters that allow animals. We are animal lovers and advocates trying to help with networking to get animals reunited with their families. We do not accept donations here nor can we direct you to a specific organization to donate to. If you post to our wall, your information may be shared so please keep this in mind before posting information you do not want shared

The elements here are important. First, the Page describes itself as a place for the posting of photos. As we explain, photo posting is one of the primary tasks taken up by a segment of pet advocates outside of disasters such that the very act of posting photos is tied quite strongly to the identity of pet advocacy. Second, the Page makes clear its role as a place for connection between people helping and searching for pets. Members reinforced early and often that the Page serve as a kind of hub that authoritatively organized information on behalf of the dispersed Sandy-related pet work happening across the social web. This, we believe, was to compel not just the Page's value, but the value and meaning of pet advocacy disaster work in general. Third, implied here and then clarified in posts, the pets represented on the Page were distinct from the numerous pets already in need of help. Members had to educate some advocates that animals lost in Sandy did not happen out of negligence: some pet advocates admonished owners of lost pets without appreciating how damaging a storm like Sandy could be to both pet and human welfare.

4.6.2 Membership & content volume

On 31 October 2012, three days into the Page's launch and two days after Sandy made landfall, the Page reached 6,000 Likes. By mid-November, it had achieved and then maintained more than 25,000 Likes with continued growth through 5 May 2013 to 28,436 Likes.

The Page had 12 administrators over its life, with six core administrators persisting as primary administrators. More active members would be invited to be administrators, and many of the decisions that shaped the direction of the Page—and therefore the work of the Page—were made by these members. Other administrators rotated out when they could not be active. All administrators (former and current) are female.

In terms of magnitude of activity, 6,683 unique users commented on the Timeline posts, and 3,932 unique users commented on the Photo Albums of the Page (a separate section where a significant amount of the "pet matching" work was done). Most of the active members appeared to be female, gathered from account names and interviewee responses. Page members produced the content shown in Table 1.

Number of Timeline Posts	1,572
Number of Comments on Timeline Posts	24,509
Number of Albums	25
Number of Photos in Albums	1,061
Number of Comments on Photos in Albums	10,639
Number of Comments Made by Admins	4,280

Table 1: Number and types of Page content.

4.6.3 Early organizing & activity

The site was initiated as a Facebook (FB) *Page* rather than a *Group,* which carry different affordances. FB Pages were first designed to support official presentation of organizations or public figures. A FB Page is visible to everyone on the Internet. People simply need to "Like" the Page for posts to appear in their own timeline. FB Pages feature five different administrator roles, each with different permissions. FB Groups are intended for small group communication and can be set up to be public, private, or secret. Unlike Pages, posts in Groups can be made by any member. FB states that Groups are most successful when the number of members is kept small. It is not possible to transfer a Group to the larger scope of a Page after the fact.

4.6.3.1 Elicitation of goals & connection to implementation

Within the first 24 hours of the Page's founding, people began posting suggestions about how to structure the Page, sometimes tagging others to attract them to the Page and to solicit their advice. The founder demonstrated an understanding of the impact this kind of disaster had on pets, which informed decisions about how to organize the Page's operations. After a person who belonged to more than 70 pet-focused FB Groups/Pages suggested that different Pages be dedicated to each State affected by the

disaster (much as other pet advocacy is organized outside of times of disaster), the founder explained that administration would be too difficult under that kind of architecture:

> Also if animals are left behind and rescued or get lost during the evacuation it is quite possible for them to be located in a different state from the owner. That was the situation with Hurricane Katrina and to a limited extent with Hurricane Isaac.

This early decision to maintain one Page also foreshadowed that the founder envisioned it as a destination for the information-sharing work of pet advocates rather than the usual bulletin board-like waypoints of other sites that field sometimes repetitious information posting. We discuss this point at further length in the *From Advocacy to Action* section.

4.6.3.2 Adapting practice to design constraints

The administrators established policies early on to direct practice. People were asked to provide as much detail as possible about lost pets. Early users tagged themselves (and sometimes each other) in photos of lost pets so that they would receive automatic notifications when someone asked a question or perhaps suggested a match. Members also asked owners of lost pets to tag themselves in photos to self-track the work being done on their pet. These were the initial steps of an improvised case management system.

4.6.3.3 Division of labor

People started becoming administrators in order to distribute labor and responsibilities, which is a critical step in the self-organization of loose coalitions (Kreps & Bosworth, 1994). Four days into the Page's life, as more people became administrators, one initiated the practice of adding initials to the end of each post they made to differentiate from each other and to internally organize their work. This practice was immediately adopted by other administrators. In addition, the administrators set up a Facebook Secret Group that was "filled with spreadsheets" (Interviewee 10) that contained personal contact and address information about foster-offer homes, as well as lists of URLs that tracked from whom and where pet information originally came. They discussed ideas and created files noting work that needed to be done.

When those tasks were completed, the files were deleted. In addition, the administrators communicated using email and phone.

The administrators described the following tasks as part of their work over the life of the Page: Answering private messages, answering comments under photos of lost pets, creating flyers, contacting pet owners for follow-up, deleting duplicate pet entries, organizing pet photo albums, organizing pet transports, and going out "old school" to areas that did not have electricity or access to the Page with paper flyers to post on trees and telephone poles.

4.6.3.4 Establishing relevance to achieve a broader network of support

In the first two days of the Page's life, multiple other pet-advocacy pages on FB shared the Page with their own communities. Mainstream news outlets around the world covering Hurricane Sandy also included reports about the Page, tying it to stories of reunion and rescue (e.g. Churchill 2012; Ng 2012; Peterson 2012). Such campaigning helped to meet the objective of establishing a larger network of people who could be on the lookout for missing pets or for matching lost-to-found pet photos.

4.6.3.5 Organizing around roles

In addition to the administration of the Page and the articulation of the division of labor (Kreps & Bosworth, 1994; Schmidt & Bannon, 1992), we characterize the visible work of the Page as a set of behaviors originally based in acts of simple photo broadcasting (that many engaged in), which were then extended to more cooperative work that expressed more durable objectives. We describe the transition between these interactions and how they structured the environment (and vice versa) below.

Many people participated within the "long tail" of Page interaction. Of the thousands of people who "Liked" the Page, many did nothing more. However, others minimally engaged in Liking or Sharing photos of Timeline posts. By "Liking" a photo, it would show up on that person's Timeline for their FB friends to see (and was the only mode of sharing on mobile devices at the time). "Sharing" (that is, choosing the Share link) was more deliberate, but had the same effect across all devices of making the photo visible to FB friends. Some commented to say that they shared a pet's photo, and several used the

convention of typing just "s" (for "shared") that had previously been adopted by online pet advocates in non-disaster efforts. This mild engagement served the function of distributing information about lost and found pets, a necessary condition for the more elaborate "matching" and case management work that followed.

Administrators encouraged members to work with the content of the Page beyond their normal pet advocacy activities. Some members who had breed- or species-specific interests would work on advertising and trying to match up those particular animals. However, active members made appeals asking that everyone work on both dogs and cats, regardless of personal preference. Recall too that a few members admonished owners who lost their pets in the disaster. These characteristics signal how strong some incoming identities were—they were advocates aligned to the animals rather than the owners. Others who were more familiar with disasters made appeals to suspend individual predispositions found in everyday advocacy (Golbeck, 2011) and instead apply broad concern to all pets and owners.

4.6.4 "Crossposting" as page launching point

Of critical import to the understanding of both the origins and the progression of the mission and organization of the Page are the members who identify as "crossposters." Crossposters are pet advocates who deliberately crosspost information about pet issues from one site to the next. This straightforward task—and the strong identity that happens to be associated with it—is the taken-for-granted work upon which the Page rests. Curiously, although crossposting has been discouraged since essentially the birth of the Internet—early Usenet groups dealt with the issue of repetitious posts in FAQs, and some sites today ban crossposting in their Terms of Use. Pet advocates, though, view their form of crossposting *as favorable and central to their identity*. Some crossposters have set up special personal accounts dedicated to crossposting pet information, naming themselves "Francie Downey-Crossposter" or "Mary Crossposter Smyth." Crossposters connect with each other, and a few crossposters publicly collate the names and social media accounts of other crossposters—believing that "crossposting saves lives." Interviewees write:

"The more people share a post, the more likely the person who lost/found the pet may see the post OR the more publicity a pet that needs a home gets the more likely he is to find that home." [P12]

"What we do is have our friends who are with rescue groups all over the United States, animal lovers, [and] shelter volunteers send us pictures of dogs and cats who are more than likely to be killed at any time…when I share the photos a rescue group in that area [it] may save that animal, or a person wanting to adopt will see the animal and adopt, or [one] of [my] 5,000 friends will share my post to their friends and it continues to be posted by others."[P8]

The strong identity of online pet activists as crossposters—a term that seems reserved for use within the pet activist community—is critical here. Crossposting was the basis of the emergent group (Kreps & Bosworth, 1994). Crossposting was nothing new for pet advocates, but what *was* new for them was managing the sudden flood of lost pets in a region, and understanding how disasters affect people and pets. Also new was the realization that the likelihood of finding matches between lost and found pets was far higher than normal, because the animals were accidently and suddenly displaced—not surrendered. This difference between routine crossposting and the information-sharing that could happen on a site built for the special conditions of disaster, transforms, we propose, activists' understanding of what they can do and achieve in their online advocacy work.

4.6.5 From advocacy to action

The desire to assist those affected by disaster events is broad (Hughes et al, 2008; Kendra & Wachtendorf, 2003), but the mechanisms for enabling action in the form of online work or commitment, as with other causes, can be unclear (Lee & Hsieh, 2013; Obar et al, 2012; Rotman et al, 2011). In addition to the socio-psychological methods for motivating action, we must consider what kind of socio-technical features and mechanisms create an environment that supports transition from latent potential to cooperative work.

We see the information architecture for this Page as a turning point in how simple online individual pet advocacy was transformed into cooperative work. Pet information is strongly visual—reports of missing pets without visual information are far less useful and far less likely to be propagated. Crossposting as a pet advocacy practice seems to have arisen after the advent of "Web 2.0" when photos could be very easily uploaded to message forums and social networking sites by most users. The ease

with which photos of animals could then be distributed to find a willing adopter gave rise to the role of the "crossposter" in the domain of pet welfare. Curiously, "crossposters" of this positive kind seem to exist only in a persistent way in the pet welfare world.

We explain below how the administrators re-organized photo information posted by others to catalog the pets they were helping and to organize the work done around each pet. These acts of organization of visual data for crowd work transformed the simple activity of crossposting—which is all about posting early, often, quickly, and widely—to include cooperative tasks that more persistently focused on each pet in an improvised case management system.

4.6.5.1 Albums

From the Page's beginnings, the Page founder took information posted to the Timeline and organized it into Photo Albums, a feature that FB supports for its Pages (see Figure 2). Facebook automatically creates three albums when the founder uploads any image: Timeline Photos, Cover Photos, and Profile Pictures. Page administrators can add more albums. During the first few days of the Page, administrators focused on listing the pets reported as lost, found, or reunited in the different location-based albums, based on the information posted to the Page timeline by crossposters.
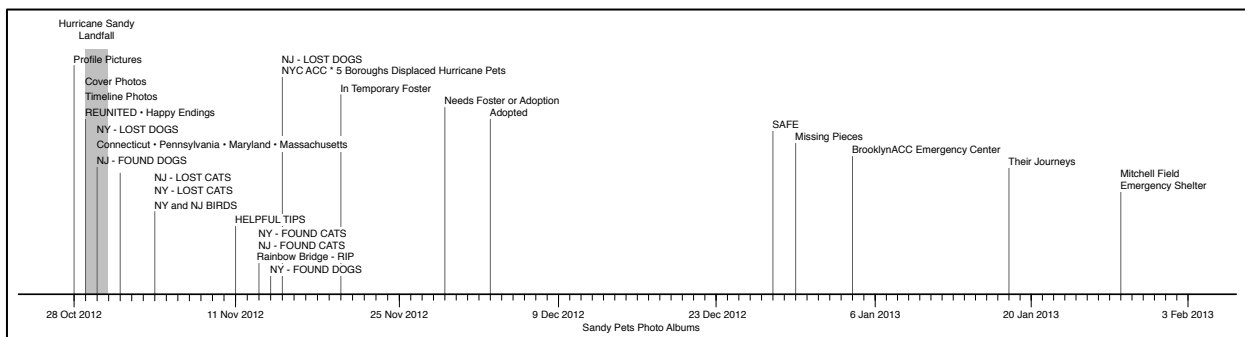
Figure 2: Timeline of photo album creation & flyer invention.

We note that one member who was active in thinking about the information architecture of the Page was invited to be an administrator because of her ideas about information management. Adapting the design constraints of FB, she customized the album faces to make the collection a clear destination for

43

online work. Rather than use the FB default of the most recent photo, she created graphics for button-like navigation (Figure 3). We note, too, that the graduation of active workers to the administrator role demonstrates that the membership itself was based on a strong work-driven model.
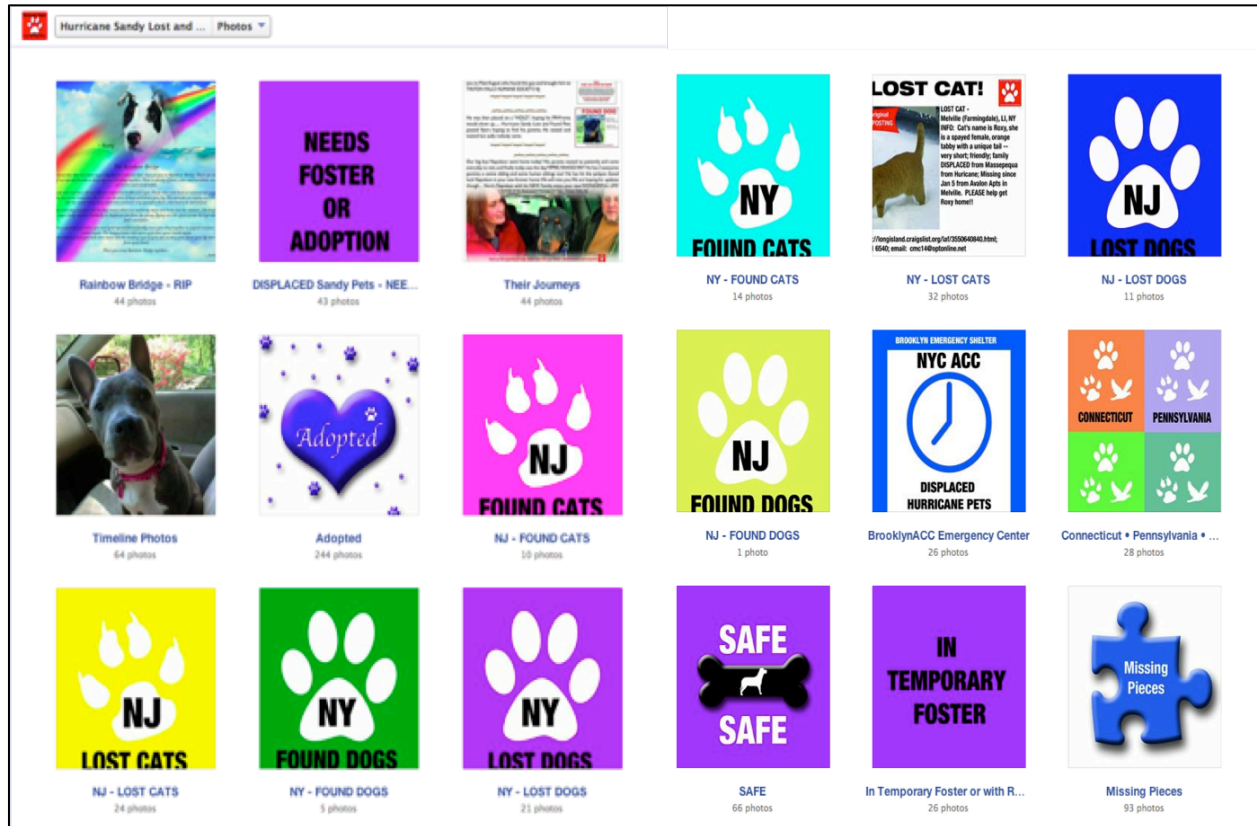
Figure 3: Photo albums.

The first album created was the "Reunited/Happy Endings" album, which shows an orientation to making sure that old information about previously lost pets was not propagated. It also shows an orientation to the goal of matching lost pet photos with found pet photos and achieving resolution. At the end of the 7-month observation, the Reunited/Happy Endings and the Adopted albums were the largest on the site with 208 and 246 photos respectively. In interviews, the more active members said that they would work until all the "hurricane kids" found homes.

Other albums created in the Page's first days reflect early suggestions by members to organize multiple Pages by State and animal type. Instead that architecture was incorporated internally into albums

in the single destination page: NY - Lost Cats, NJ - Found Dogs, etc. There were 10 albums of these types created by 15 November. The admins added others on topics for which people sought information for a total of 25 albums.

The administrators constantly updated the albums as a way of organizing incoming information about lost and found pets. When a case was resolved (that is, a pet was matched, reunited, adopted, or found deceased), the administrators moved it to the appropriate album. This information management demonstrates a strong commitment to the arc and completion of the work. The albums as an information architecture for visual information brought the reasons for crossposting work into focus.

However, this organization also implicitly challenged the goals of some crossposters, which are to post often and widely. When people were found to be posting pet information about animals that had already been organized into an album, the administrator deleted the replication posts "so as not to miss any [new] pictures or posts." The Page made this policy public with a post saying they did not want to offend anyone, which received 65 likes, but also received two comments from people who stated that they were trying to make the information "as visible as possible" to counteract that pets had been filed away "on the forgotten list." The crossposting principles that the Page was set up to foster were then challenged because the Page effectively solved a problem that crossposters usually face—that of the ephemerality of posts. The information architecture of the Page was organized in a way that enabled information to persist and for pet advocacy work to shift from individual ad hoc crossposting to the more collaborative efforts of "matching" lost/found pets.

4.6.5.2 Flyer templates

Another critical element to support the information architecture of visual information was the introduction of "flyers" that used a template to describe each pet that was lost by an owner or found by someone looking for the pet's owner. When possible, it included a description, location, contact, information about prior crossposts, and the original source of the information. A member who graduated

to administrator took the lead on creating flyers that were "easy to read" and fit standard American paper sizes for printability and postability on trees, sign posts, and so on (see Figure 4).

Figure 4: A standardized flyer used to represent each pet case in the photo albums.

This work began on 2 November. Then, critically, each flyer was put in the relevant album, effectively creating a more navigable case management system. This action kept all the relevant information about each pet within the image of the post, ensuring all the details were kept every time the images were shared on Facebook, so people seeing the image did not need to click on it to open additional information attached to the image. A participant explained in an interview the effect this had on the organizing functions of the site:

> "When you have crossposters, you might get the same image from 8 different people. By creating our own flyer, it identifies for me right away that we already have this animal. I know we already have it, it's in an album, it's being shared. I think it's a draw for the page, but it also shows us that we've already got it." [P10]

The idea that they "had" the animal indicates that they had cataloged it and formally incorporated it into their production functions. It also suggests a kind of caretaking concern in two ways: 1) that the flyers were a kind of proxy for the pets and that they were being accounted for, and 2) that the

responsibility of the site was to be a useful terminus for crossposted information that otherwise pings around uncertainly in the ether. The admin posted on 3 November:

> EXHAUSTED! I will continue to make flyers and post in the am…I have not blinked, moved or eaten today because I wanted to get these stories shared. Thank you all for crossposting/sharing so we can have happy reunions. That's what it's all about right?

4.6.6 Matching work & connections to the ground response

The organization of the flyers in albums and a consistent effort to ensure that details from crossposters were correct set the stage for an element of work that connected the online advocacy with on-the-ground usefulness. The posts containing the flyers were the micro-places of work coordination; even when photos were moved between albums, the commenters could "stay" with the pet.

4.6.6.1 The rise of "matching" work

On 1 November, one day after the storm dissipated and three days after the Page launched, an administrator posted:

> Please help try to match pets. Look at photos of lost and found pets and try to help match them. You can do that from anywhere. I am in <a far-away State> and may have matched two within the last hour.

This is telling because the idea of "matching" pets between the lost photos and the found photos (that is, pets found by someone other than their owners) was not common practice. Some crossposters seem to do this, but it was not an explicit or well-articulated task. Crossposting seems largely focused on rescue activities and amplifying messages of help (because during non-disaster times, most pets are voluntarily surrendered and then need to be rescued by someone else). The idea that their work could lead to reunions was new enough that it got a response: 169 likes and 41 shares. Ten members wrote in support, indicating that it was not something they had thought of, saying: "OMG...that's awesome" and "Great idea!"

Some needed additional information about how to go about matching. Someone replied:

> you need to look real close at markings but just making someone aware that there is a similar match around is good. Never know it could be the same one.

Another member suggested that the scope of the matching work could be broad, and that people could look on findtoto.com and Craigslist for matches. Such comments reinforced the idea that the Page could serve as a matching hub for the much larger world of the internet. The administrators would move pets to one of the end-story albums no matter how or where the match happened online.

After this initial period, it became standard for people to work within the albums on individual pets to identify matches. People made suggestions for matches, and conversations ensued over their likelihood. The suggested matches were given to the contact for each pet listing for follow up. Often the owner of a lost pet would give feedback by commenting on their pet's post. Before a pet's flyer was moved to the Reunited Album, members sought proof of the resolution (similar to other verification tasks in disaster-related problem solving (Vieweg et al, 2008)).

An example was the case of "Butterscotch," a male orange and white tabby cat missing since 29 October from one of the hardest hit areas of the hurricane: Breezy Point, New York. Butterscotch was posted in the "NY - Lost Cats" album on 9 November. The post received 254 shares, 92 likes, and 32 comments. Many comments pertain to matching work, with suggested matches to pets elsewhere on the Page as well as on other online sites. The comment stream ran until 11 April, with members and administrators giving feedback about the match suggestions. The updates showed the Page was invested in sustaining the community that had mobilized around pet matching.

4.6.6.2 Connections to on-the-ground response

Some of the work connected to the physical search for lost animals. Analysis of posted data and interviews reveal that non-administrator members who were geographically local to the disaster went to the neighborhoods of lost pets to distribute flyers. One Page member explained in an interview how she corrected information and translated the work of remote volunteers into meaningful work on the ground:

"As I was sharing posts from the page, I would often notice incorrect information. Things like flyers with "Neptune, NY" on them, when I knew Neptune was here in NJ. So I would comment on those posts to have them make corrections... At the time, I didn't realize the people volunteering behind the scenes on the page weren't locals! So they had no sense of which town was where, or what areas were close to others. They started asking me questions about specific missing animals - "Could this found cat in ANYTOWN be the same one that is missing from OTHERTOWN?"" [P3]

"Napolean," a Rottweiler, was found in the Cliffwood Beach Area of New Jersey. Before he was captured, he was added to the Page's Albums with a picture of just the dog's paw print and "search and rescue needed" (Figure 5). Eventually, Napolean was captured and housed by someone who knew to report about his case on the Page. People then shared a new photo of Napolean so that he could be matched. He was suggested as a match for other missing Rottweilers, but these were never correct. However, because of the public work on this case, a family came forward to adopt him when his owner could not be found.
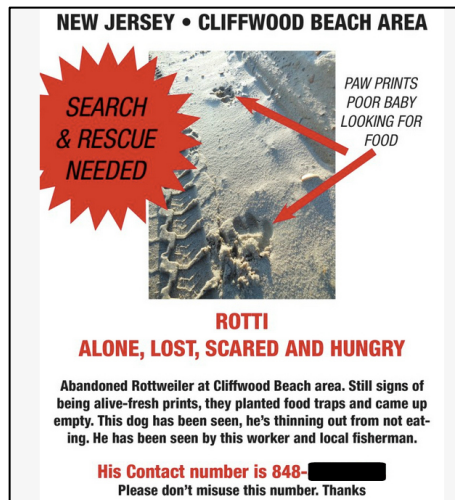
Figure 5: Napolean's flyer.

The matching work still rested strongly on the idea that crossposting spread news of the plight of animals far and wide, as the person who helped find a missing dog posted:

I just want to thank everyone again for all the cross posting. Without it, this dog might never have found his parents. The final sharing total was over 11,000 posts. Thank you everyone!

Disaster management designates the post-rescue stage as "recovery," which extends over a long period. Long-term recovery efforts can be hard to sustain for digital volunteers (Starbird & Palen, 2013) even though their subjects of interest are still affected. Users engaged with the Page were involved in long-term on-the-ground recovery work: Three months after the hurricane, temporary shelters to house pets whose owners were most in need began announcing closures. Only about half the owners returned. One of the Page administrators who was volunteering on the ground offered to create a Page album to help the pets find homes. With the assistance of Page members, many were adopted. The interviewee said that this experience helped "to grow our network even bigger" (Participant 10).

4.6.6.3 Offering resolution

The Page community's commitment to the successful homing of the pets is seen in the steady growth of the Reunited and Adopted albums. The Reunited album, created on 29 October, had more than 200 posts and is matched in size only by the Adopted album. News of reunions was encouraging to workers, as a poster wrote: "that's just wonderful!...several of us have been scanning the pics looking to match the lost/found pictures!!"

Curiously, many people appeared to believe the Page was critical in the reunion of pets with owners, even though matching work included links from other online sources, and even though very few of the culminating narratives written about the pet directly identified a match made on the Page itself. In interviews, administrators and members alike were unsure of the number of successful matches made on the Page. Although all felt matches happened, none had a readily available record. Nevertheless, people believed that the reunions of pets with their owners happened as a result of the Page, which likely encouraged people to persist in the face of a difficult, uncertain task:

Out of all the FB posts, this site is my favorite. You can see results. This is amazing how people have taken the time out to help. Truly amazing and I cry every time I see it work.

The administrators created more albums and updated flyers to provide a conclusion to the pets' "journeys," which we believe had the strong effect of showing an arc of collective work toward some completion. The "SAFE" album collected information about animals successfully "pulled" by rescue organizations from shelters. The Rainbow Bridge RIP album memorialized pets that died either directly because of the hurricane or because they were euthanized. The pets' completed stories often were told in a narrative compiled from the comments made by members, another instance of reinforcing the importance of collective action (Figure 6).

Figure 6: An end-story narrative flyer.

4.6.7 Propagation of the organization

During the final writing of this paper, an EF5 tornado devastated the town of Moore, Oklahoma on 20 May 2013, killing 24 people. People from the Sandy Page are part of a similar effort for the pets of Moore, and their stated mission represents an evolution with a new claim to be "trained 'online' first responders:"

…a group of volunteers who utilize social media and other offline resources to help reunite lost pets with their owners in the aftermath of disasters.

We combine our talents and knowledge, gained from reuniting families and animals after other disasters, such as Katrina, Joplin, Sandy, the Bastrop Wildfires, and the North TX tornadoes and most recently the West TX Fertilizer Plant Explosion. You might say we are trained "online" first responders.

The Moore Oklahoma Tornado Lost & Found Animals Page was launched employing similar practices that developed over the course of the Sandy Page. An administrator said she ensured that it began with separate albums and a consistent look to the flyers, just as the Sandy one evolved to. A few members of the Sandy Page began to suggest possible matches on the Moore Page. We see early evidence in this of an attempt at sustained self-organization with repeating patterns of coordination (Dynes, 1970; Kreps & Bosworth, 1994; Starbird & Palen, 2013).

4.6.8 Post-event accounting: How many hands?

With thousands of commenters and Likes on the Page, and a great deal of organization happening to make the Page viable, it would be easy to believe this volume of work was widely distributed. It is hard to know how much attention the Sharing and Liking of pets drew to the Page. From the Page analytics, we see that 60% of those who commented on the Timeline and 68% of those who commented within the albums left just a single comment, suggesting transient engagement. However, it could be that even one comment was valuable: the person who found Napolean commented just once upon Napolean's capture to notify others (with others verifying the claim). Across the seven months, data show that the number of posts, photos, and comments remained high in the first couple of months, which is a indication of ongoing engagement into the recovery period after Sandy was no longer in the news (Figure 7). There is drop-off as the pet issue becomes less salient, but the photo activity shows less of a drop-off than the commenting and other non-photo posting, suggesting that a core group were committed to the work of pet matching.

Not everything was optimistic. The tedious matching work was described by a participant as the necessary "dirty work" of the Page that not everyone wanted to do (Participant 10). Other respondents said that they lost FB friendships because of crossposting, which some found to be overbearing. The

lesson here might not be to aim for everyone mobilizing for a cause, but rather to create environments that make tedious work more attractive while still making functional use of a larger but only mildly engaged crowd.
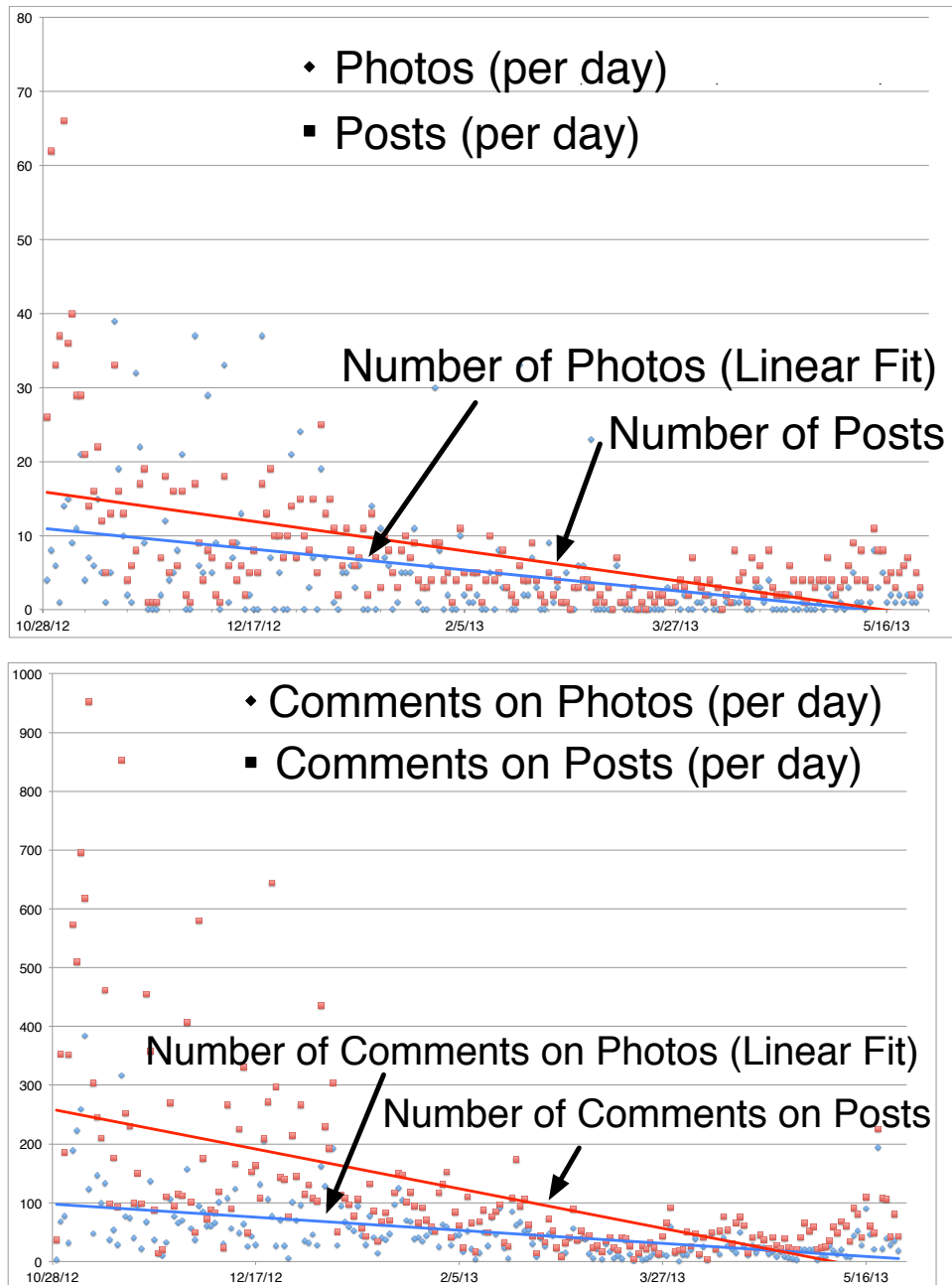
**Figure 7: Daily activity for creation of posts and photos (top);
and comments on photos/posts (bottom)**

4.7 Discussion

Mobilizing advocacy is a central question in today's networked world (Gladwell, 2010; Obar et al, 2012; Starbird & Palen, 2012). This study considers how work practice and a digital environment as a site of interaction for a highly distributed group of volunteers were co-adapted so that it might achieve the goals of accomplishing tasks as a group. Advocacy organizations may see social media as effective, but it is often difficult to integrate it with existing practices of connecting with audiences (Obar et al, 2012) and to engage long-term committed volunteers (Voida, Harmon & Al-Ani, 2012). One could tackle the issue of mobilization as a matter of attaining critical mass, or understanding the social psychology of advocacy, or other theoretical frames. Here, we see that design decisions—even those for which there are many imposed constraints by the service provider—are important in igniting mobilization.

In recent years, disaster events have given rise to the influx of online digital convergers who want to help (Fritz & Mathewson, 1957; Hughes et al, 2008; Kendra, & Wachtendorf, 2003; Starbird & Palen, 2011). Among these digital convergers are those who were already performing advocacy work online, though often in an ad hoc fashion. In the site we examine here, which we believe to be "the state of the art" in online pet welfare disaster response volunteer work at the point in time that it was instituted, came to be built upon implicit knowledge of the crossposting that pervades online pet advocacy. A few of the lead people had prior disaster experience, but most other members and administrators had little experience with respect to the particular matters of pet welfare in disasters.

In online crowd work, the matter of structure of the work is central. This is because much of the work that can be done includes manipulation of data, or the consumption or generation of information resources. In their study of the digital volunteers who instituted the "disaster desk" in response to the 2011 Peru earthquake, Starbird and Palen (2013) reveal how work was restructured in response to the restructuring of the information environment volunteers were working in—which itself was an exasperated response to a confused division of labor and in the end enabled the group to sustain itself relative to its production functions.

In this case of matching lost pets, the information architecture was highly organizing to the group and graduated the information dissemination activity into a more structured case management system. Both the work and the mission came into focus, connected to efforts on the ground, and brought this special interest group to a workable state of mobilization. The information structuring here had to make use of the highly visual information that pet advocates needed to work—photos of pets. The visual nature of the information was already the reason crossposting in pet advocacy was as it was: so that people could be repeatedly appealed to about the plight of particular animals that crossposters believe needed rapid help. The administrators made use of existing crossposting behaviors but organized the information generated so that it could be housed, standardized, and made persistent. This in turn had the effect of making clear what the production functions of the Page should be to a newly banded group of inexperienced disaster volunteers, which was that of rapid matching to quickly reunite suddenly displaced pets with people.

Such attention to the information architecture transformed the work of advocacy from an impulsive and transient "clicktivism" (Obar et al, 2012) into action that had a chance to be sustained for longer engagement—if not for very long volunteering commitments (Voida et al, 2012) then at least for longer task commitments. This observation maps to that of earlier work by Kreps and Bosworth (1994) on the nature of self-organizing among (often volunteer) groups responding to disaster. In their terms, the Page would be described as arising out of loosely defined "activities" (crossposting) for most of the active members, which were then shaped by the "resources" in the form of the affordances of Facebook's Page features. This then gave rise to the articulation of the "task" of matching, which surprisingly had not previously been an explicit notion in crossposting work—the focus had been on pet rescue in non-disaster situations. In this case, people reoriented to the understanding that matching between lost and found pets—rather than the rescue of abandoned pets—is the solution for the setting of disaster and is a natural off-shoot of the visual information-sharing they were already engaging in. It also set the stage so that "site seers" (Hughes et al, 2008) who had not previously been a part of the crossposting movement could

become a part of the mobilization. Imposing structure on previously unarchitected, highly visual work brought the idea of advocacy work—mobilization—within this community clearly to the fore.

The administrators also communicated resolution of the pet cases, which was a critical part of mobilization—and they did so in keeping with the information architecture they developed for the problem-solving work. These practices created the sense of completion of work—which communicated that there was work being done in the first place. Even when the actual matching work happened on another site or privately, the Page assumed the responsibility of calling the work completed for the entire large and amorphous pet advocacy world. This, we believe, appeals to the value of mobilized pet activism writ large.

4.8 Summary

The Hurricane Sandy Lost and Found Pets Page on Facebook sprung from a special interest group that represented an existing large segment of online society—pet lovers and advocates—that needed a structured information environment to spur further self-organization to assist in the aftermath of Hurricane Sandy. Innovations around the organization of visual information as well as other social practices articulated the cooperative work they could conduct—an improvised case management system—and in turn that work clarified the mission and larger social ordering of pet advocacy.

4.9 Study One: Epilogue in Reflection of the Dissertation Questions

I will now reflect on how this previously published study addresses the research questions that guide the body of this dissertation. Study One answers research questions RQ1, RQ2, RQ3, RQ4 and RQ6, with a focus on the ways information about animals affected by disaster is collected and managed online, and the ways in which collaborative work is organized around the information, with the aim being to fill in the gaps and support reuniting of animals with families. Below are the ways in which Study One has answered the research questions.

RQ1 What kind of information gets collected about animals; how is it gathered, managed and used?

In this study we see that the kind of information about animals in need that is collected and shared online in normal times is adjusted to meet the particular needs of animals in disaster. Information gaps are a hallmark of disaster. This study shows these information gaps exist around pets in disaster, just as they do around people and other areas such as infrastructure. In this study, we see pet advocates' use of a social collaborative tool, Facebook, to collect and organize whatever limited information they could to try and identify animals displaced from their owners, placing them in a format reflecting a "case management" system. When this was established as a process, they then turned their attention to a newly identified opportunity to do work, attempting to match the pets that were in the albums.

RQ2 What kind of information about animals affected by emergency appears in online and offline arenas?

Study One shows the concentration on collecting as much information about the animals and their status as possible in an ongoing way. The online effort worked to constantly update each animal's information to be as current as possible. Producing standardized flyers that could be printed "old school" and placed in affected areas supported the distribution of information beyond the confines of online areas, and embraced information dissemination to those offline as well.

RQ3 Does the information identified, gathered and shared in both online and offline spaces intersect, and what effect does that have?

When an animal was included in the system, we observed ongoing collaborative work around each post as people worked to suggest matches from other places online, as well as by making phone calls to enquire about animal status offline. New information was then brought back to the central site of work, the Facebook Page, and shared with others. This made the site more responsive and engaging for its users than a noticeboard where flyers might capture the status of an animal in a single point in time. The

currency of information fostered ongoing engagement of the pet advocates across a larger span of time, as was shown through the ongoing postings to the Page long after the effects of the Hurricane were over.

RQ4 Who uses the information gathered, and how?

In Study One, we saw a pre-existing ad hoc group who self-identified as pet advocates come together to work collaboratively with others of like mind, focusing on improving the outcomes of the disaster for affected pets. It is notable that the primary focus of these pet advocates remained on the animals rather than on the owners. These advocates were intrinsically motivated to respond to the needs of pets, and this meant reuniting them with their owners, or in some cases, finding them new homes if their owners were forced into relinquishment.

The information gathered about each pet was compared to other information found on and offline, and suggestions for matches were made on the Page. These suggestions were followed up and resolutions were identified.

RQ6 Is it possible to use social collaborative tools to improve information flows around animals affected by disasters?

The rise of the use of social collaborative tools such as Facebook has supported the pre-existing work of pet advocates in making the plight of animals visible, particularly those affected by disaster. In Study One, we saw the work of pet advocates online progress from an ad hoc, loosely connected but largely individual process to one of coordinated, distributed work with a focused aim.

Information-sharing about affected animals moved from a broad distribution aimed at awareness to one of active, collaborative engagement focused on improving outcomes.

Study One answered the research questions pursuant to an online domain. Study Two, described in Chapter Five, answers the research questions through the lens of the *interrelationship* between on-and offline environments.

CHAPTER 5. Study Two. The Intersection of Information Online and Offline: "Casting a Net" Online to Identify Expertise and Organize a Successful Offline Response in the Evacuation of 38 Horses Following the Colorado Floods.

5.1 Study Two Summary

Study Two considers the intersection of information online and offline and how that information was used in supporting the evacuation of horses following the Colorado Floods in 2013. This study answers RQ1, RQ2, RQ3, RQ4 and RQ5. In this work we see how expertise was sought, articulated and actuated across online and offline worlds to enable the evacuation of 38 horses from an isolated ranch in the mountainous region of Northern Colorado following a series of devastating flash floods in September 2013. The shared equine expertise held within a loosely connected community of practice bridged spatial-temporal limitations and afforded opportunities for practical assistance and response, both virtually and on the ground. Interaction via social media articulated the parameters of the emergent problem to be solved, and "cast a net" to find the expertise necessary to address different aspects of the perceived problem. Eventually, more than 60 people with equine expertise converged onto the ranch, bringing their materials to execute a single-day evacuation and relocation of the herd.

The text contained within Sections 5.2 through 5.6 is a reprint of White, J. I. & Palen, L. (2015). Expertise in the Wired Wild West. In *Proceedings of CSCW 2015*. It is reprinted with the permission of my co-author, Leysia Palen. I will now present this study and then conclude the chapter with reflections on how this study answers the research questions.

5.2 Study Two Introduction

Disasters create myriad problems. Official responders are often so taxed that they cannot attend to every need in a community. Indeed, the very nature of disaster compels residents of an affected region to take charge of their own recovery because the circumstances are dire and the resources are few. People self-organize to "get things done." Many consider community members as the "true first responders" for activities that include rescue, evacuation assistance and medical care (Kendra & Wachtendorf, 2007; Tierney & Quarantelli, 1989).

5.2.1 Social media in crisis response

Such observations have been extended to the study of a new arena of social interaction, that of social media during disaster response. By understanding that the online convergent crowd exhibits similar behaviors as the offline crowd, this body of research looks beyond noisy online communications to see how subgroups of "digital volunteers" accomplish—or try to accomplish—work through that medium (Palen et al, 2009; Perng, Buscher, Wood, Halvorsrud, Stiso, Ramirez & Al-Akkad, 2013; Sarcevic et al, 2010; Starbird & Palen, 2011; Starbird & Palen, 2013; White et al, 2014). Though that research acknowledges that the work of the online effort must connect in some way to activities on the ground to fully assess its importance, to date there has been little work that considers how online and offline work in the aftermath of disaster intersects. (Two exceptions are Starbird (2013) and Wulf, Misaki, Atam, Randall & Rohde (2013)). Additionally, we have little understanding about how spontaneous digital volunteers choose the tasks they could attack, and how the medium of social media might influence the topics around which groups organize. We do, though, see groups working across problem areas such as crisis mapping (Soden & Palen, 2014), medical support (Sarcevic et al, 2010; Starbird, 2013), location information provision (Starbird & Palen, 2013), situational awareness (Perng et al, 2013) and, notably for this paper, animal welfare (White et al, 2014).

5.2.2 Animals in disaster

This study reports on a volunteer activity that responded to livestock concerns during a flooding disaster in Colorado. The matter of animal welfare in disasters is a major problem that community members often must tackle without official support. Over the last decade, the plight of animals in crisis events—both pets and livestock—and how that affects human decision-making about evacuation has been made increasingly clear (Hagar & Haythornthwaite, 2005; Heath, Kass, Beck & Glickman, 2001; Hunt, Al-Awadi & Johnson, 2008; Irvine, 2009; Zotarelli, 2010). Many people will not evacuate without their animals, or they may delay their decision to do so. Following Hurricanes Katrina and Rita, where approximately 70,000 pets were separated from their families and fewer than 3% were reunited (Irvine,

2007; White et al, 2014), the US passed the PETS Act (2006) for the inclusion of companion and service animals in evacuations and sheltering. However, the Act does not address the needs of those who own livestock, including equines and other large animals, even though their owners are often challenged with the same questions about the welfare of their animals as small animal owners. Furthermore, large animal owners often depend on those animals for their livelihood, and disasters can be devastating for these owners in both psychological and financial ways (Hagar & Haythornthwaite, 2005). It is difficult, and often impossible, to logistically evacuate large animals, and the lack of legislative support means that owners of livestock must take the lead on decision-making.

The growing interest among the online pet advocacy community in disaster response was described by White, Palen and Anderson (2014), who studied the large-scale, self-organizing activities of animal welfare advocates who engaged online to suggest matches between lost and found pets over the months following the 2012 Hurricane Sandy. There was evidence of some connection between what was happening online and on the ground, but the extent of this was unclear, even to study participants (White et al, 2014).

5.2.3 Disconnection between offline & online response

Indeed, a major criticism of much current crisis social media research is that it does not consider the relationship between online work and offline or on-the-ground activities. Wulf et al (2013) is a notable published location which considers this. It is an important concern. Is there a gap in the research because the online-to-offline connection is not happening, and therefore all the attention put to social media activity magnifies the role social media are playing (or could play) in disaster? Or is the behavior such that the research cannot tackle it because it is hindered by the logistical difficulties of deploying to a sometimes diffuse and hard-to-access disaster site at the right time to observe and study such activity? It is likely that influences of both are occurring. The majority of online-offline connections that do exist are very subtle and difficult to capture empirically, especially under disaster conditions.

This paper examines a case where the online work of information gathering was brought to bear on an offline or on-the-ground problem, the sensemaking of which demanded particular kinds of expertise. Where prior research faltered because it could not place researchers on the ground in a far away site while simultaneously examining online behavior, we were able to study an event that was an outcome of devastating floods in our own geographical area. It should be noted that we studied a single event, and do not suggest that this happens frequently. Instead, our aim was to learn from a situation that graduated from the online reporting of a problem (which was not a solicitation for help) to the mobilization of interested volunteers who devised and implemented an offline solution over an extended period for a time-and safety-critical situation. That it happened close to our home town where we could access all aspects of it, both on- and offline over a protracted time period suggests that these kinds of ensembles of online and offline work in disaster settings are not rare, but that "being there" during the disaster creates the opportunity to witness them.

5.2.4 Research objectives

This paper examines the case of what the volunteers referred to as a "self-assisted evacuation" (a term further explained in Section 5.4.7.5) of 38 marooned horses that were left isolated by extensive road damage caused by devastating floods on a high mountain ranch in the "wild west" of Colorado. The account considers how online and offline work came together under conditions of specialized expertise-sharing that drew upon people near and far, digitally and physically. In this study, we examine how a problem with an uncertain solution under time-critical circumstances is solved across people, time, place and materials. In addition to emotionally and financially supporting the ranch owners, the online activity served to "cast a net" to find expertise around the subject of horse-care and ranching. These experts then articulated the problem of the marooned horses and the geography of the mountains where they were located to develop a plan that would allow volunteer "horsepeople," who were connected primarily through social media, to converge onto the ranch and evacuate the horses "down mountain" in the uncertain conditions of a post-flood environment without harm to the horses, themselves, or their

equipment. Furthermore, the application of their expertise on the ground was realized and shaped by the layout of the roads, the locations and temperaments of the horses, and the constraints and possibilities of their materials and equipment.

In this online-meets-offline account of cooperative work, we see connections to the classic literature in CSCW around matters of mutual awareness in safety-critical systems (Heath & Luff, 1992) that are partially achieved online and only "satisficingly" (Simon, 1996) achieved offline. We see how performances around paperwork intended to connect the online to the offline are once again superficial (Suchman, 1997) and that the offline work is ultimately refigured primarily to communicate its successful completion back to a waiting, online crowd. We see how problem definition, work articulation (Schmidt & Bannon, 1992), and the materiality of work (Nomura et al, 2006; Rosner, 2012) come together to make the work happen in a socially, spatially, and temporally-distributed manner (Hutchins, 1995). Finally, one of the primary contributions of this research lies in the examination of the solicitation of expertise in a digitally connected world, where widely distributed and diverse expertise must nevertheless be realized under highly localized conditions.

5.3 Methodological Approach

5.3.1 Sites of study

The fieldwork of this ethnographic study first began with online observation of Facebook activity in a group set up specifically during the Colorado Flood event, named *Colorado Equine Evacuation and Disaster Response Network/Fleet of Angels* from September 11-October 25, 2013. On October 2, a member crossposted a link to the Back Country Horsemen's website calling for volunteers to assist with the needs of a ranch owner in a mountainous remote area of Northern Colorado at 8500 feet (2600m) above sea level. "Palisades Ranch" is a pseudonym used in this study for the name of the ranch, and pseudonyms are used for all names of the people involved.

The physical site of study, Palisades Ranch, is set on 600 acres. The Ranch operates as a breeding facility for competitive show horses, each valued in the tens of thousands of dollars.

The floods were so intense that the region experienced a year's worth of rainfall over a four-day period. Following days of heavy rain, the ranch owners were evacuated on September 11, leaving 39 horses behind. Parts of county road access to the ranch eventually washed away and became impassable during the storms and the resulting flash floods. Because of the poor road conditions, the horses were "marooned"—which was the official status of *people* who were isolated in the mountains for the same reason and had to be airlifted in what the National Guard called the largest air rescue since Katrina (Pearson & Howell, 2013). Though domesticated animals were airlifted out with their owners, operating on the directives of the PETS Act, livestock were not.

The ranch faced serious threats: Rain and flood waters could cause existing feed to mold; wet conditions could damage or limit access to the little remaining seasonal pasture grass; and horses could be standing in sodden pasture, which could lead to hoof damage. With the owners so far away and with limited access to their property as well as a lack of assurance from officials, it was hard to know how dire the flooding and food situations were, or how quickly they might worsen. What is more, the winter season strikes hard and early at that elevation in Colorado, and, as time passed during the month of September, it was unclear whether the horses could survive for long without proper care. Eventually, a group of volunteer "horsepeople"—experienced owners and caretakers who were loosely connected online but describe themselves as "united by a … common bond and passion" for horses—came to the ranch to move the horses "down mountain" to a temporary ranch location. The "self-assisted evacuation" happened on Sunday, October 6 over the course of 13 hours with more than 60 people participating — some using their own horses—and approximately 20 trailers.

As an important point of clarification, early in this story, the number of horses to be evacuated decreased from 39 to 38, which explains why both numbers appear in this account. Between the flooding and the evacuation, one of two stallions was killed by the other after they were turned out from their pens into a paddock by an unidentified would-be helper long before the expert horsepeople arrived. The stallion's death was a catalyst for a concentrated mobilization of response from horsepeople, both online and offline.

5.3.2 Ethnographic investigation

Prior to the October evacuation, I had been collecting data on other livestock welfare issues in Colorado in the wake of the floods. I had been conducting interviews with ranchers, feed providers, the emergency hay bank and emergency responders. On October 2 I learned of the situation at this Ranch through a Facebook group I was monitoring. From that point on I collected all prior and current Facebook data related to the Ranch. I responded to the call for volunteers for the evacuation as a researcher, and became a participant observer who was in direct contact with those coordinating the evacuation.

I subsequently assisted with the evacuation of the horses on October 6, shadowing the ranch owner, Trudy, throughout the day as she traversed her large ranch and engaged with horses and helpers. The morning after the evacuation I drove to the temporary, rented ranch where the horses and owners would spend the winter season. There I spent four hours following up with the ranch owner, employees and two volunteers who had come from Texas to assist. I was the only person present at the Ranch during the evacuation day who was unfamiliar with horses, a point that delighted Trudy because she knew that the research would not be tainted by the "strong views" that horsepeople often held.

This research thus developed into a multi-sited ethnographic study (Marcus, 1995), an approach that provided the necessary mobile lens to this particular research environment (Büscher & Urry, 2009).

I audio-recorded many conversations with Trudy and took nearly 200 photographs of the evacuation. The week following the evacuation, I interviewed seven participants who had volunteered on the evacuation day plus two officials, a ranch employee, and the owners once again. These interviews were conducted in person and by phone, as circumstances allowed. I used photographs taken on the evacuation day as probes in the interviews (Boehner, Vertesi, Sengers & Dourish, 2007). In addition I collected personal email correspondence between the evacuation organizers, neighbors and officials. Follow-up questions and interviews by email and telephone clarified points over an even longer duration of time. The interviews were transcribed and then analytically combined with other documents, field notes, and visual data to produce a complete picture of the evacuation's coordination activities.

5.4 Analytical Description

This ethnographic reporting focuses on how loosely-connected members of a community of practice with equine specialization, "horsepeople," mobilized online and offline, and worked with the ranch owners to organize and implement an evacuation. These equine experts used social media to recruit help from their broader community of horsepeople to move the horses down-mountain to a temporary ranch more than three hours' drive away. We document how a larger distributed group of interested observers articulated the full extent of the problem that Trudy faced through remote, mostly online interaction on Facebook, by email, and telephone, which eventually led a subset of them—who did not otherwise know each other, and with some coming from outside the State—to converge on the mountainous ranch location and evacuate 38 horses on a single day.

We identify times of conflict, and challenges that were overcome through the flexibility of experts in circumstances that were unusual and emergent. This research reviews matters of coordination between stakeholders who had not worked together prior to this event, over multiple media before and after, and across physical places; and with respect to the "living" inventory of livestock, which imposes a level of urgency and degree of expertise necessary for such an evacuation.

The next section portrays an overview of the features of the evacuation planning and implementation. Some portions of the evacuation are highlighted to convey the "telling" examples (Erickson, 2008) of the nature of the coordination.

5.4.1 Flooding & human evacuation of the Ranch

The owners of Palisades Ranch were subject to a mandatory human evacuation order on September 12, the second and heaviest day of rainfall during the Colorado floods. Trudy, one of two ranch owners and the prominent figure here, made their situation public by posting on her personal Facebook Timeline. They were able to evacuate with their dogs, but left their 39 equines behind. In the flurry of activity in the hours following the human evacuation, a neighbor of the ranch, Alexander, who owned a small plane and so could evacuate but still fly back and forth when the weather cleared, offered

to watch Trudy's herd and fly in grain. Due to the weight of the grain, however, Alexander found he was only able to transport three bags per trip—not enough to feed 39 horses. It became clear this was not a viable long-term plan.

Unfortunately, nearly a week after the human evacuation, an unidentified person entered the property and let loose the two stallions who had been penned. It is likely that the would-be helper thought the stallions did not have access to food, not realizing that they must be penned for their own and the other horses' safety. When checking the horses on September 18, six days after the mandatory human evacuation, Alexander found that one stallion had killed the other. He suspected a National Guardsman had been responsible for their release, as they were in the area to check on conditions. When she was told of the death, Trudy was deeply saddened but decided against reporting it to officials, saying, "I would not take someone's joy. He doesn't know horses. He thought he was protecting them."

5.4.2 Online connection

As Trudy relayed information about her situation to her Facebook friends—many of whom were also horsepeople— they started making suggestions and asking questions to grasp the situation. For example, some did not understand how expansive and rugged the Rocky Mountains are, and that the horses could not be "ponied" or led down to the plains. The online followers of her story became more knowledgeable about the situation as their questions and her answers unfolded. The death of the stallion was a particularly important moment in communicating the gravity of the situation. As in any protracted disaster situation and certainly during the recovery phase, uncertainty rules the day while people wait for changing situational assessments and directions about permissible returns home. By the time Trudy realized that a "self-assisted evacuation" was the only practical possibility, in large part due to the information-gathering conducted by her growing set of online contacts, 13 days had passed since her own evacuation. It then took only another five days to lease a temporary ranch and evacuate the animals.

Trudy's initial Facebook post provoked an unintended, but positive, response. Thinking that she was sharing only her frustration and distress, she said that she had "50 mares stuck on the mountain"

(Figure 8). Having no expectation that people would come to her aid, what was meant to be an approximate number was transformed into the target that others organized around, and it propagated for the entire time up through the evacuation—and even after the evacuation when there was still uncertainty about the scope of the on-the-ground work that was ultimately conducted.

September 18, 2013 · 🌐

Everyone has asked for updates and I have some though none are good. The WORST is that our Western Pleasure stallion A Hot Temptation is dead. There are NO roads left for 7 miles to get to this road in the pictures that lead to our house and mares. The road pictured here to our house is on flat land, the road approaching this road and our ranch is up and down and gone. We have 50 mares stuck on the mountain, no hay stock (3/4 of one remaining 3x3x4 as of today) and no possible way to get hay to them. On a good note we did get several bags of grain in on our neighbors plane for the remaining stud. Lots of work to do, lots of door knocking, lots of out of the box thinking. If they could just bring us road supplies, all of us are willing to do the work ourselves but something has to break soon. When I called Larimer County EOC to tell them the situation, they said "we do not show County Road 59 closed", I mean REALLY of course it is not closed it is GONE! And so was the end of today.

Like · Comment · Share

Figure 8. Trudy's Facebook update.

On the same day that Trudy posted news about the death of the stallion, a horseperson in Missouri saw the post and sent a Facebook message to Jane, a ranch owner she knew in Pueblo, Colorado to solicit in-state help. Jane in turn contacted Frank of the Back Country Horsemen of Northern Colorado (BCHA) by email. Although Jane was located in Colorado and could better leverage the equine social networks there, we note that Pueblo is still more than two hours' driving time away from Boulder, Colorado (the nearest city to the ranch, which itself was still a distance away). Jane and Frank, together, began collecting information about the Ranch, including its accessibility. Frank contacted Trudy and over the next few days, the three of them pooled information from their conversations with officials. Together, they brainstormed solutions that could help the horses of Palisades Ranch.

Trudy was initially reluctant to accept help. In a follow-up interview she said,

It made me squirm a little bit. I was embarrassed at first … I'm not used to getting. I'm used to giving. I don't like attention on me.

This confirms our observation that the mobilization was a ground-swelling, and although Trudy was involved in supplying information about the situation, significant action was being staged by others on her behalf in preparation for the massive undertaking of a 38-horse evacuation. Trudy had never met Jane or Frank, but understood the motivation of the volunteer response was altruistic, and decided to accept and encourage their help.

5.4.3 Conflicting official information

As they conducted their planning for a possible herd evacuation, the volunteers did not act independently of officials. Because the horses were not in immediate danger, officials understandably considered the situation a low priority as they were still locating people on the missing persons register. When Frank shared the initial ideas for an evacuation of the Palisades horses with the Boulder County Sheriff's Office, he was summarily told there was a roadblock along the planned route, and that those who breached it would be arrested.

Frank, whose career had included 25 years' experience in law enforcement, did not give up. He had better luck with Larimer County Sheriff's Office, where he once worked as a mounted officer with the Sheriff's Posse. A "Posse" is a legal entity of non-paid workers who respond to a sheriff's request, and has its origins in the 1800's American West. In response, deputies from Larimer County Sheriff's Office went up to the ranch themselves, checked road conditions, and relayed that there was in fact no roadblock. The disparity of information between the two agencies reveals the kind of information gaps that frequently occur during mass emergencies and are a source of motivation for people taking problems "into their own hands."

In addition, on September 24, Trudy's husband was told that no hay would be slung in by officials, and that they would need to source and fund the feed and its transport themselves. On September 25, the prohibitively high cost of helicopter rental compounded with imminent winter weather

brought Trudy into agreement with Frank and Jane, who had been making evacuation contingency plans the entire time. Trudy began to search for a temporary location for her horses.

Date	Event
Sept 12	Ranch owners evacuated.
Sept 18	One of 2 stallions discovered dead.
Sept 19	Jane contacts Frank. Both contact Trudy. Planning begins.
Sept 24	News that there will be no hay drops by FEMA or the State.
Sept 25	Focus turns entirely to a herd evacuation. Trudy begins looking for a ranch to lease.
Oct 1	Temporary ranch lease signed. Evacuation day set. Frank sends email and posts web announcement searching for volunteers, which propagates across social media.
Oct 3	Snow conditions predicted for evacuation day, but team proceeds, with contingency plans.
Oct 4	Trudy moves into temporary ranch. Local reconnaissance on ranch and road network performed.
Oct 6	Evacuation day (with clear weather).

Table 2: Timeline of events.

5.4.4 Online support: Raising money through an auction

While the remotely distributed volunteers and ranch owners made contingency plans for the evacuation, other online helpers sought complementary ways to support the effort. One person created a Facebook group for support, where people began to donate money along with goods or services to be auctioned, with proceeds going towards the needs of the ranch. The donated items were mostly horse-related (clothing, equipment and even stud fees). Participants used the comment threads to bid. Good-natured bidding and conversations ensued across the auction threads. The group celebrated updates by Trudy. Because the first auction attracted a great deal of support, they held a second.

The auctions were set up unbeknownst to the grief-stricken Trudy who was mourning the loss of the stallion and distressed about the rest of the herd. The two auctions raised an astonishing US$22,000. Trudy discovered the auction's existence after a few days through a reporter who had called her for comment about her "really good friends." Ultimately, the proceeds helped Trudy pay the lease on a

temporary ranch and buy hay, which had become expensive due to the extensive damage that the floodwater had on Colorado's hay supply.

Trudy's work led to securing a temporary ranch and the lease was signed on October 1. Trudy, Frank and Jane agreed to set the evacuation to happen five days later—24 days after the rainstorms and flooding began. On October 4, Trudy began to prepare the temporary ranch. Mary, a friend from Texas, came to help, and in turn brought one of *her* Facebook friends, Audrey. Frank continued to make the logistical arrangements for the evacuation, updating Trudy and Jane as he went. Note that this core trio had yet to meet in person.

5.4.5 Information sharing builds a network of online experts

Trudy continued to post online. The posts were shared across the network of horsepeople and organizations, and received many likes and comments, all with messages of support and occasional suggestions of evacuation locations for the horses. The attention of the online community of equine-specialists had clearly been engaged.

When Trudy was securing and preparing the temporary ranch, she did not have time to post updates on evacuation plans. Instead, Jane and Audrey tagged Trudy in their Facebook posts about the evacuation plans, effectively posting on her behalf since the posts then appeared on Trudy's Timeline.

5.4.6 Expanding the reach for help

With the full impact of the planning to move the horses upon them, and with time-critical decisions to be made, Frank took on the lead role of soliciting the help of experienced horsepeople through his online networks. Frank asked his partner, Louise, also a horseperson, to take on the role of managing the paper-based administration of the evacuation day, while Frank focused on organizing the volunteers and physical logistics.

On October 1, Frank used his standing and connections as president of the Boulder County Horsemen's Association to attract appropriate volunteers for the evacuation. Addressed to his "fellow equestrians," Frank sent an email outlining his plan, stating that he was looking for:

Ten to 12 riders (wranglers), up to 25 4WD three- or four-horse slant load or stock trailers for transport.

To lend authority, Frank explained his recent history with Palisades Ranch and that he was supervising the effort, but that the owners and their employees would have the final say on how the day went. Frank made it clear that "complete cooperation is necessary by all who sign up." The email was shared throughout the equine community by email, websites and Facebook pages.

Between October 1 and October 6 (evacuation day), Frank received approximately 100 email messages expressing interest. Not all interested people were appropriate for the task. Frank sometimes needed to correct assumptions and use his experience as a horseperson and former Posse lead to select qualified candidates. As Frank explains:

I had people telling me ... I don't know how to rope or anything, but I'll come with my horse – and I said, rope? What? What are you going to rope? ... I said no, we don't want a rodeo, we want everything calm and quiet.

The selected volunteers were emailed an information sheet that included directions to the property, contingencies in case of poor weather, and cell phone numbers of eight people from the Northern Colorado Back Country Horsemen organization whom Frank trusted. He booked more volunteers to come than he thought were required for what he thought were 50 horses. As he anticipated what faced him, including the uncertainty about the numbers of volunteers who would show as well as the psychological state of the horses, he remained flexible. Frank says:

Working with volunteers is different to when I worked with the Sheriff's Department and we had an operation. You were deputized and by golly, you were coming. We asked you to come, we're going to order you to come and you come. When you have volunteers you can't hardly hold them to that.

After seeing a Facebook post, the Weld County Posse also decided to assist with some of their members in an *official* call-out, even though, remarkably, the originating and the destination ranches were not a part of Weld County. On the evacuation day, the Posse members came in uniform, adding visible authority and underscoring their expertise. However, they did not seek to take control. Instead, they saw themselves as supporting the efforts of Frank and his team. As an existing volunteer group, the Posse was

able to mobilize more easily than new, episodic volunteers (something we see in other volunteer situations (Voida et al, 2012)). Barb, the Weld Posse coordinator, explained that she was not surprised that Weld participated when the Larimer and Boulder County Posses did not:

One of the advantages that Weld County has is that we don't have to carry a weapon or be post-certified, so our numbers are much bigger. They only have seven or eight on the Larimer County Posse, so they don't have a big group to draw from.

Note again that Frank and Louise were not local to the area, and were working remotely until the evacuation day. Weather remained poor and work demands meant Frank and Louise could not travel to the Ranch to check access. Instead of personally surveying the location to establish best routes, they had a friend who lived locally travel the planned route and identify on a map any unrepaired road damage, and suitable places for parking and loading of horse trailers. This happened on Friday October 4, two days prior to the Sunday evacuation.

We also note that, somehow, the actual number of horses—38 after the stallion died—was never accurately figured or communicated by Trudy. Frank was basing his evacuation logistical preparations on the original 50 that Trudy rather casually communicated in her very first post, which had propagated online. It was even reported over time to be as many as 60 horses, and as few as 45 in the digital tracings we reviewed. This was one piece of information that never got corrected, even on the day of the evacuation, though Frank was not worried about this disparity. This suggests that the tracking of the horses was done based on their "presence" in the pasture rather than matched against an inventory. We will return to this issue in Section 5.4.7.2.

5.4.7 Evacuation day

5.4.7.1 Psychologically readying the horses

Evacuation day was the first time the ranch owner had seen her horses since she had evacuated 24 days earlier. The reunions were emotional and took some time, as Trudy greeted each animal. Some

horses approached her directly while others remained dispersed across the ranch pasture, which was now very low on edible grass.

The time spent welcoming the animals was critical to successfully herding the horses. Trudy needed to gain the cooperation of the lead mare, which would indicate to the other horses that the activities and new people were acceptable. Most of these horses were not used to being "ponied," (that is, being led with a lead rope by a rider on another horse) and as herding animals, equines prefer to stay with those they know. Frank relied on Trudy's personal knowledge of the horses to determine how best to gather and load them in trailers, but when the *in situ* practicalities of timely decision-making and next-in-line trailer capacities presented themselves, he also used those constraints as his guides. Here we see applied, expert inventory management as a skillful interplay between a real-life, time-critical "packing problem" (Lodi, Martello & Monaci, 2002) and the psychological needs of sentient creatures.

Figure 9: Riders pony horses out of the pasture.

5.4.7.2 Summoning of expertise trumps pro forma paperwork

On the day of the evacuation, 44 volunteers signed in on a form prepared by Louise, the volunteer in charge of evacuation-day administration. When Louise and Frank reviewed the sign-in forms after the evacuation, they found that because volunteers filled in the form themselves, only a third were legible and many were incomplete. As researchers, we had thought the form would be part of a security or tracking effort, but interestingly, in follow-up interviews, the organizers said they were more concerned about thanking volunteers afterwards. In addition, Louise brought waivers for volunteers to sign, but with the focus on the practical aspects of the evacuation, they found it too difficult to manage, so none were completed.

Rather, as the hauling trailers left, a volunteer recorded the license plate and number of horses in the trailers. That was on yet another, separate, piece of paper—which, once again, was not used. The paper, and the data it held, were not shared with the destination ranch, likely due to the lack of phone or data connectivity in the mountainous terrain. To the research team, the unworried neglect of all of the paperwork brings into question the very value that this particular system of coordinated work attributed to the paperwork in the first place. Furthermore, even though participants afterward stated the intention to connect what had been online relationship development to offline interaction, paper tracking turned out to be largely pro forma for both that purpose as well as for inventory management. This suggests, instead, that management of the inventory (the herd) was based on the mere presence of that inventory (i.e., the shared understanding that if there's a horse, and Trudy says it is hers, we will move it until there are no more horses). The *imagined* work that occurred during the planning processes involved paperwork, and therefore represented, once again, the rationalized version of work as Suchman's contributions continue to remind us (1987).

Furthermore, the *expertise* of the horsepeople was what was being summoned—along with patient cooperation—and the demonstration of their craft to mobilize a heavy and sometimes opinionated inventory was sufficient for granting what resulted in almost unconditional trust. Volunteers at the

destination ranch counted the horses as they arrived, but that was primarily to post the information to a waiting audience on Facebook. As Frank said:

We didn't know who was going to be there and what their phone number was. I knew somebody was there, but I didn't know who.

5.4.7.3 Communication via passing by on set route

Despite their extensive preparation, volunteers discovered new information about the road on evacuation day. As the first volunteers drove the seven miles of dirt road towards Palisades Ranch from the highway, they found that in many sections it would be impossible to have two trailers pass each other. The organizers had planned to have trailers coming in and out from the loading area, but they realized that would not work. Instead they staged the trailers further away along the highway at its junction with the dirt road. Two volunteers stayed on the highway with the drivers/trailers and directed them to the "Trailer Loading" area sequentially as it became available. Communication between the two people giving directions and those working in the "Parking & Admin" and "Trailer Loading" areas happened via verbal messages that were passed along between the drivers coming in and out. This worked well, as the two helpers had to only come down twice over the 13 hours to clarify issues.
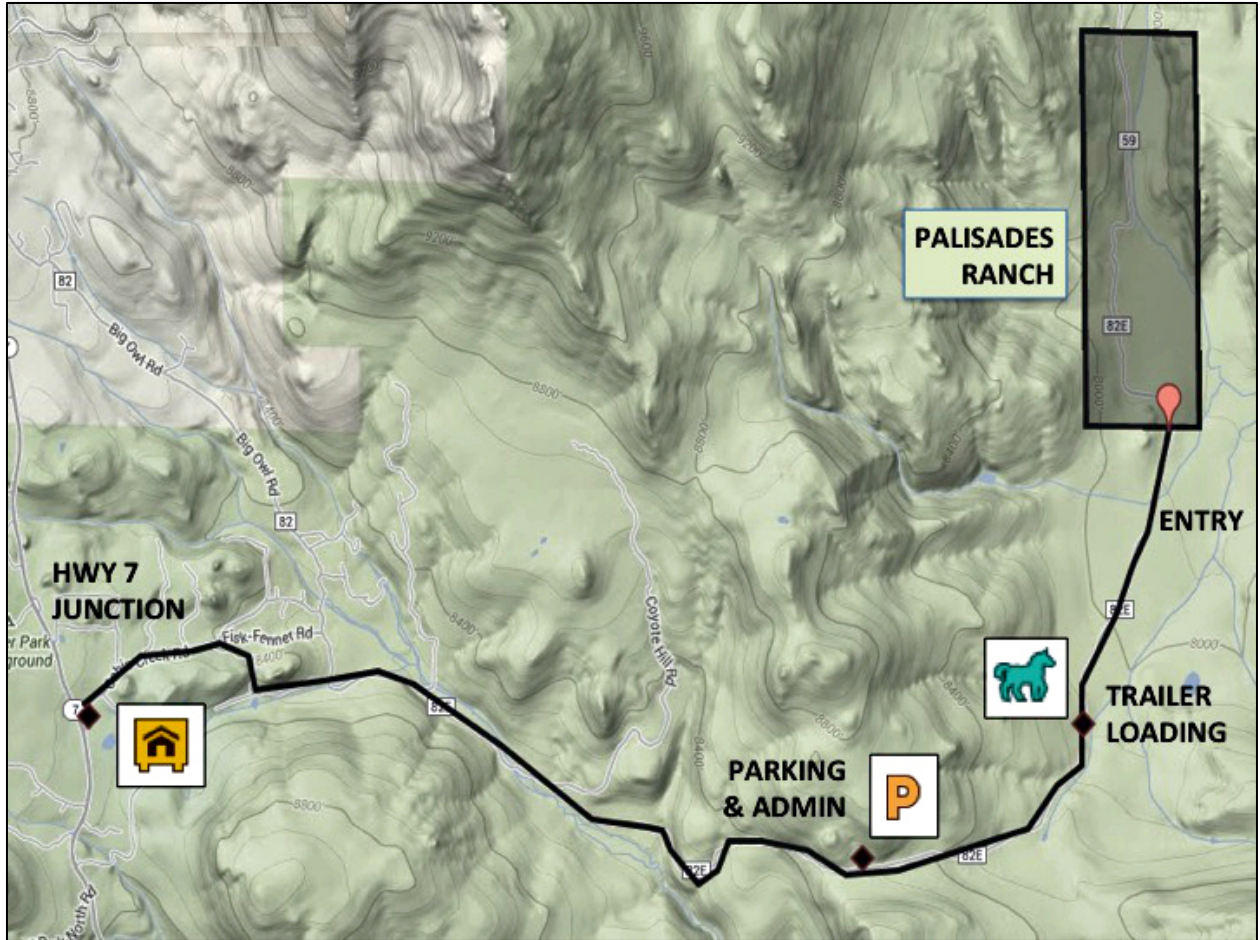
Figure 10. Map of the Ranch and the approach.

Indeed, Frank had intended to use radios to communicate across the four staging areas, but their radios relied on line-of-sight and did not work in the woodland terrain. Like the trailer train, riders verbally passed on information at the Trailer Loading Point when horses were loaded and before they headed back into the Ranch.

5.4.7.4 A distributed work environment enabled by expertise

The expertise of the volunteers was important to supporting the distributed work arrangements, such that a micro task—for example, ponying a horse—could be performed within the confines of a person's expertise, equipment and tools, while still working as part of the larger coordinated activity of many horses, people and trailers. Their shared familiarity with equines, tools for managing the animals,

and a common equine-specific terminology smoothed the work, which was especially important because they did not know each other. Trudy recognized the importance and value of this expertise:

These people have given more than money. They have given time and talent. That's worth so much more…

Figure 11. Posse members in uniform talking with Ranch owner.

5.4.7.5 Conflict with officials and neighbors

The property line at the entrance of Palisades Ranch runs directly along the junction of Boulder and Larimer Counties. Frank had different experiences working with the two counties. One county knew of the evacuation plans and provided information to aid in the planning stages, but communications with the other county stopped with the inaccurate instruction about a non-existent roadblock.

On the afternoon before the evacuation, Jason, a neighbor whose ranch is located adjacent to Palisades Ranch on the Boulder County side, heard second-hand about the planned operation and

complained to the county. Jason had concerns about the plan to herd the horses through his property, which was necessary because the county road was washed out through both Palisades Ranch and his own. Not knowing the people involved and having a strained relationship with Trudy, he was worried that the evacuation would be dangerous, and that some of his horses might be collected along the way. There had been no direct communication between Jason and the organizers until late on the day prior to the evacuation, when Jason emailed Frank, questioning the plans. Frank replied that Jason should speak directly with Trudy, and that if Jason also needed ranch assistance, they would be happy to help. At 2:30am on the day of the evacuation, the Boulder County deputy sent an email to Frank, strongly suggesting rescheduling the evacuation, and at minimum recommending the engagement of Animal Control to:

> *...assess the condition of the horses… and if there is a legitimate need to immediately 'rescue' some or all of them, then maybe we can make something happen.*

Up until this point, the effort had internally been called a "rescue," perhaps in part to mobilize interest. Frank had not thought of the external and legal implications of using this term. In addition, the sudden re-engagement of the sheriff at this late stage of planning exposed a critical failure to coordinate with neighbors. Frank assumed Trudy had shared the plan with her neighbors—indeed, Trudy had written on Facebook about her supportive neighbors—but the relationship between her and this particular neighbor had been tense. In fact, Trudy felt direct communication with Jason was unnecessary as there was no intention to involve his animals. On the morning of the evacuation, Frank arrived and reached a just-in-time compromise—the plan to herd the horses out got changed to ponying and leading them out—but not before heated words were exchanged between Trudy and Jason. Frank then renamed the effort to be a "self-assisted evacuation," to clarify intent and plans to those outside the effort.

5.4.7.6 Keeping track of horses & trailers

The Ranch owner, her spouse, and their two staffmembers were the only people who knew the horses' names. They were distributed across the ranch and Trailer Loading area, attending to different

needs through the day. They did not have consistent contact with the volunteers at the three key sites—Trailer Loading area, Parking & Admin, and the Highway—and therefore could not name and count all the horses as they were loaded.

Figure 12. Loading horses into trailers.

The highway-based volunteers rotated trailers between the two staging areas in batches of five. When each of the loaded trailers reached the highway, the drivers spoke with the volunteers who confirmed directions to the destination ranch 51 miles away at a 4400ft drop in elevation. The drive was three hours long because of road impasses. Those remaining roads were in compromised condition in numerous areas, and required a high level of skill to navigate with a fully loaded horse trailer. The drivers discussed the best way to make the trip with the aid of printed maps, but the drivers did not have the benefit of feedback from those who had already made the trip. Happily, as the afternoon progressed, a

Boulder County Sheriff's deputy (who came to see the progress) relayed that a major canyon road closed since the floods would reopen late that day. This reduced the trip by one hour, allowing the last few trailers to travel the steepest part during daylight.

5.4.7.7 Errors that disrupted the system

Late in the afternoon, coordination around the horse trailers, which had been going well, went awry. A series of miscommunications about the number of horses awaiting evacuation had propagated through the system. A local rider, Angela, who had been ponying horses and was leaving the site on her own horse, passed through each of the staging areas—the Trailer Loading area, and Parking & Admin— and finally saw five trailers moving toward the Parking & Admin area from the highway. Angela performed a personal calculation of horses that still needed to be evacuated, the trailers she had observed in the parking area as she left, and then those waiting on the highway, and thought some would not be needed. What she did not realize, however, was that Frank had planned that the riders would not do the additional, tiring task of transporting the evacuated horses, given that there were less than the planned 50 horses. In other words, Angela did not have a view of the distribution of labor, and though she had performed a calculation on the material evidence (marooned horses and trailers) and presumed that to be evidence enough (and indeed, that had been how they had been working), the immaterial aspects of work were beyond her ken, and meant that she could not assign proper meaning to the material evidence. With this observed but incomplete information as her rationale, she told the five drivers they would not be needed.

Upon hearing this erroneous news, the trailer drivers turned around and returned to the highway where one of the highway volunteers assured them that they *were* needed, emphatically asking Angela where she had gotten her information. Angela was confused but apologetic. In a follow-up email, one of the affected trailer drivers said:

I felt confident that [highway volunteer] had been down where the loading was and had the updated information. The person on the horse was riding out so I questioned (in my mind) how she could know how many were left.

Another problem came up later in the afternoon when Harry, who knew the Ranch owner personally, arrived to help. Trudy and Harry had agreed privately that he would take the single remaining stallion and another equine to the temporary ranch, but neither had shared this plan with the organizers. When Harry arrived at Palisades in the early afternoon, he personally surmised that the evacuation process was flawed, and simply informed the volunteers at the Parking & Admin area he would "go down and check it out." The volunteers deferred because he said he was affiliated with the owner and they assumed he was an employee. Harry loaded five horses at the Trailer Loading area and brought them *up* to Parking & Admin where trailers were waiting to go *down* to the Loading area. Instead he unloaded the horses from his trailer, and reloaded them on the trailers at this higher point in the loading sequence. This reordering of the process disrupted what had been a smooth system. It upset the horses, and disrupted the pattern of coordinated work to which the volunteers had become accustomed. After Louise complained to Harry, he acknowledged her authority and that his adjustments were not helping. They reverted to the original process, and Harry moved only the two animals to the temporary ranch, as originally planned.

We see these disruptions as insights into how much the group grew to depend on repeatable, clear actions taken by others. This was the basis for quick development of *intersubjective knowledge* between people and horses they did not know, and for a task that they had never done before, but which had to be completed before dark. In this scenario, we see how Angela became so dependent on the *direct mapping* of the available-horse-to-available-trailer method that she did not realize that other plans, which were invisible to her, were in place for managing what to her appeared to be an excess of trailers. Furthermore, we can see how the distributed group used stations in the landscape to mark the stages of work that were repeated for every horse. The breaking of the coordinated patterns of work, as they were mapped to the landscape, disrupted a system that had worked for most of the day without a great deal of immediate communication between people at different workstations.

5.4.7.8 Home on the range: Arrival at the destination ranch

There were three volunteers at the destination ranch tasked with receiving the trailers as they arrived: Jane, Mary and Audrey, who were introduced earlier in this narrative. Due to the intermittent cell phone reception in the area, no-one at the new ranch knew how many trailers to expect, nor when they were likely to arrive. As the trailers began to arrive, it became clear that some organization was going to be needed to prevent bottlenecks on the driveway. A fourth volunteer was found in Jodie, an employee from the telephone company who had earlier set up the phone service and wanted to help despite a lack of horse experience. She stationed herself at the driveway entrance, and as trailers arrived, she held them back until Jane and the others were ready to receive a new trailer.

In contrast to the loading at the evacuation site, where careful attention was paid to putting horses that got along in trailers together, the volunteers at the destination ranch had not been instructed how best to paddock the horses together. Rather, Jane, Mary and Audrey, as experienced horsepeople, relied on observing the horses' behavior. Audrey said:

I knew to watch them. If there was a problem in the paddock I was ready to go in and remove a mare and put her in the other one.

Fortunately, apart from a few scratches and rubs from the side of the trailers, the horses were not injured, and were successfully penned in the new paddock. By 8:00pm the evacuation was complete. Trudy arrived at the new ranch just after the last trailer had left. She was informed that the horses were all well, and the evacuation was deemed a success.

5.5 Discussion

There are many lessons from this account. Below, we will discuss the following key issues: First, the *improvisational nature of emergency response*; second, *expertise in safety-critical work*; and third, how these matters play out in *ensembles of online and offline work* where the expanse of digital connection as well as the situated, co-located and collaborative expression of expertise intersect.

Threaded throughout these arguments is the idea of distributed cognition particularly as it materializes in the on-the-ground work, but also through prior online preparation. Through this lens, we see how ideation of solutions sprung from uncertain expressions of problem statements, which were quickly forwarded to the local (or local enough) domain experts—in this case, horsepeople in Colorado. We see how expertise interacted with the material conditions of work in a way that suspended the need to have prior working relationships with one's colleagues-of-the-day. Much like other specializations—air traffic control (Halverson, 1995; Mackay, 1999), subway control centers (Heath & Luff, 1992), and snow sweeping (Juhlin & Weilenmann, 2002)—the actors do not necessarily know each other, but they trust their own expertise, others' expertise, and common features of the material environment to allow coordinated work.

Notably, no one had prior experience with such a large-scale evacuation in an environment affected by flooding. This was where a number of psycho-social phenomena came into play, such as the human tendency to "make do" and improvise with tools at hand, as well as the idea of reciprocal trust springing from mutual liability. From a distributed cognition perspective, we see how Frank, as the "expertise concierge" (in the words of McDonald and Ackerman (1998)), reduced the macro goal of herd evacuation into a horse-by-horse evacuation, leveraging the constraints of trailers and making use of the road network as a structure to enforce ordering through queuing and sequenced communication. We discuss these aspects in greater detail below.

5.5.1 Improvisation

By viewing this event from the perspective of emergency management, we learn how intentional a self-organized response can be. Mass emergencies call for on-the-fly flexibility to adapt to changing circumstances and available resources across large numbers of people. Sociology of disaster scholars Mendonça et al. (2001), and Kendra and Wachtendorf (2007) characterize this as *improvisation*, which has strong parallels to scholarship in CSCW about the nature of situated cognition or situated work (Hutchins, 1995; Suchman, 1987) as well as the relationship between informal and formal aspects of work

(Palen & Liu, 2007; Suchman, 1983 & 1987). The difference in the discussions around improvisation is that it is often attached to large-scale endeavors of work. As such, in studies of mass emergencies, the focus shifts to how members of the public converge onto disaster sites to help physically (Fritz & Mathewson, 1957; Kreps & Bosworth, 1994; Tierney & Quarantelli, 1989)—and now digitally as well Starbird & Palen, 2011; White et al, 2014).

These spontaneous volunteers interact with formal aspects of the response to use whatever resources they can access to perform even critical tasks like rescue, transportation to hospitals, and debris removal (Kendra & Wachtendorf, 2007; Mendonça et al., 2001; Tierney & Quarantelli, 1989). Kendra and Wachtendorf (2006) highlight this in their insightful telling of the stunning waterborne evacuation of a reported 500,000 people off Lower Manhattan in the wake of the 9/11 attacks. They describe that a "motley" array of personal and commercial vessels converged onto Battery Park in an orderly though clearly unplanned affair. Although social scientists of disasters have been making this point for years (Kreps & Bosworth, 1994; Solnit, 2010), it fails to significantly permeate federal policies and even simple everyday conceptualizations about the nature of mass emergency work (Palen & Liu, 2007).

Accounts of similar phenomena in the online space have drawn the attention of researchers who are exploring how online work "matters" and how/if it connects to the "real work" on-the-ground. This debate, raised at the beginning of this study, may be justified—but it also may be premature. Requests for proof of direct connection between online and offline work in disaster response may be being asked too soon and in a world in which it is difficult to have both a watchful eye on the online response and be present in-situ to observe the connected activity on the ground, assuming it happens at all.

In the Colorado floods of 2013, we see that online and on-the-ground connection and work *did* happen, although how much is not something we can answer. That said, a rare disaster put this research team in the right place at the right time to study the behavior. This horse evacuation case teaches us how the improvisational work of domain experts produces sustained commitments to work (over a month long). This case study also portrays the ways in which the open-ended parts of the problem were being

staged online until they could culminate in the execution of offline work, which also required domain expertise.

5.5.2 Expertise in time- and safety-critical work

Expertise is a type of embedded knowledge developed within a cultural, social and cognitive environment (Fitzpatrick, 2003). Expertise supports the ability to apply knowledge in different contexts (Fitzpatrick, 2003), including in emergent situations that require experts to improvise, as Normark and Randall note (2005).

In this horse evacuation, we see how relevant domain expertise made the event possible, with all of the initial ideation arising out of a demonstrable online interplay between statements of distress, problem articulation through public questioning and suggestions, and the alerting of a community of practice around horse care. Indeed, effectively all of the evacuation planning—except for the securing of a temporary ranch—was done by people who were unaffiliated with Palisades Ranch or Trudy, its owner. The volunteers connected with each other through their expertise and mutually witnessed the gradual scaffolding of the problem articulation and solution for a situation that, as fellow horsepeople, alarmed them. We note that as horse lovers, they may have been acting to benefit the horses even more so than their owner, Trudy, as has been demonstrated in other studies of pet advocacy mobilization (White et al, 2014). Some who did not assist with evacuation planning instead participated in online auctions that raised significant funds, notably around items related to equestrian matters—reinforcement of this being a community of practice at work.

At the evacuation site, participants arrived with a preliminary understanding of what roles they would play—riders, drivers, and administrative roles, with those assignments reinforced by the type of equipment and helper-horses they were asked to bring. However, uncertainty, was of course, still present. That uncertainty was mitigated by intersubjective knowledge that specialized experts share, in this case about the business of equines.

Work in flight deck operations (Hutchins & Palen, 1997) articulates how intersubjectivity enables overlays of even incomplete gesture or speech upon artifacts to constitute meaning between only the people who have interacted with such socio-material environments before, even when they have never worked with each other. We see similar behavior here in the loading and transporting of livestock, where knowledge of the use of equipment such as halters and trailers, and the nature of working with equines constituted intersubjective meaning between these horsepeople, who had never worked together prior to this event.

Furthermore, calling on Fitzpatrick's ideas, the horse evacuation was an environment where expertise was deferred to and leveraged rather than seen as a commodity to be managed in such a way that it strangles innovation (Fitzpatrick, 2003). In fact, the pride of specialization *enabled* professionalism and mutual respect between people because of their craft. In addition, their expertise centers on *living creatures* and the uncertainty that comes with horses as social individuals further highlights a high level of respect for equine expertise across a very large and distributed community of practice. The horses, it must be remembered, were also actors in this ensemble.

We have noted how trustful Trudy had to be of people she did not know. Indeed, they are people she cannot even thank personally because the paperwork system "failed." In this event, she knew she would need to relinquish control (which might have contributed to her delayed decision to evacuate her horses). In turn, we must also recognize that the volunteers voluntarily assumed liability for driving in terrain and roads that had been damaged by recent floods, where the connection to the official response was unclear (though earnestly pursued), and by carrying horses on their equipment after a taxing day. We see this as "reciprocity of liability" but critically, it was based *on the implied consent that only experts can give,* and this is what made the arrangements work.

5.5.3 Ensembles of online and offline work

In Study Two, we see features of expertise being leveraged to different advantage in online and offline settings, which had corresponding temporal qualities.

5.5.3.1 Digitally casting a wide net to help with rare problems

In the initial weeks, long before Trudy had even imagined a herd evacuation, her distress, expressed online, unintentionally brought experts to the fold who proceeded to ask her questions and make suggestions that more precisely identified and articulated the problem. They sought details about her Ranch, the horses, the terrain, and the post-flood conditions. The digital world, thus, allows the casting of a wide net to gather expertise, which can be very useful when the problem is rare or uncertain, as was this case.

5.5.3.2 Expertise in situ to execute solutions

Studies of work practice in co-located safety-critical environments examine how people employ not only intersubjectivity, but also mutual awareness of action that arises from being co-located (Dourish & Bellotti, 1992; Heath & Luff, 1992). This was certainly at play on the Ranch in both macro and micro ways. The evacuation of the horses depended on the presence of the horses being in the pasture rather than on any kind of starting or even exiting inventory. In micro ways, the riders, loaders, and unloaders "read" the horses' temperaments and relationships to other horses to best lead and load them. The people took their cues from where they were in the chain of four staging areas to know what to do next, and from their spatial relationship to each other and the horses. Notably, while these smaller tasks included long stretches of waiting, requiring a great deal of patience over a long and tiring day, these workers remained dedicated and were sustained by a persistent commitment to the larger, shared goal of evacuation. The calm that blanketed the group was a result of their shared expertise, even in an untested situation. Certainly, in the aftermath of disaster, calm operatives are a highly valuable commodity.

5.5.3.3 The magnifying effect of uncertainty expressed through social media

However, the presentation and awareness of the work in the large was imperfect, and was based in that space on sometimes hastily written posts by Trudy that said, for example, that her many neighbors were supportive. But as we have noted, no one directly consulted the *adjacent* neighbor whose land had to be traversed to get around road damage. This became a problem during the evacuation and indeed

someone affiliated with the recalcitrant neighbor referred online to the event as a "manufactured crisis" and "fiasco." It is not the goal of this study to judge whether the evacuation was ultimately necessary, but we do highlight the tensions around this disagreement, and the ways it sheds light on the function of expertise, the uncertainty of disaster, and social media as a way of participating in disaster response.

We note that there were many indications that suggest that the evacuation was important to the ongoing welfare of the animals and ranchers. One horse had already died, and in my direct, onsite observations I witnessed the surprising and extensive damage to mountain roads. In addition, Trudy remains in her temporary ranch because county road repairs are incomplete at the time of this writing, 15 months after the flooding.

Some participants called the experience "life changing" in that it offered a new view of what they, themselves, could do and what could be done in community-based disaster response. In an interview a week after the evacuation, Frank, the lead organizer noted how remarkable the effort was, although he also said that once he got up to the Ranch he observed that "in my mind, [the situation] was worse than it was." Jason (the recalcitrant neighbor) and some emergency managers also questioned the action. We may believe that in their general unwillingness to support the effort, officials were simply unaware of the needs of livestock in this event. However, Jason, who felt the effort was extreme, is also an expert horseperson who resides directly next to the Ranch.

Some may conclude from Frank's hindsight that the situation was exaggerated, but this is a dangerous place to land. By doing so, we miss many of the finer points about the nature of collaboration and emergent problems. Note that Frank does not regret the actions he took, only that the actions might not have had as drastic a benefit as perceived a priori. Such is the situation with disaster. We easily dismiss how *uncertain* disaster situations are or can become, and how a goal in safety-critical work is to avert situations *before* they become problems. Much of the work in safety-and time-critical matters in CSCW appreciates the implications of vigilance, mutual awareness, and, of course, error, especially propagated error. It is all too easy to blame "pilot error" when a sequence of preceding systemic conditions took place to set a pilot up for perceiving the problem as he or she did (Perrow, 1984; Wiener

& Nagal, 1988), including one that warns of hazard. Indeed, disaster can *magnify* problems, not necessarily out of proportion, though that can happen, but rather so that we focus on specific details when many things are happening. Both meanings of magnification are at play in emergent disaster situations that require rapid action as problems are gradually articulated.

We note that neither the officials nor Jason were engaged in the social media attention on the Ranch as the evacuation was being planned. Calling upon media theory, which considers how mass media frames and focuses the kind of attention an event receives (Downs, 1972; Gamson, Croteau, Hoynes & Sasson, 1992), social media can do the same. Recall that the event was initially called a "rescue," suggesting immediacy and danger. The death of the stallion was dramatic and unusual. The public display of questions and answers about the situation not only scaffolded the understanding of the parameters of the problem, they engaged and compelled a particularly skilled and interested, watchful audience. Finally, the Colorado floods achieved international press: It was a significant disaster event. We might see the plight of Palisades Ranch as a "way in" to grapple with the enormity of an event that engaged the hearts and minds of a community of practice.

This case is notable in that the starting conditions were not known to anyone involved in the earliest planning. Coordination happened "in the dark," that is, without environmental feedback of what they were facing. Even Trudy could not access her Ranch—the weather on the Colorado Front Range had been terrible for days, even weeks. Exposed "burn areas" from prior years' wildfires in the mountains created risk from mudslides and other unsafe conditions for traversal by car. Indeed, emergency personnel discouraged passage so that they could continue with missing person recovery and airlifting, which happened for days after the rains stopped. Ranchers were immediately worried about the viability and pricing of the Colorado hay supply. They had concerns about getting supplies up before winter snowstorms set in, which weather forecasters said were imminent. The surprising and welcome arrival of glorious, clear weather on the day of the evacuation was seen not as evidence of miscalculation about the severity of the situation, but instead, volunteers considered it to be a stroke of luck, as many had brought snow chains and cold-weather clothing.

Disaster—with all its uncertainty and threat—combined with the delivery by social media to a very particular audience attenuated the need for action—highly crafted action.

5.5.3.4 Materiality of onsite expertise

Finally, work in CSCW and distributed cognition has long considered how artifacts mediate and enable work. As we have described in this account, physical presence and properties of equipment—specifically trailers—played a role in supporting coordination, or even in the failing of it (citing the mistaken rider who told drivers to leave).

The visual traversal of trailers across a shared route, even though there were four different staging areas some miles apart where trailers waited and horses were loaded, meant that over time the coordinated work was made visible as each trailer passed on their way in and out. Riders and drivers also passed on information to the volunteers staged at each site, which ensured a mostly common sense of the state of the work. The presence of breakdowns reveals that the system was otherwise running smoothly, and the team worked quickly to revert back to a functional state.

Furthermore, to link this back to the matter of expertise, we see that expertise was displayed through material objects: People wore clothing that was consistent with their identification as equine experts (such as boots and cowboy hats), and the Posse members wore their uniforms. At the Ranch, one job was to hand out halters and lead ropes to riders. If riders' preferred materials were not available, their expertise allowed them to adapt to what was at hand. As Rosner (2012) explains, this goes beyond the "affordances" of objects (Norman, 1999) and instead goes to what the tools represent to their craft and their expert execution of work. Recalling an earlier quote, even the misuse of ropes as a tool when stated only as an *idea*—"*I don't know how to rope or anything*"—is a sign of a novice.

5.6 Conclusion

In Study Two we describe how problems incurred on Palisades Ranch during the 2013 Colorado Floods brought about the convergence and blending of online and offline expertise. The use of social media enabled the problem that the Palisades Ranch faced—the marooning of 38 horses—to be made

visible, which had the consequence of casting a wide net to locate, engage and mobilize appropriately skilled people throughout a community of practice. These volunteer responders brought their expertise to this unusual context, and improvised throughout the planning and execution of a livestock evacuation. The ever-present information gaps and challenges inherent in disaster response were overcome through the pursuit of coordinated work, which came about through the complex blending of grassroots and managerial activity; intersubjective knowledge that comes from expertise; and in the physical display of the movements of the horses and equipment across the geographical landscape. Activities conducted on- and offline frequently, though discontinuously, connected the two spaces across the long span of the event. However, we must recognize that there were also marked breaks of connection between the offline sites too (the two ranches and roads in between), and that those disconnections arose due to the terrain, conditions and distance. In other words, the imagining of work that can be conducted online and offline should not be reduced to simply to a matter of nominality (that is, "online work" versus "offline work"), but rather understood with respect to the disaster conditions that temporally-and spatially distributed collaborative work must accommodate.

5.7 Study Two: Epilogue in Reflection of the Dissertation Questions

This study answers research questions RQ1, RQ2, RQ3, RQ4 and RQ5, with a focus on the ways people "cast a net" across social media to attract the attention of those with equine expertise in attending to the problem of evacuating horses from a ranch that had been marooned by the effects of the Colorado floods. This study shows how expertise can be identified and focused on identification of a problem, and how experts are able to innovate with the materials they could bring to the physical evacuation to attend to the needs of the marooned animals—all while work online continued through auctions that sought to raise funds to support the Ranch owners. The collaborative and improvisational work done across both on-and offline spaces resulted in a successful evacuation. This study answers the research questions in the following ways:

RQ1 What kind of information gets collected about animals; how is it gathered, managed and used?

In this study, information about the plight of the marooned horses was shared on Facebook. However the information was not originally shared with a view to motivating a response. Instead, the Ranch owner, Trudy, communicated a situational update of the status of the Ranch as being under (human) evacuation. One person in Trudy's Facebook network who holds equine expertise independently decided to act on the information. She made phone calls and sent emails to other equine experts she knew to explore the possibility of intervening and to build upon the information in Trudy's post. She aimed to "fill in the gaps" around the information to better identify the parameters of the problem, even though she was only loosely connected to Trudy.

In this study, the information being gathered was about the predicament the horses were in, *not about the horses themselves*. For the responding experts, the horses were the known commodity. The most salient gaps in information pertained to the situation the horses were in. This information was perceived to be even more important than establishing the exact number of horses affected, because the number of horses could be addressed by straightforward adjustments to numbers of trailers and other known resources. The expert responders focused on the factors that might influence the improvisation of response. They collected relevant information, shared and discussed it with necessary and relevant others, and used it to inform their response.

RQ2 What kind of information about animals affected by emergency appears in online and offline arenas?

We saw information about the affected horses appear first on Facebook. Subsequently, as a response was being developed, we saw the core team of equine experts use Facebook, email and equine-focused websites to communicate their specific needs, and identify other experts who might be able to help. The information became targeted, and as people who wanted to join the effort emailed the organizer, he used his own expertise and experience to determine who should be invited to join the offline response.

The information shared referred to the predicament the animals were in. The catalyst for the mobilization of the offline response was the death of the stallion, which highlighted the uncertainty of the conditions at the Ranch and resulted in alignment between Trudy and those leading the volunteer effort regarding decision-making. It also led to a directed engagement of online response, with two online auctions raising more than $22,000.

The information shared online and in offline communications about the Ranch and its predicament was based in fact. However, for these passionate horsepeople, the information generated an emotional response as well. In communications with neighbors we saw online and offline responses that reflected disagreement about the actions taken, and on the perceived need for the evacuation. Increased communications created balance in the response and allowed for realignments and compromise between the experts.

RQ3 Does the information identified, gathered and shared in both online and offline spaces intersect, and what effect does that have?

This study provides clear evidence of information that was identified, gathered and shared in on- and offline spaces. At all stages of the effort, information shared to a broad audience online focused on the ongoing status of the Ranch, and organization of a response. People took the information they saw online and used it as a basis for other action. For some, this meant creating and engaging with online auctions to raise funds for the Ranch. For others, it led to identifying volunteers with appropriate expertise and resources online to effect an offline evacuation, as well as to engaging with officials and others who could provide information that would help articulate the parameters of the problem.

Not all information gathering and experience sharing was positive. Officials were not in agreement across the volunteer effort. At times, officials did not have complete or up-to-date information. Furthermore, while some officials used their engagement with volunteer responders as a way to update their knowledge, others, such as the official at the Larimer County Emergency Operations Center who

advised Trudy that they did not have a record that County Road 59 was closed, used the facts they had, even though Trudy knew that the road in question was completely gone.

RQ4 Who uses the information gathered, and how?

The information gathered informed the kind of response that equine expert volunteers determined they could do. The information motivated them to respond both online and offline. They used it to identify the problem and to gather appropriate human and material resources to solve it.

RQ5 In what ways does the information flow impact the work done in animal-centered emergency response?

While we saw links between the online and offline flows of information, they were not seamless and information being shared was often incomplete. Information gaps that were perceived by different actors in the network created disagreement. A focus on increasing communication between actors, and increased attention on gathering as much information as possible up to the evacuation resulted in smoothing the work of the volunteer response, and brought the volunteers in line with the requirements of the recalcitrant neighbor as well as the Sheriff's office.

CHAPTER 6. Study Three. Information Offline: Exploring Ways Collaborative Technologies Can Help Information Management at Animal Evacuation Sites

6.1 Study Three Summary

Study Three highlights the importance of recognizing the *practice* of responders working with animals in evacuation. This study shows the importance of not relying on top-down documented procedures of work when considering opportunities to create an intervention, even if improvements in information collection, management and dissemination are likely to occur.

As a participant observer with Community Animal Response Teams in Colorado, I worked in a deployment for the Black Forest Fire in 2013 and had hands-on experience with the resources used onsite during that event. Ongoing membership of these teams over the subsequent 22 months led me to propose and develop ideas for two information support tools with staff and volunteers who would ultimately use them.

Inductive analysis across my combined experiences, observations and interviews, as well as developing the two projects, show the need to recognize and elevate the implicit aspects of coordinated work in animal evacuation. This recognition, examined in depth below, also serves to highlight the demands on workers and the kinds of information gaps that exist between officials and workers at different levels of animal evacuation.

6.2 Study Three Introduction

This study is the largest of the three studies completed for this dissertation. While broad in scope, Study Three informs research questions RQ1, RQ2, RQ4, RQ5 and RQ6. The study reports on my experiences as a participatory observer as a volunteer member of the Douglas-Elbert County Community Animal Response Team (CART) in Colorado from June 2013 through January 2015.

In this study we see the ways in which information is gathered and managed in evacuations. We see the impact that the availability of information onsite and its sharing offsite has on the ways work is structured, and how animals are cared for. The focus on paper-based information collection and management, with that information being transferred to others via telephone, constrains officials who are

not onsite in how they are able to support the needs of those working directly with the animals, and in how they are able to report post hoc.

The use of ethnographic methods beyond the scope of a single evacuation event in this study assisted in relationship building that led to two projects. These projects included the use of social collaborative tools to design interventions that I have named "Information Support Tools." In the process of conducting these projects, I explore the potential to improve information flows in animal evacuation (RQ5), and also make explicit aspects of nuanced collaborative work which inform RQ1, RQ2, RQ4 and RQ6. The two Information Support Tool projects are presented in Section 6.7 of this chapter.

This study began with my participation onsite at two animal evacuation sites that were mobilized in response to the Black Forest Fire in Southern Colorado in June 2013. That fire event is outlined below.

6.2.1 Background: Effect of the Black Forest Fire

The Black Forest Fire began on the afternoon of June 10, 2013 and took 10 days to be 100% contained. The fire destroyed 509 homes and charred more than 14,000 acres in the Black Forest, north of Colorado Springs. The Black Forest Fire was the most costly and destructive fire in Colorado history (Rocky Mountain Insurance Information Association, n.d.).

Ultimately, the fire evacuation area covered 94,000 acres (147 square miles) and the evacuation zones directly affected 13,000 homes and 38,000 people across the three counties of Douglas County, Elbert County and El Paso County (see Figure 13).
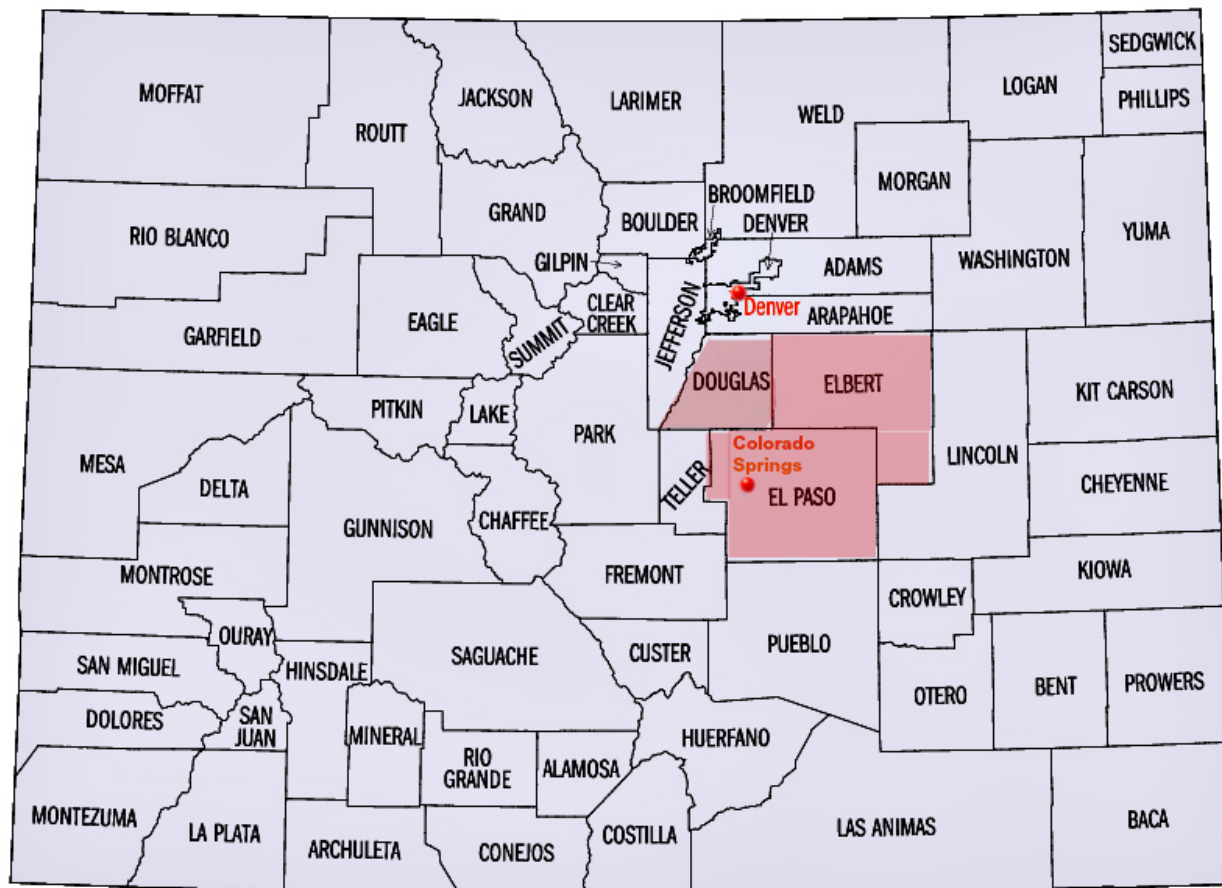
Figure 13: Counties with animal evacuation sites in the Black Forest Fire, 2013.

Two main evacuation shelters for animals were established for the fire: Kiowa Fairgrounds in Elbert County and Calhan Fairgrounds in El Paso County, which sheltered people along with their small and large animals. Additionally, the Humane Society Pikes Peak Region (HSPPR) accepted small animals, and the Norris Penrose Event Center in Colorado Springs accepted large animals. Each of these evacuation centers was located up to an hour's drive from each other and the impacted evacuation zones.

6.2.2 Methods

6.2.2.1 Working as a participant observer at animal evacuation sites in Colorado

Prior to the Black Forest Fire event, I had no existing relationships with emergency responders in the counties under evacuation. On the second day of the fire, I telephoned the Director of Emergency Management for Elbert County and explained my research interest. He invited me to attend the

Emergency Operations Center (EOC) in Elbert County. When I arrived, he wrote and signed a letter approving my access to the evacuation site at Elbert County Fairgrounds, where I would subsequently work as a participant observer and researcher. Over the following week, I worked at two animal evacuation sites. First, I worked for five days at the Elbert County Fairgrounds. Following its demobilization, I was invited by the Humane Society of the Pikes Peak Region to take on a shelter manager role at the Fairgrounds in El Paso County, where I spent a day and a half.

To identify myself as a student researcher as well as member of the Community Animal Response Team (CART) while onsite, I wore an emergency volunteer vest with a nametag (Figure 14).

Figure 14: Identification as student researcher.

My activities onsite at Elbert County Fairgrounds included working with other volunteers cleaning and bleaching wire crates and feed bowls, delivering messages between the small and large

animals areas, and helping organize feed as it arrived. It was busy and physically demanding work in hot conditions. Not knowing how many or what species of animals each hour would bring meant the work was done in an atmosphere of immediacy. The range of animals onsite was diverse, which is typical of animal evacuations across Colorado. For example, at the Elbert County Fairgrounds evacuation site, we managed the care of mice, pigs, a turkey, ducks, chickens, rabbits, dogs, cats, goats, horses, alpacas, llamas, donkeys, and two yacks, among others.

El Paso County Fairgrounds cared for a similar range of animals. When I arrived onsite at El Paso County, many animals had been released as the majority of evacuation orders had been lifted and people were able to return home. There were, however, a number of horses, goats and fowl still onsite without identified owners. My engagement at El Paso County Fairgrounds, therefore, focused on interviews with the workers who were still present, and with shadowing an officer from Animal Control who was relaying information about animals with unidentified owners to the Humane Society of the Pikes Peak Region (HSPPR) to help match displaced animals with owners who had called to report their animals as lost.

I used ethnographic methods to gather data for this study. I took field notes at the end of each day at each of the evacuation sites I worked at during the Black Forest Fire event. In addition, I took hundreds of photographs across the evacuation sites and conducted semi-structured depth interviews on the final day at each site with barn managers and volunteers who had worked there consistently. After the demobilization of the Black Forest Fire animal evacuation sites, I attended and took notes at two debriefing meetings: One meeting was for those who had been involved with animal evacuation, the other was for the overall evacuation effort. Following this, I contacted CART leads in Jefferson County and Larimer County, and interviewed each of them for over an hour. This was necessary to identify common practices and to gather reflections on other evacuation events to ensure my observations at the Black Forest Fire was consistent with other animal evacuations in Colorado.

I continued to record my observations since the Black Forest Fire event through to January 2015 as a trained member of animal evacuation teams in Colorado. The details of this membership are described below.

6.2.2.2 Membership of Colorado animal evacuation teams

Following the Black Forest Fire event, I became a member of the Douglas-Elbert County Community Animal Response Team (also known as DE-CART). DE-CART combines human and material resources to cover animal emergency and evacuation response in both Douglas and Elbert counties. In my role as a member, I attend monthly meetings and training sessions, and completed three online FEMA courses that were a requirement for membership.

PetAid Disaster Services invited me to train for the state level team, the Colorado Veterinary Medical Reserve Corps (COVMRC). I completed that training and also became a member of that State-level response team.

My engagement as a team member has provided a foundation for detailed data collection and inductive analysis, combined with relationship building and observation of work processes beyond that which could be achieved through attending a single evacuation event. These relationships fostered a level of trust with officials and volunteers that enabled this research.

6.2.2.3 Design of Information Support Tools

I used participatory design methods, specifically focusing on information collection methods to design two different, yet complementary, projects that I call Information Support Tools. The experiences that I gained through the projects contributed to a broader understanding on my part of the ways and potential for information collection, management and dissemination in animal evacuations, and the importance of making explicit the practices of work. I report on the design of the two Information Support Tools in Section 6.7.1 of this chapter, as they are key to answering RQ5. The remainder of Study Three informs RQ1, RQ2, RQ4 and RQ6. Overall findings for this study are provided at the end of the chapter.

Below, I outline how information flows across animal evacuations and the effect these information flows have on the work done, as evidenced through the data collected for this study.

6.3 Animals in Evacuation: How Information is Gathered and Managed on the Ground

6.3.1 A proliferation of paper

Animals are surrounded by paper in evacuation. Paper-based forms exist at every stage, from pre-evacuation through to release from an evacuation site, and they form the basis of the visible aspects of information flows. As an example of this, I will outline some of the forms and their use across an animal evacuation, beginning with the Request for Service form. I will also outline the Intake Form, used when animals arrive onsite, and the Stall Care Card, which is used to monitor animal care. Finally, I will describe the check-out process, and describe the ways in which animals and their owners were identified using paper that was physically attached to them.

6.3.1.1 Pre-arrival: Animals needing help to evacuate

I begin with an outline of what happens when an animal needs to be retrieved from a residence under evacuation in Jefferson County.

Humans who are under an evacuation order may be away from home when an evacuation happens, or they may have had other reasons to leave their animals behind, such as a lack of crates or trailers. Many of these human evacuees call the Emergency Operations Center (EOC) requesting that officials retrieve their animals from within the evacuation zone. When the call comes in, the call taker at the EOC hand writes information about the animal such as address and species on a "Request for Service Form" (Figure 15). The EOC then telephones that information through to the Staging Area within the evacuation zone where a volunteer also hand writes it onto a blank, but identical, Request for Service Form. That form is handed to a responder, who goes to retrieve the animals from the address identified on the form. The Request for Service Forms have pre-printed peel-off duplicates, which are torn off and kept at the various points through which the animal is transferred. The final copy travels with the animal to the evacuation site and is kept with the animal's onsite paperwork. Ideally, after the evacuation is over, the completed forms are collected and returned to Animal Control, where they are matched and used as part of the post hoc reporting process for the After Action Report.

Emergency Evacuation/Rescue Request

Jefferson County Sheriff's Office – Animal Control/J-CART – 303.271.5070

Received Call	**Call Taker:**		**Date:**	**Time:**
Assigned Call	**Assigned Team:**		**Date:**	**Time:**
Action #				

Caller's Name:		Phone #:	Cell:

Caller's Address:

Animal Owner's Name: (If different than caller.)		Phone #:	Cell:

Evacuation Location:
(If different than caller.)

Animal Owner Aware of Request?	YES	NO
Address Posted? (If no, include directions/landmarks.)	YES	NO

Access Instructions (garage code, hide-a-key, unlocked windows, pasture/barn access, etc.):

Animal Species/Detailed Descriptions (List):

*Include special instructions (hiding places, loading instructions, loading order, medical issues/concerns, special diets, handling tips/instructions).**

Species	Size/Color	Sex	Name	*Special Instructions	Animal ID #

Responding Group:		Team Leader Name:	Cell:

Time Arrived at Location:		Time Cleared Location:

Actions Taken:

Follow Up Required:	YES	NO
(If so, what follow up?)		

Additional Comments:

Copies: White – Staging, Yellow – Responder Returns Form to Staging after Completion, Pink – Completed Form to Team Leader

Figure 15: Request for Service Form. Note the intended duplication at the bottom.

6.3.1.2 Arrival on site: Intake forms

When animals arrive at an evacuation site in Colorado, additional paper forms are used to register them. The main form used onsite is officially called the "Emergency Impound Form" (as animals taken into the evacuation site are under the care of the Sheriff's Office, and thus are "impounded"). Generally, volunteers and officials know and refer to this form as the "Intake Form." There are two versions of the Intake Form, one each for large and small animals. The form includes fields for the animal species, owner and contact details (if known), and the identifying number or name given to the animal (described next, in Section 6.3.1.3). An example of one of these forms, used in Jefferson County for large animal intake, is shown as Figure 16. Similar to the Request for Service Form, note the intended carbon duplication for different stakeholders across the evacuation, listed at the bottom of the form.

The Jefferson County Intake Form has been adopted for use by many counties across Colorado, although not all counties have the form professionally printed with carbon duplicates. Often the County replaces the name with its own at the top, and simply photocopies the form.

These forms enable information collection about animals from the earliest stages of an evacuation. Once the animal arrives onsite, another way of identifying it using paper is used. This is through the use of paper tags and collars that are physically attached to the animal or its crate, as described below.

Figure 16: Intake Form.

6.3.1.3 Onsite animal information management

6.3.1.3.1 Collars and tags for animals

Animals at evacuation sites are identified in ways that rely on paper *being physically attached to them*. Large animals are provided with a "Rump Tag," a water-resistant paper-based round disc that is affixed with glue to the animal's hindquarters (Figure 17).

Figure 17: Rump tag in use at Elbert County Fairgrounds.

The Rump Tag features a preprinted bar code and number, which the evacuation site volunteer copies onto the animal's Intake Form. Instead of Rump Tags, small animals such as cats and dogs are often provided with paper collars that are wrapped around their necks with their owner's last name and

phone number written on them (Figure 18, left). Other small animals such as rabbits and chickens have the paper collars attached to their wire crates (Figure 18, right).

Figure 18: Paper collars for cats (left); attached to crates (right).

6.3.1.3.2 Binders full of animals

As Intake Forms are completed, they are filed in binders in the barn manager's office (Figure 19). Forms are filed in numerical order according to the animal's identification number, or alphabetical order according to the owner's last name. Over the course of an evacuation, a fairgrounds site may receive hundreds of animals. Information about all of them is collected and managed this way.

Other paper forms used in animal evacuations, but not examined in this study, include volunteer sign-in forms, owner agreement contracts for the care of their animals onsite and other administrative forms. Together these forms combine to support the visible work done by the onsite Community Animal Response Teams.

Figure 19: Intake Forms being added to the binder.

6.3.1.3.3 Checking out: Wristbands for owners

When animals leave the evacuation facility, their owners must go to the barn manager's office to "check out." At this point, the animal's paperwork is taken from a binder, the owner is confirmed, and the paperwork is annotated as released. The Intake Form is then moved to the back section of the binder.

At Elbert County Fairgrounds, which sheltered hundreds of animals during the Black Forest Fire evacuation, the check-out process was inefficient as people were sometimes either unaware or reluctant to ensure the required paperwork was completed before they left with their animals. This proved to be an important issue, as large animals in Colorado need to be approved for release by an accredited State Brand Inspector, to confirm ownership. As areas that had been under evacuation had orders lifted and people began to take their animals home, some onsite animal owners became concerned about security

and worried that people who were leaving with animals were not held to the check out process. Some of the animals were very valuable, and there were concerns they might be stolen.

To address this concern, and ensure that people obtained the necessary Brand Inspection, the Brand Inspector onsite at Elbert County Fairgrounds decided to implement a wristband system. When owners checked out at the barn manager's office they were given a pink paper wristband. The CART then placed a volunteer at the exit points of the Fairgrounds to check that anyone leaving with an animal had completed the check-out process, evidenced through their wearing of the wristband. This system was firmly adopted, and even CART members who had animals under evacuation at the Fairgrounds were compelled to be part of the system (Figure 20).
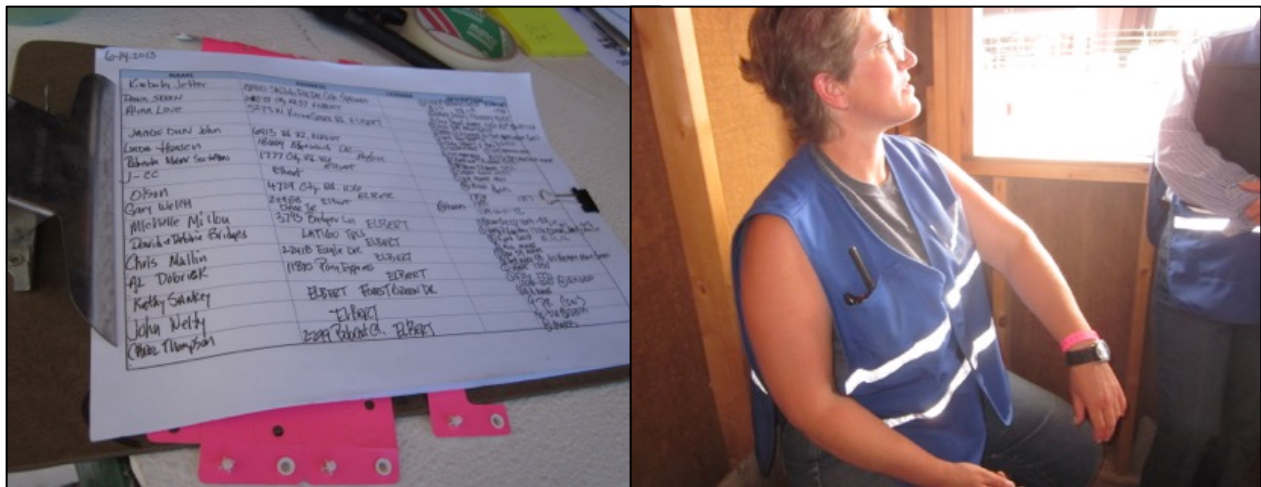
Figure 20: Pink paper wristbands for check out (left);
a CART member wearing her wristband (right).

The wristbands made visible that the check-out process had been completed. Anyone who was not already aware of the process simply needed to be told they needed a wristband to be allowed to leave with their animals, and to get one they must go to the Barn Manager's office. This simplified the communication, and directed people to the correct location so they could then be told the more detailed information about obtaining a brand inspection if they were removing large animals.

Making information visible in this way was effective. However, there were other ways information availability was limited, in both intended and unintended ways, as outlined below.

6.3.2 Limitations of access to information

6.3.2.1 Properties of paper determines possibilities for action

Recording information on paper influences the way it can be used to support action (Sellen & Harper, 2002, p.17). Using paper forms provided different levels of security for animal owners and workers onsite. The Intake Forms were kept in each of the barn managers' offices, where only approved people were allowed access. This ensured that the paperwork remained orderly, and that contact details were not easily available. Owner contact details were generally shielded from volunteers because occasionally a well-meaning volunteer might be concerned about the apparent welfare of an animal at the evacuation site, and may contact the owner to discuss their care of the animal, or even report the owner as abusive to Animal Control. These issues are not the focus of the evacuation site. Furthermore, animals may have already be under the care of veterinarians or have other circumstances that the volunteer is not aware of. In the past, these actions on the part of volunteers have compounded stress for owners already under the duress of evacuation. Therefore, limiting volunteer access to information about owners is a necessary precaution.

This level of information security, though, was not consistent across all paper forms. Some information related to the animals was placed in open view. For example, the Stall Care Cards taped in each stall, recorded the ongoing standard care and management of each animal (Figure 21, left). Volunteers working onsite at Elbert County Fairgrounds updated the cards progressively over the evacuation with entries related to food, water, exercise and so on. When the site was demobilized, the cards were often dirty and ripped, due to being exposed to the weather and common afternoon thunderstorms, so they were often thrown away (Figure 21, right). Additionally, some animals are destructive of their environments, and more than one Stall Care Card was eaten.

When Stall Care Cards were ruined by the environment (such as weather, or the animals themselves) and were then disposed of at the end of an evacuation, so too the information they contained was lost. For workers on the ground, this wasn't important—they had finished using the information and

were not aware of any further need for it. However, the disposal of the paper-based information meant that officials would be unable to access any of that information after the fact—creating an information gap should an animal's owner have an issue with their animal's care and want to get a report from the Sheriff's Office when the evacuation was over.
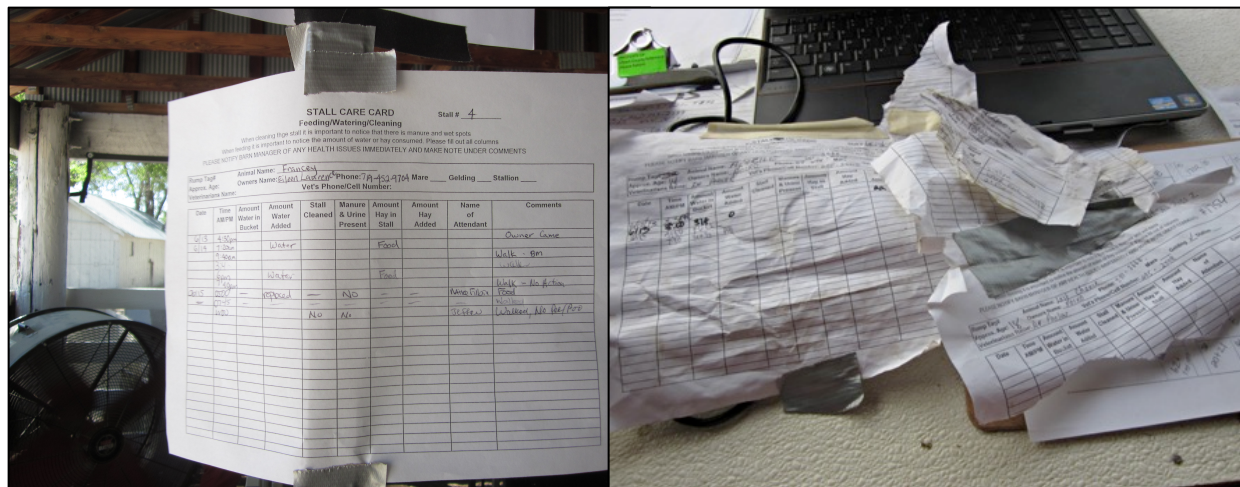
Figure 21: Fresh Stall Care Card (left); Stall Care Cards after evacuation (right).

Just as Intake Forms were kept secure in the Barn Managers' offices, information stuck to the walls of the barn managers' offices was also kept from public view. This information included offers of donated resources such as pasture and information about lost animals. Barn managers wanted to ensure that the sharing of this information was controlled.

Visiting veterinarians used whiteboards in the barns where animals were kept at both evacuation sites to record the care of animals affected by the fire. Animals owners' privacy was retained by limiting access to the barns to approved volunteers and owners. However, similar to the discarded Stall Care Cards, information on the whiteboards was erased at the end of the evacuation event. This made it difficult for officials to reconstruct the care provided to animals by veterinarians, if there were a need to do so after the event. These observations reflect and reinforce the lessons from Sellen and Harper (2002, p. 137) who state:

> *"what people do with paper documents in their hands and in their minds is bound up with a division of labor. These specifics and their relation to the affordances of paper are often opaque and difficult to understand even for those deeply familiar with them."*

Beyond control of the paper-based information, there was also a remarkable effort to limit access to information held by humans. At Elbert County Fairgrounds, the Incident Command van was situated at the main entrance to the site. After the first couple of days, the van was sectioned off with official tape looped over chairs surrounding its entrance to stop people constantly entering the van (Figure 22). The fact that people were constantly trying to access the Incident Command van to ask questions indicates a lack of information availability. The decision to rope the van off reduced access to information even further, but it appeared to be effective in stopping people enquiring at Incident Command, which was apparently the sole aim.

Figure 22: Limiting access to the Incident Command Van.

6.3.2.2 Verbal information transfer: Effect on cooperative work

There are unintentional ways that access to information has on cooperative work. These effects are more difficult to see, at least until they are made evident through the practices of those working with the animal evacuation. At the animal evacuation sites, the "whispering chains" form of verbal transfer of messages often led to information gaps. For example, at Elbert County Fairgrounds, information ranging from the time of the next briefing through to requests for more water bottles or what might be available for lunch was sometimes missed. However, these gaps were fixed quickly by having frequent catch-up conversations.

6.3.2.2.1 Onsite: Foot-based verbal communication

Fairground sites are geographically wide locations, with a limited line of sight across large spaces. During the evacuation, volunteers and officials on the ground were distributed across the full area as they worked in the barns and stalls, and constantly moved between locations.

The primary method of communicating on the ground was verbal, relying on micro-level face-to-face communications between volunteers working onsite and the people bringing in animals. The content of these communications included letting volunteers know consistent information, such as they should not feed horses (which was the owners' responsibility for animals with identified owners), or that water needed to be checked. Repeating these communications verbally was inefficient. For example, if people were not directly situated near those speaking, the message had to be repeated to others over the few minutes following the first communication. As a member of the Red Cross said during a debriefing, "We needed to over-communicate. We need *more* communication."

I observed that communication was most frequently done on foot, with people walking to other locations onsite to transfer messages and ask questions—a sometimes time-consuming task when people were difficult to find and constantly on the move. To speed up the process, there were three ATVs onsite. These were used by official representatives from the Sheriff's office, and by volunteers working with large-scale logistics such as pen set-up.

6.3.2.2.2 Offsite: Minimal access to information from on the ground

Officials working offsite also experienced limited access to information they wanted. The only way each of the animal evacuation sites was connected with the offsite Emergency Operations Center (EOC) was by telephone calls to the onsite Incident Command van. At both evacuation sites I worked at, Incident Command was located at the top end of the fairgrounds, quite a distance from the barn managers' offices.

It is standard practice for the State level EOC representative to call at least once each day to ask the number of animals at each site. The evacuation sites are rarely ready to transfer even that small amount of information because it is distributed across the paperwork at each barn, and the phone call from the EOC might come at different times each day. The need to identify the required information from each barn and total it necessitated a return phone call from Incident Command (D. Schnackenberg, personal communication, July 8, 2013).

The EOC in Douglas County also takes calls from the public. Operating under the National Incident Management System (NIMS), the Emergency Support Function (ESF) #11 desk in the EOC is charged with needs surrounding agriculture and natural resources, and is reported to be "the busiest desk in the EOC in every fire we've had [in Douglas County]." (A. Walton, personal communication, September 30, 2014). Callers to the EOC seek information to support their evacuation decision-making such as whether to take their animals or leave them, when to leave, where to go, and if they can donate hay, food or other supplies (A. Walton, personal communication, September 30, 2014). Repeating information through these individual phone calls about each of these items takes a lot of time, and the answers are almost always the same.

6.4 Information in Flux: What is "Known"

At each evacuation site, small ad hoc teams within the CART come together to perform tasks such as building pens and moving animals. Volunteers then re-orient themselves to other tasks, as directed by the barn managers. All this work is done with a sense of urgency, as the unpredictable nature

of animal evacuation means animals may suddenly arrive en masse—or not at all. This changing environment calls for volunteers to be flexible and open to accepting conflicting information without question. As one official told me:

"To be good at volunteering you need to be able to be told something is blue today, green tonight, blue tomorrow, and then red tomorrow night, and adjust to working within that. Also [there is a] need to adjust the rules according to situations that come up, and to support and work well with others who are doing the same" (D. Schnackenberg, personal communication, July 8, 2013).

People working at these sites must contend with a fluidity of knowledge and understanding about the current situation at the animal evacuation site. It is hard to know what information needs correcting and what information actually stems from a change in procedures. It appeared that information was at times unreliable, but this was not a reflection of the source or the quality of the information. It is rather a condition of working in emergency response.

Volunteers also need to turn quickly from one known condition to another as it becomes realized. This indicates and requires a level of expertise. As trained CART members, most have experience from non-disaster work with animals as well as experiences at different evacuation events. Thus, these workers hold expertise that informs their practice.

6.5 Communication Technologies Used at Different Levels of Response

Not all information at the evacuation sites was transferred by foot or telephone. Walkie talkies were present at all sites, but they had limited use due to lack of coverage and a lack of chargers. With only a limited number of walkie talkies available, they remained accessible only to key people on the ground such as barn managers. Even for this small number of people, there were other problems in using the walkie talkies. At the end of the second day at Elbert County Fairgrounds, the barn manager forgot to instruct her overnight replacement how to charge the walkie talkie. Thus when the daytime barn manager arrived in the morning, the walkie talkie was dead and remained useless the entire third day.

This invites the question, "Why not use cell phones?" The volunteer CART members did not use (ubiquitously common) cell phones to support their communications onsite. Cell phones have become a

fascinating area of study, particularly in the ways they have become normalized for communication, even in intrusive and disruptive ways (Ling, 2008). However, barriers to adoption and use of cell phones have also been shown to be many and complex (Katz & Aakhus, 2002; Rice & Katz, 2003). Barriers to cellphone use by volunteers at animal evacuation sites may include not knowing other members of the teams well enough to want to exchange contact numbers, not owning a cell phone, and/or simply being wholly absorbed in the physical task at hand. Whatever the case, the overall lack of cell phone use did not impede the work being done. Messages were transferred and animals were cared for, without any dangerous situations or significant lapses.

While the telephone and walkie talkie were the main tools of communication in use by officials and barn managers at Elbert County Fairgrounds, and other volunteers relied upon verbal communications, a test of a system that had been purchased by Veterans Affairs was also conducted, to ascertain whether it might be possible to digitally monitor animal movement.

6.5.1 Software pilot at Elbert County Fairgrounds

A team from Veterans Affairs arrived at Elbert County Fairgrounds to conduct a pilot project using the proprietary Intermedix patient management software system, to see if it might be able to be used for animal evacuations. The Intermedix system uses a specially designed handheld scanner to scan barcoded paper tags that are affixed to humans and their belongings in an evacuation, when the humans may not be independently communicative, such as when they are in a nursing home or hospital.

I assisted in conducting a mock evacuation of some rabbits using the system, pretending to move them from this evacuation site to another location (Figure 23). The Veterans Affairs team was enthusiastic, felt the test went well, and shared the experience with the barn managers and Director of Emergency Management at the site. However, during a conversation with the Brand Inspector afterwards, he told me he was unimpressed, saying he believed the system wouldn't help him manage the necessary brand inspections required by the State of Colorado.

Figure 23: Pilot of the Intermedix Patient Management Software System adapted for animal evacuation.

6.6 Discussion

6.6.1 Paper forms used for information collection and management

Adding to the challenges of using many paper forms across the evacuation event, volunteers did not complete any of the forms in a uniform way. They provided different levels of detail, and often completely ignored many fields on the forms. Trained volunteers are instructed to record the information on the Intake Forms themselves, rather than having owners complete them. This aims to assist in ensuring consistency in recording, and eliminates the problems that may occur when faced with literacy issues of evacuees (PetAid Colorado Disaster Services, 2015). However, if one volunteer takes on the job of filling

in many forms on behalf of animal owners, this may result in consistently incomplete information being collected, or worse, in many fields of information being completely ignored.

These kinds of problems are similar to those referred to in literature about information collection and management about patients in medical environments. For example, the structured fields within the paper forms used in animal evacuation do not support making additional, informal notes that might help with caring for the animal, an issue which has also been observed in research in hospitals (Chen, 2010; Hardey, Payne & Coleman, 2000). People tend to make their own additional notes on paper scraps. Paper forms also do not provide tracking of who wrote down the information at each point (Bossen, 2011), a common concern across medical environments and evacuation sites. Additionally, in the realm of animal care, with many fields available for information entry about animals and owners, there is a lack of understanding about who may need to access the information collected (Chen 2010), and what use the information might have beyond the evacuation site.

Over time, a veterinarian may incorporate information from the Stall Care Card into an animal's health record, and ultimately, the Sheriff's Office would like to keep this information on file in case of post hoc enquiries. However, workers filled out the forms to the extent *they felt necessary*, leaving many fields blank, thus limiting access to and use of the information (Fitzpatrick, 2004; Zhou, Ackerman & Zeng, 2009).

6.6.2 The role of forms in the structure of the response team

The aim of paper forms is to provide a procedural structure to the ways work is done by recording information at each stage, from animal intake through to release. These forms make explicit areas of work where information can be collected, while ignoring the "invisible work" (Star & Strauss, 1999) that is vital to ensuring that flows of work are completed. However, this invisible work still exists, and operates on top of the layer of paperwork.

It is important to note here that the CART members, particularly those who have been members of the teams for a long time, have invested a significant amount of thought and energy to developing the

paper forms to support their work. They have coordinated their revisions and updates to the forms, and see paperwork as key to demonstrating their accomplished organization of the ways the work is done. This visible accountability is important (Bardram, 1997). For these volunteer teams, it would be unwelcome to suggest that paper-based forms should not be used.

Generally, CART members are happy to continue to manage information with paper, and are interested in finding ways to increase the longevity of paper. For example, at the debriefing meetings following the Black Forest Fire, CART volunteers suggested plastic sleeves as a way to better protect paper forms from the weather and animals.

6.6.3 Limitations and inefficiencies of paper forms

The affordances of paper as an information management tool include advantages such as resilience (Luff, Heath & Greatbatch, 1992; Hartswood, Procter, Rouncefield & Slack, 2003), flexibility in the way they are laid out and the way they are easily updated (Sellen & Harper, 1997), easily viewed (Heath & Luff, 1991; MacKay, 1999), portability and more (Sellen & Harper, 2002; Nomura, Hutchins & Holder, 2006). Paper forms are effective in that they keep information private to single-access copies and their production incurs minimal expense. As shown in the above descriptions, all of these were observed at these evacuation sites.

However, paper is not the most efficient way of recording and managing information in an outdoors fairground environment, let alone during an evacuation event. In that location, environmental elements such as wind and rain (along with destructive animals such as goats) are likely to limit the longevity of papers and the information they contain.

Additionally, the information stored on these pieces of paper is often needed by people beyond the spatial bounds of the fairgrounds, and beyond the temporal bounds of the event. During and after events, State and Federal operatives would like to be able to access information from all animal evacuation centers about the animals at each site, their care, etc. If this were possible, it would enable a comprehensive understanding of the situation at each location, as well as across an entire event.

Despite these identified advantages of retaining paper records, there is no single information repository spanning all evacuation sites in Colorado. In a multi-sited evacuation, to gather information about the animals being held at each location, the representative at the EOC must telephone and enquire. This lack of information availability compels the EOC to ask the most basic of status questions, such as "how many animals and what species are onsite?" so that information gathering is as straightforward as possible. The EOC uses this information to help determine where to direct people with animals still being evacuated. However the limited information availability constrains reporting on finer details such as which animals at a site do not have identified owners.

6.6.4 Access to information influences cooperative work

It's important to remember that members of Community Animal Response Teams (CARTs) are volunteers, focused on animal welfare. As such, they are not interested in work or information that they do not recognize as directly supporting that outcome. Recording information beyond that which can be used to directly support day-to-day animal care operations often seems to them to be a waste of time. Volunteers tasked with completing the forms enter information that they personally consider is "enough," and which reflects the ways *they* know information is used.

Interestingly, training for CART teams includes a high level overview of the National Incident Management System and how animal emergency management fits within it (PetAid Colorado Disaster Services, 2015). Training does not include finer details such as the need for information flows between different levels of actors. Generally, CART members onsite do not consider the after-the-fact reporting needs of officials, which is likely due to the pressures of work on the ground and because they simply do not know what is needed. If they knew the difficulty that officials experience finding out details of an evacuation after the fact for After Action Reports, perhaps CART members would be more diligent about completing more fields on paper forms. This represents another information gap. An update to volunteer training could improve this, and thus improve coordination between workers both on the ground and offsite.

However, training is not a complete solution. Even if every evacuation site had their current animal and species count at the ready for a phone call from the EOC each day, it still would not fill other information gaps, such as knowing information about animals without owners and details about veterinary care status for each animal.

6.6.5 Access to information influences animal reunification with owners

At Elbert County Fairgrounds, an easel was located close to the Incident Command van at the main entrance. That easel held volunteer check-in/check-out forms, and a white board for information sharing with the public and visiting media throughout the evacuation (Figure 24). However, the information that was shared was inconsistent and often incomplete. For example, one day the board listed a few displaced animals that were onsite, but the list did not include two dwarf goats we had been seeking the owner of for more than three days. This omission may be associated with the distance between Incident Command and the Small Animals Barn (located at opposite ends of the site), and the need to transfer information between locations on foot. Whatever the case, the two dwarf goats remained unclaimed at the end of the evacuation and this inefficient information flow may have contributed to the inability to reunite them with their owner.

Figure 24: Easel at entrance to Elbert County Fairgrounds.

6.7 Information Support Tool Design Projects

As part of this study, to address RQ5, I conducted two Information Support Tool design projects aimed to explore whether it might be possible to improve the capture, management and dissemination of information through the use of social collaborative technologies. I will now outline these two projects and their outcomes.

I first outline the Mapping Project Information Support Tool (the Mapping Project) in Section 6.7.1.1. That project incorporated participatory design methods to create maps to help people in decision-making and to access animal evacuation sites in Elbert County and Jefferson County. The text contained within Sections 6.7.1.1.1 through 6.7.1.5.2.2 is a reprint of White, J. I. & Palen, L. (2015). Participatory Mapping for Disaster Preparedness: The Development & Standardization of Animal Evacuation Maps. *In Proceedings of ISCRAM 2015*. This reprint appears here with the permission of my co-author, Leysia Palen.

After the Mapping Project, I report on my experience developing a second Information Support Tool, the proof-of-concept prototype of the Animal Evacuation Management Tool (AEMT), detailed in Section 6.7.1.2.

An overall analysis of the two projects, along with the data discussed so far in this study and how they answer the research questions, is contained in Section 6.8.

6.7.1 Information support tool 1: Mapping Project

6.7.1.1 Project summary

Animal owners face complex decisions in evacuations. In the US, an Emergency Operations Center is often inundated with calls from animal owners who are aware they are under pre-or mandatory evacuation, but are unsure of what to do about evacuating their animals. Often animal evacuation is a highly improvised activity for owners and responders, though there is a now a general push toward streamlining procedures because of the high impact the matter of animals has on society's welfare during times of emergency. Below, we report on the use of participatory design methods in a mapping project to support the range of people involved in animal evacuation during mass displacement events. The work provides insight into both procedures and standards for creating evacuation maps that communicate clearly with the public and across the range of emergency responders.

6.7.1.2 Introduction

Animals play a vital role in the lives of humans. For many, companion and service animals are members of the family, while for farmers, livestock are critical to their livelihoods. The loss of animals during the UK mad-cow disease crisis demonstrated how economically and psychological devastating the loss can be to farmers (Hagar & Haythornthwaite, 2005), yet the plight of animals in disaster often goes unreported. For example, though there were "no deaths" reported in the Christchurch, New Zealand earthquake of September 2010, more than 3,000 animals were killed, which mainly impacted farmers (Glassey & Wilson, 2011). Research shows that people take into account a number of factors in

evacuations (Dynes, 1983; Quarantelli, 1980; 1990), and the matter of their animals is a significant one that informs decisions. For animal owners, the decision of how to evacuate, where to go, when to go, and so on, is complicated by the human-animal bond (Hunt, Bogue & Rohrbaugh, 2012; Irvine, 2004b; 2009).

In the US, the PETS Act of 2006 alleviated some of the problems of human-pet evacuation. The legislation was a result of the devastating effects of the 2005 hurricane season in the US, when many people failed to evacuate because their pets were not allowed on public transport or in evacuation shelters for humans. For those who did evacuate, upwards of 70,000 pets were separated from their families and euthanized or left to die. The PETS Act now enables people to evacuate with their companion and service animals on public transportation. It also provides financial support for animal shelters in affected regions (Leonard & Scammon, 2007; Mike et al, 2011). The PETS Act, however, does not have contingencies for large animals.

Still, even with the PETS Act in place, people may delay evacuating, or not evacuate at all out of concern for their animals. Challenges in transporting animals, especially if they do not easily fall within the scope of "companion and service animals" covered by the PETS Act, increases the burden on animal owners who may have to seek outside support (White et al, 2014). This may further delay evacuation, or even lead to evacuation failure.

For people who own animals in Colorado, where the work reported in this paper was conducted, it is common for the county's local fairgrounds to receive animals during a disaster evacuation. Wildfire is the most common mass evacuation hazard in the region. When such evacuations occur, the workload is tremendous, as animals, people, and equipment converge onto fairgrounds that have been hastily converted into shelters for a range of large and small animals under stressful and usually high-temperature conditions. Once at the fairgrounds, owners often leave their animals behind and trust that they will be monitored and cared for. Teams of trained volunteer animal responders known as Community Animal Response Teams (CARTs) manage the animals on-site at the fairgrounds. They also often provide logistical support for those needing assistance in moving their animals, and care for animals displaced from their owners (PetAid Colorado Disaster Services, n.d.).

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The focus of this project was to streamline these important activities and create information resources that are helpful to emergency management personnel, CART volunteers, and animal owners. Specifically, we report on a participatory design activity that created easy-to-use maps that support the complicated logistics of a large-scale animal evacuation. The project reports on how computer science students and emergency responders (both professional and volunteer) created standards (including map symbols, layout, and messaging) for use in animal evacuation. We discuss how a team of students and practitioners created and deployed fairgrounds evacuation maps for two counties in Colorado, including lessons learned around matters of map development and community engagement. The resources created—including map symbols and a checklist field guide resource —are made available so that other regions might do the same (see Section 6.7.1.5.2.2 for details of how to access those resources).

6.7.1.3 Background: Maps for animal evacuation

Because convergence onto fairground sites means that people come from near and far, the logistics are complicated, and there are few maps to instruct people what to do once there. Fairground maps are often generic maps that show only the physical features of the land (buildings and fields), and are not tailored to the multi-animal use of an emergency animal shelter. They do not provide information about how the shelter will be *used* for the evacuation. This complicates the organization of the effort and therefore the instructions to the public because of insufficient intersubjective awareness about what needs to be done. The lack of intersubjective awareness between evacuees, CART volunteers and officials in an evacuation context limits the extent to which some of the coordinating work of getting animals onsite can be decentralized to those owners who are bringing them with trailers and trucks.

Fairground sites are geographically large spaces with a range of infrastructure. Though many members of the public may have attended their local fairgrounds in normal times, the way the sites are set up in animal evacuation mode is different. Animals may be sheltered in different locations to those people may expect them to be housed, and may even be placed in temporary pens. Traffic flows may be restricted, and security requirements call on visitors to the site to complete sign-in procedures and other

paperwork. Arrangements over the course of the evacuation period could also change, with animals being moved to different areas onsite as new animals arrive and as the CART reassesses its resources. The lack of a *shared* map resource reflecting the current state of the site leads to misunderstandings, and thus likely misinforms action (Dymon & Winter, 1991).

Research on the use of maps in emergency has included the societal impacts of mapping hazards (Monmonier, 1997; Dymon & Winter, 1991; Dymon 2003), and recent work has explored the pervasiveness of social technology and the use of crowd involvement to create maps in crisis (e.g., Liu & Ziemke, 2013). The socially constructed meaning of maps is also important. For example, Henderson (2013) invited Hurricane Katrina survivors to render cognitive maps after the disaster, highlighting how people nevertheless have multiple contextual understandings of space. The availability of open data mapping tools (Soden & Palen, 2014), specifically OpenStreetMap, invite new thinking about co-creation of maps of land use for critical situations that have short temporal durations—maps that impose meaning on how features like buildings, fields, arenas, and parking lots are to be used for a specific situation; in this case, animal evacuation.

Dynes (1994b) states that, "the goal of emergency planning is to anticipate courses of action based on projected problems and possible solutions." With this and the previously referenced literature as the foundation, we envision how the creation of maps of locations *in evacuation mode* using social technologies in collaboration with officials and volunteers could produce a valuable resource.

6.7.1.3.1 Using participatory design to leverage expertise

The creation of these maps calls upon more than local knowledge or an ability to use digital tools, though these are of course necessary. The creation of useful maps that make visible how the physical infrastructure is assigned and how the traffic must flow during a high-convergence evacuation depends upon the expertise of those working with animals at such sites. It is important to note that those working with animals at these locations are often aligned with multiple agencies, and they may only come together for exercises or call-out responses. Participatory design (Greenbaum & Kyng, 1991; Muller, 2003; Muller

& Druin, 2012) with a community mapping influence (Amsden & VanWynsberghe, 2005) incorporates multiple stakeholder input to best reflect how maps should appear and what they should include, while concurrently supporting community development through engagement around the task.

6.7.1.4 The Mapping Project

To support the demands of creating such a map, students experienced with using digital tools and who were invested in supporting a community project were included, as well as people who were experienced in fairgrounds use in evacuation operations. None of those involved were formally trained as designers. Instead, we used participatory design techniques to ensure good and accurate design, and to give the stakeholders ownership of the resource creation, so that it might be then be adopted, distributed, and used (Schular & Namioka, 1993; Muller & Druin, 2012).

The goals of the project were to:

a. Provide a map that efficiently presents information to the public to help in their decision-making for evacuating with their animals, both small and large;

b. Improve the coordination and flows of traffic in accessing fairgrounds sites;

c. Provide the people who work at and with animal evacuation sites (e.g., CARTs, Animal Control, Directors of Emergency Management and fairgrounds staff) with the opportunity to include the aspects they most wanted people converging to the fairgrounds to understand; and

d. Provide CART members with a relationship-building opportunity beyond the temporal-spatial confines of a disaster deployment, along with ownership of the resource they produced.

6.7.1.4.1 Execution

The project was conducted over five weeks in Spring 2014. Eleven students in the Social Computing course at the University of Colorado Boulder launched the project as part of their course capstone work. In this reporting, the computer science student participants are referred to as "student designers." A selection of subject matter experts (SMEs) who are active in the operation of two

fairground sites when in an evacuation mode were invited. The SMEs were CART members, fairground managers, local animal control and county and state-level emergency management officials. In Elbert County, three stakeholders participated in the onsite mapping session, and in Jefferson County, six stakeholders participated. The student designers divided into two teams, with six students working with stakeholders at Elbert County Fairgrounds and five students working with stakeholders at Jefferson County Fairgrounds. I arranged the access and coached the teams throughout the project.

6.7.1.4.1.1 Elbert County Fairgrounds

I am a CART team member and, as mentioned above (Section 6.2.2), I worked at Elbert County Fairgrounds through the Black Forest Fire event in 2013. I saw the problems of evacuation logistics first-hand, and have built a strong relationship with those animal and emergency managers, giving me the opportunity to propose this project to them. Elbert County Fairgrounds is located in a rural area in Southern Colorado. The location has multiple points of access and limited lines of sight. It is well known by local residents who visit the Fairgrounds for recreational activities such as rodeos. The Fairgrounds Manager supplied us with the map of the facility (Figure 25, top), which gives basic information about structures, their location onsite and their size.

6.7.1.4.1.2 Jefferson County Fairgrounds

Jefferson County Fairgrounds is located along the Front Range in Northern Colorado. The CART for the county is recognized as a leader in its procedures, an important reason the project was conducted there. The Fairgrounds Manager supplied us with a map of the facility (Figure 25, bottom), which, similar to the map of Elbert County Fairgrounds, identifies the locations of structures and areas of general use.

Both sites have been put into operation multiple times in recent years as animal evacuation sites. An important benefit of conducting the project at two sites with different stakeholders was that it helped scaffold joint work, thus making the results more generalizable for other fairgrounds beyond this project.
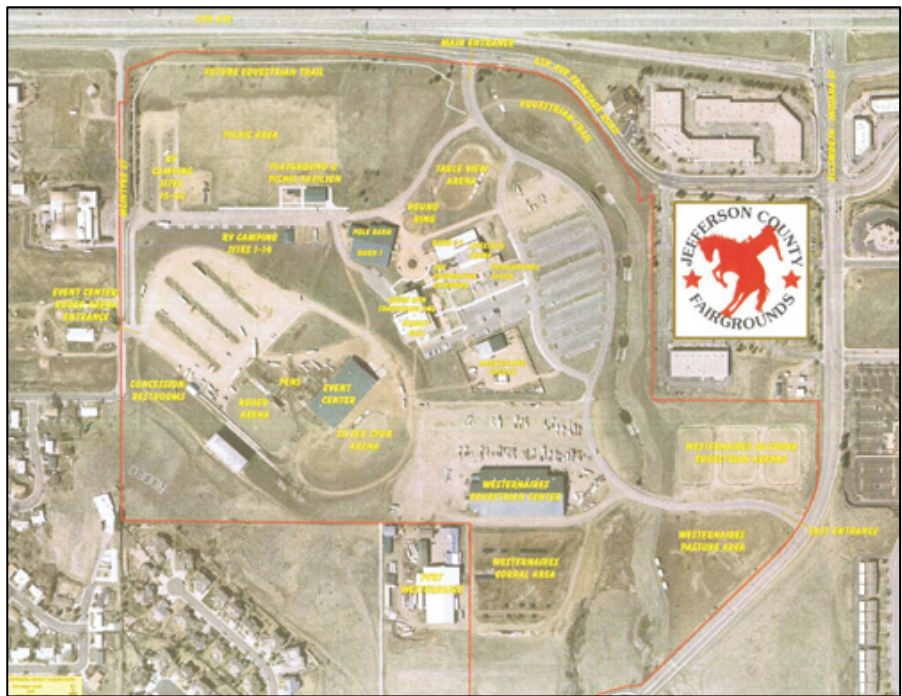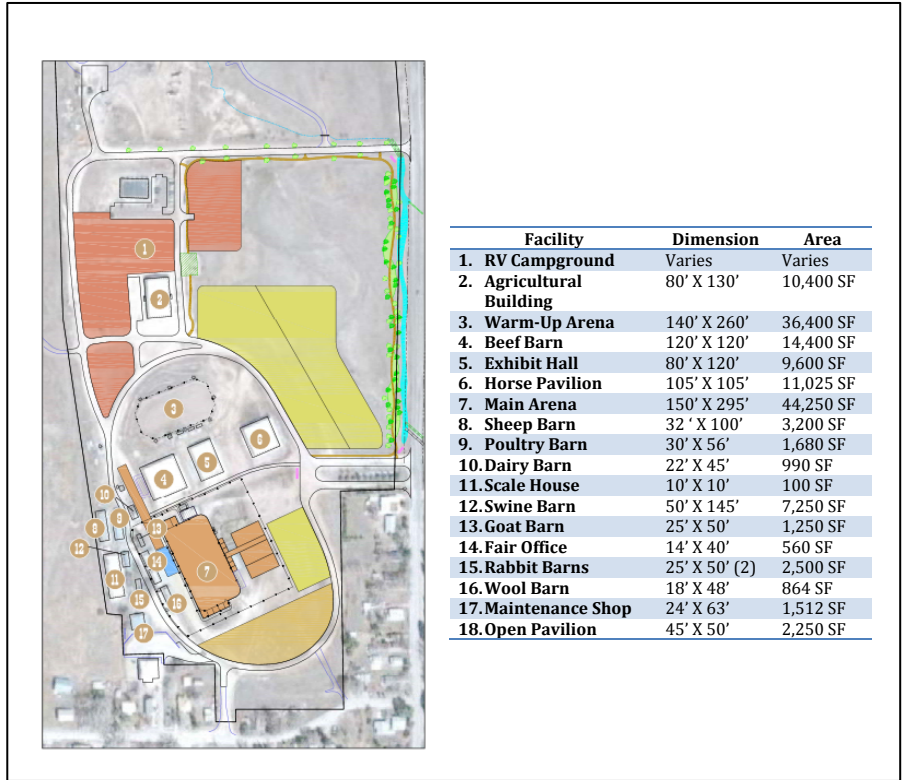
Facility	Dimension	Area
1. RV Campground	Varies	Varies
2. Agricultural Building	80' X 130'	10,400 SF
3. Warm-Up Arena	140' X 260'	36,400 SF
4. Beef Barn	120' X 120'	14,400 SF
5. Exhibit Hall	80' X 120'	9,600 SF
6. Horse Pavilion	105' X 105'	11,025 SF
7. Main Arena	150' X 295'	44,250 SF
8. Sheep Barn	32 ' X 100'	3,200 SF
9. Poultry Barn	30' X 56'	1,680 SF
10. Dairy Barn	22' X 45'	990 SF
11. Scale House	10' X 10'	100 SF
12. Swine Barn	50' X 145'	7,250 SF
13. Goat Barn	25' X 50'	1,250 SF
14. Fair Office	14' X 40'	560 SF
15. Rabbit Barns	25' X 50' (2)	2,500 SF
16. Wool Barn	18' X 48'	864 SF
17. Maintenance Shop	24' X 63'	1,512 SF
18. Open Pavilion	45' X 50'	2,250 SF

Figure 25: Existing maps for Elbert County Fairgrounds (top); and Jefferson County Fairgrounds (bottom).

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6.7.1.4.2 Preparing to map

The project was scheduled to be completed within a five-week period as described in Table 3.

Week	Activity
1	*Student designers:* Conduct literature review on animals in disaster, CART operations, participatory design methods and evacuation and purpose-built maps. *Stakeholders:* Receive briefing on the goals of the project. Explain the project aims to provide an information resource they might find useful in communicating to the public in evacuations.
2	*Student designers:* Use OpenStreetMap to create a base layer of infrastructure and roads for the fairgrounds sites. Export these maps to Walking Papers. Identify questions to ask to assist with knowing what needs to be mapped, and what does not, and send to stakeholders before on-site mapping session. *Stakeholders:* Review student designer questions in preparation for mapping session. Gather any existing maps and information to assist the process. At the end of week 2, hold the on-site mapping session.
3	*Student designers:* Transfer information from field papers into a new map design that reflects the site in animal evacuation mode. Create map symbols as appropriate. Email maps to stakeholders for feedback. *Stakeholders:* Review maps, and provide feedback to students via email. Detail elements that need adjustment, addition or deletion.
4	*Student designers:* Incorporate stakeholder feedback. Create second iteration of maps. *Stakeholders:* Provide student teams with preferred means and format for receipt of the maps – digital, paper, etc.
5	*Student designers:* Deliver final maps to stakeholders in preferred formats.

Table 3**: Mapping Project schedule.**

6.7.1.4.2.1 Development of questions to guide the mapping session

In preparation for the onsite mapping session, students posted questions to a shared Google document. During Week Two, the authors reviewed the questions, and answered those we could, based on our own experience. Expecting that many more questions would become apparent once in the field, I reworked the remaining questions to serve as a semi-structured guide for interaction with the stakeholders. I grouped the questions into three categories: Infrastructure, Resources and Traffic Flows (Table 4). I distributed this set of questions to each of the stakeholders via email two days prior to the mapping session.

1	INFRASTRUCTURE
1.1	What are the main check in/out places?
1.2	Which animals go in which location?
1.3	Do you have a location for animals that 'do not play well with others?'
1.4	Where are the temporary structures located? (Emergency Operations Center, temporary pens, anything else relevant?) Would you like these on the map in some way?
1.5	Is there a difference in the setup for different evacuations? (We want the map to be useful in most circumstances. We want to talk about the best way of doing that.)
1.6	Human toilets - Which would you like the public/volunteers to use?
2	RESOURCES
2.1	Feed - Where is it stored? Different types?
2.2	Water - Where are the main water access points?
2.3	Electricity - Where are the main outlets?
2.4	Information – Where do people with animals on site access information?
2.5	Donation control - What donation information is desired on the map, with a drop off location?
3	TRAFFIC FLOW
3.1	How do you want people to access the Fairgrounds? Is it different depending upon: a. What type of animal they are bringing in? b .Volume of traffic eg. During demobilization?
3.2	Where do you want people to park?
3.3	Would you want the animal intake/release process noted on the map?

Table 4: Questions for the mapping session.

6.7.1.4.2.2 Creation of the "base layer" map and "field papers"

The two teams of student designers used OpenStreetMap (OSM) to outline the fairground sites, including built infrastructure and roads. This created a base layer of the sites. When the outlines were done, the teams then exported the OSM maps to a service called Walking Papers (http://walking-papers.org). Walking Papers allowed us to create a printout of the selected area, divided into segments that could be easily printed and then annotated with pen. We decided that each of the students should have their own set of field papers so that there were multiple records of data from the mapping session, which would then provide confirmation for the location of elements to be mapped for each site. Figure 26 shows the field papers generated for Elbert County Fairgrounds.

6.7.1.4.3 Mapping session

The student designers and stakeholders gathered at each site (a few days apart) for a two-hour mapping session. We provided nametags and an overview of the plan for the session. We shared the existing maps of the site and printed the sensitizing questions to help guide the collaboration.

6.7.1.4.3.1 Identifying what to map

We spent the first hour in conversation guided by the questions. The stakeholders shared their experiences with respect to site management with a high level of detail about their work and what they wished could be supported by a good map, reflecting the experiences of Elovaara and Mörtberg in their cartographic mapping work (2010). As the stakeholders described their work practices, the sensitizing questions became more of a reflective checklist to ensure the team covered everything. Numerous times the students needed to clarify aspects of where the particulars of evacuation work happened, leading to detailed conversations about such things as animal check-in procedures. At Jefferson County, we realized a good amount of the evacuation work happened in a small area of the Fairgrounds. This became a focus for the mapping task.

Furthermore, this discussion provided a depth of detail that then created opportunities for the stakeholders to reconsider *in the moment* inefficiencies in their work. Their suggestions for new solutions were immediately incorporated into the new map. This orientation moved the stakeholders from "what had been" and "taken-for-granted assumptions" to a forward-thinking collaboration around what could be made better (Madison, 2005).

At Elbert County, one of the stakeholders said she had been disappointed in the last major evacuation, the 2013 Black Forest Fire event, when people converged onto the site using the main entrance, which could have led to blockages on the main road. She suggested that a northern entry would be better. Another suggested the inclusion of an area for media staging. Other additions included the location for Incident Command and the Salvation Army food truck, both of which have assigned locations during evacuations but, because they are not permanent fixtures, are not noted on any maps. Additionally,

some onsite locations were renamed on the map for the evacuation context. For example, the "Scale House" was renamed the "Small Animals Check-in."

During the first hour of the mapping session at Jefferson County Fairgrounds, the Fairgrounds Manager explained that recent work onsite meant that one internal road was now wide enough to accommodate trailers traveling both towards *and* away from the area the CART had designated for large animal drop-off. The CART members discussed this and decided to adjust the planned traffic flows based on this new information.

These illustrations show how participatory design enabled the stakeholders to negotiate with each other about what was important to have for an evacuation map—or not. They needed to articulate features of their work that were not necessarily known to all others. Information they wanted the public to know was as important as the information they did not want to share, such as the locations of electrical outlets (deemed a security risk) and toilets (so the public would not have access to all parts of the site). The stakeholders recognized the limitations these decisions imposed on the maps, rendering them less useful for workers onsite.

The Jefferson County stakeholders determined that their animal response team was established and familiar enough with the Fairgrounds in an evacuation context that they would only need a single map for public use. On the other hand, after going through the same process at Elbert County Fairgrounds, the stakeholders there determined they needed two maps; one for the public, and one for workers.
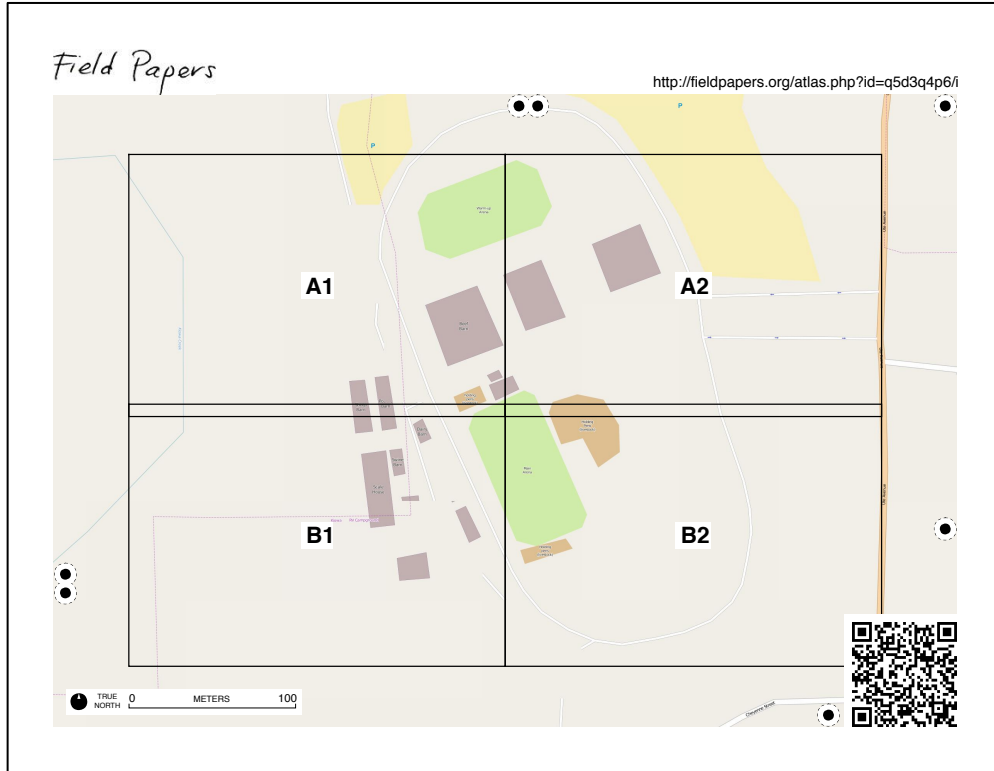
Figure 26: Field papers for Elbert County Fairgrounds.
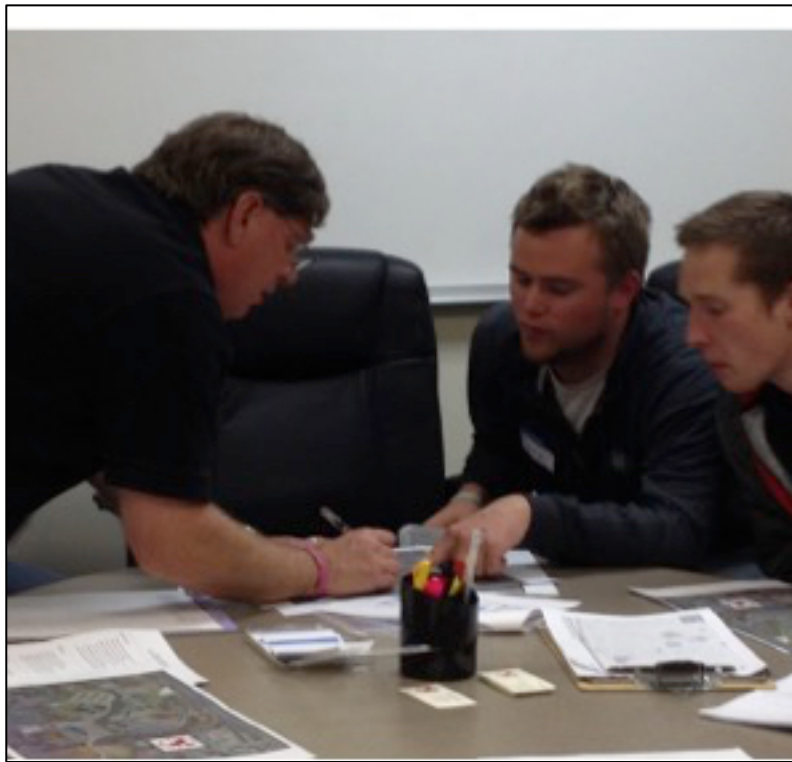

Figure 27: Stakeholder working with student designers.

6.7.1.4.3.2 Walking the traffic flow of evacuation

The stakeholders, student designers and I then walked the fairgrounds site together, following the flow of traffic routes they had identified. In our planning, we had originally thought this would be done in pairs or threes, however one stakeholder at Elbert County suggested the group walk together so that collaboration could continue if new questions arose. As we walked together, stakeholders continued to share some experiences from previous evacuations, which built on the general information the students already knew about animals in disaster.

While walking the routes, the stakeholders pointed out the infrastructure and other elements they had described earlier, so we could better understand the way the site would "look" during an evacuation. The students made notes on their field papers and took photographs. The mapping sessions were each completed within two hours.

6.7.1.4.4 Development of map designs

In the few days following the onsite work, both teams of student designers consolidated their field papers and photographs so they could create the first maps. When they were complete (Figure 28 right, Figure 29, bottom), we emailed them to stakeholders to obtain feedback.
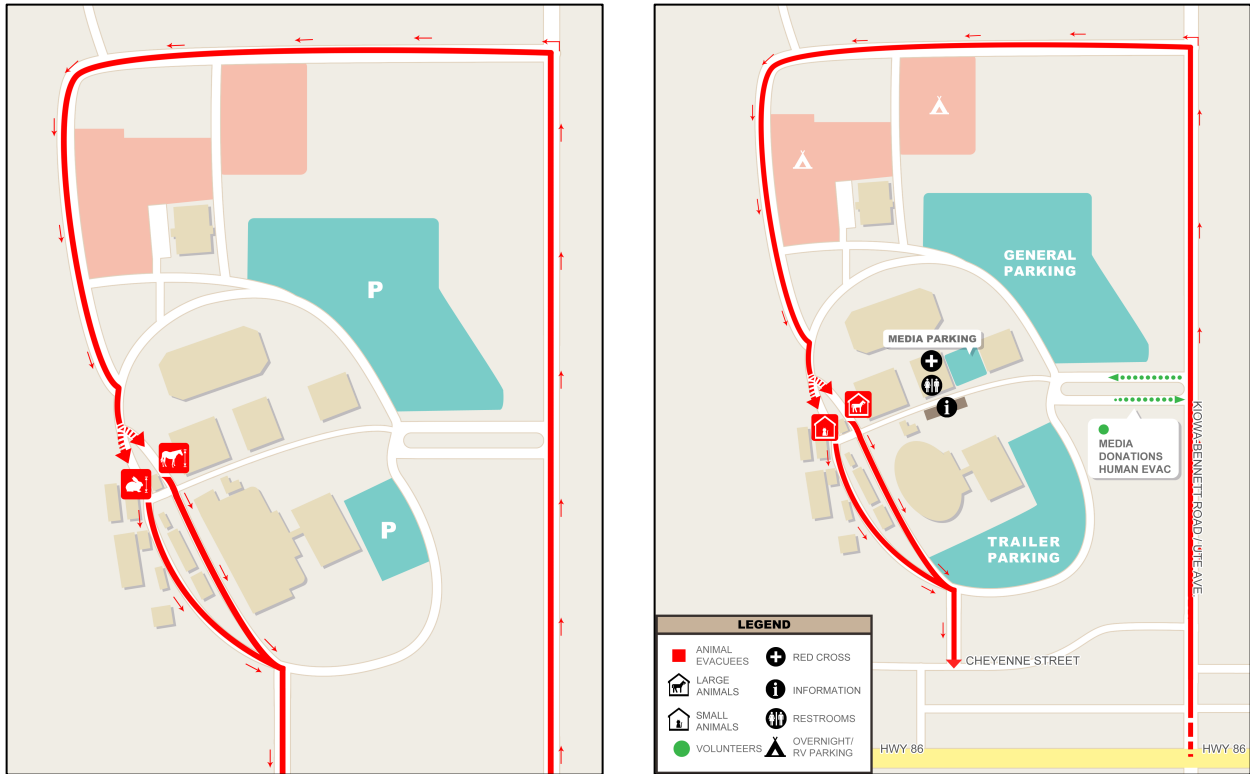
Figure 28**: Example of first map (left); and completed map (right) for Elbert County.**

6.7.1.4.4.1 Using stakeholder feedback to iterate map designs

Most feedback across both sites concerned the labeling of different locations and infrastructure. Stakeholders at Jefferson County decided to remove some labeling of infrastructure, saying they needed flexibility for structural use depending upon the type and needs of an evacuation. In addition, word selection became a focus at this stage. On the mapping day, the stakeholders had used the term "haulers" to refer to their own large animal transport, but realized upon printing the map that this could be confusing to the public (Figure 29, top). They decided to clarify by renaming it "private haulers" (Figure 29, bottom). Similar design alterations were requested by Elbert County, such as adjusting the shape of the main ring.

In the process of emailing their feedback to us, the stakeholders for Jefferson County continued to ask questions of each other, to clarify flows of work in areas they were unfamiliar with. For example, one stakeholder asked the site's Fairground Manager:
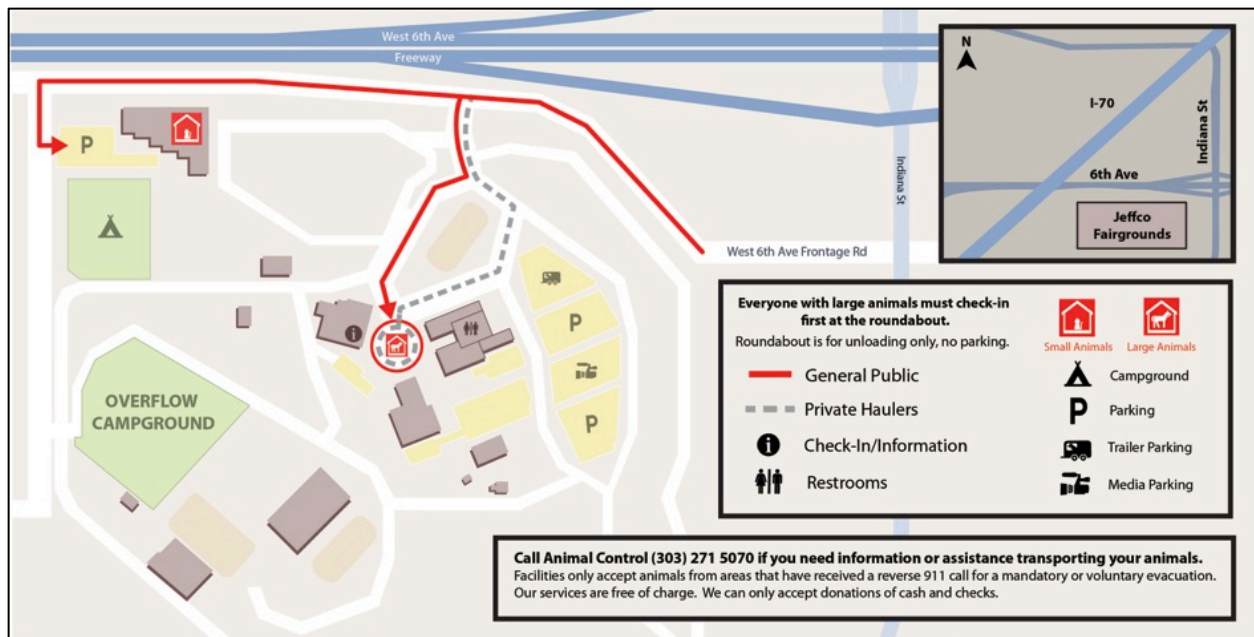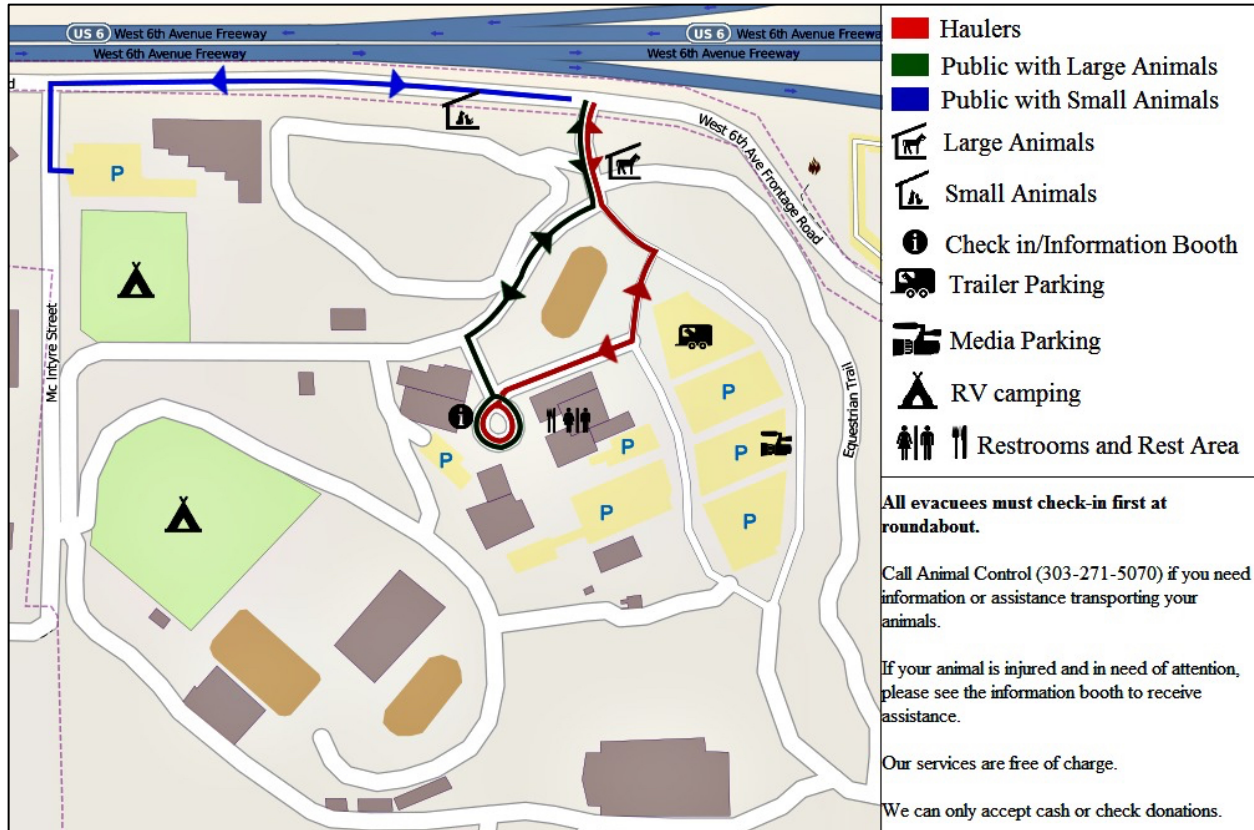
Figure 29: Example of first map (top); and completed map (bottom) for Jefferson County.

"Does the Fairgrounds also allow for tent camping if necessary – or at least in an emergency? Or is it only RVs all the time?"

…to which the Fairgrounds Manager responded:

"Normally we have limited tent camping sites, but in times of emergency, we have the flexibility to allocate additional space for camping. Communication is critical during these times."

The students iterated the designs, and by Week 4 they had produced the final maps (examples of these maps are shown as Figures 28, right; 29, bottom; and 30).

Figure 30: Instruction sheet for Elbert County.

6.7.1.5 Experiences

The goals of the project were to first, design maps for the public to improve coordination and flows at animal evacuation sites; and second, to provide stakeholders with a relationship-building opportunity through map creation. Experiences related to these goals are detailed below.

6.7.1.5.1 Designing maps for the public to improve coordination and flows at animal evacuation sites

Stakeholders at both locations approached the mapping project with the belief that it would be of use to constituents, and that the resulting maps would improve coordination. The student designers took on the technical load of producing the maps while the stakeholders focused on the elements the maps should include.

6.7.1.5.1.1 Maps as efficient information resources

The progressive question and answer work before the mapping began, and then working onsite with stakeholders meant that the team could together filter meaningful detail from otherwise vast experience. The level of detail on the maps needs to support efficient communication for precise, safety-critical and fairly time-critical work. Detail in the maps was focused on foregrounding the infrastructure and routes to enable efficient movement to and within evacuation sites, eliminating the gridlock that can occur when large vehicles and trailers traverse narrow roads. The decisions about what to include in maps are challenging. Schmidt (1998) has said, "the gist of design work can be said to consist of exploring and identifying the interactions between conflicting requirements so as to be able to decide on an acceptable compromise," and this was true of this project's experience. The teams at each site appreciated that the maps needed to contain *just enough* information (Brown & Duguid, 2002), to help the public quickly understand what was expected at the sites. These collaborative decisions led to maps with clear and simple information.

In addition, the stakeholders joined in on the project with the full intention that the maps would be used. Jefferson County features its map on its website and emergency blog (http://jeffcosheriff.blogspot.com/p/blog-page.html). They report, "The map is simple, clear and easy to understand and will give people—even those under duress—the ability to safely and quickly navigate to a safe haven for their animals." The Elbert County map will be deployed by the Public Information Officer in the event of an evacuation.

6.7.1.5.1.2 Using standardized map symbols

Research shows that it is preferable to use standardized symbols in map creation (Akella, 2009; Robinson, Roth & MacEachren, 2010 & 2011; World Humanitarian and Country Icons, 2012). Wherever possible, we aimed to use standardized symbols common to emergency maps, however we were unable to find symbols that were particular to animal evacuation. We created two symbols as part of this project, one to symbolize the sheltering of small animals, and one for large animals (Figure 31). Both symbols were developed through iteration with the stakeholders along with the maps.

We submitted the two symbols to The Noun Project, an open source international symbol repository. They are now included in its crisis symbol collection for humanitarian open mapping use around the world.
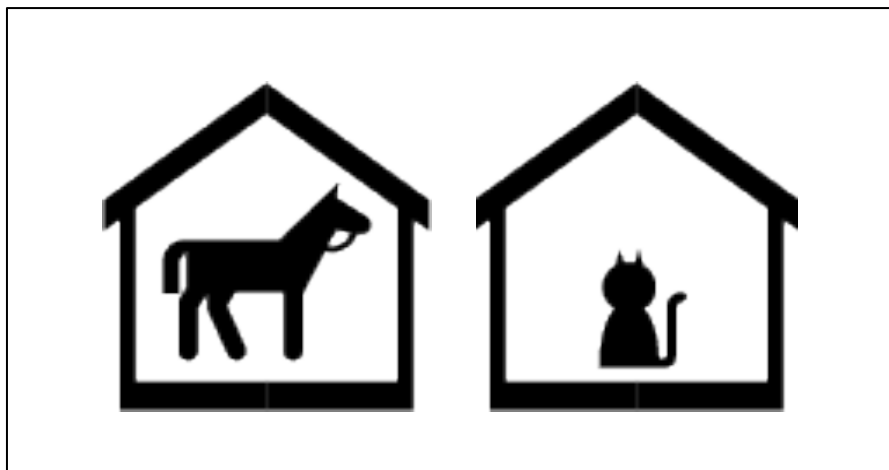
Figure 31: Large and small animal shelter symbols. These symbols are now publicly available through The Noun Project.

6.7.1.5.2 Providing stakeholders with a relationship-building opportunity through map creation

The mapping project included CART members, officials and other stakeholders such as fairgrounds managers, who may not otherwise have had input into the processes and flows of work at these animal evacuation sites, even though they have an interest in how the sites are put into operation. During the mapping session (and for those at Jefferson County, continuing through subsequent email communication), the stakeholders saw opportunities to adjust their previously established plans and worked together to suggest and make changes (Parker, 2006).

The decision to use participatory design techniques involving a cross-section of stakeholders also invoked challenges. It was common for stakeholders to hold different views on what the maps should include. However, it was the stakeholders' differences that made this a rich experience, for it was in the process of the mapping that different perspectives were revealed, adjustments and compromises made, and consensus discovered *between the stakeholders themselves*. Future implementations might also include animal owners as part of the design exercise, to gain insights from those not familiar with a location in evacuation mode.

6.7.1.5.2.1 Bonding through sharing stories

Throughout the mapping effort, stakeholders shared evacuation stories. The experience of emergency response is unusual, even for those who are regularly engaged with it, and sharing stories provided personal and professional connection between all participants. One of the newly hired emergency managers (who is in charge of all aspects of disaster, and was learning about the details of animal evacuation) shared that the mapping session provided useful information that would not have been available another way, saying, "I had heard lots about it, but I had no idea how big an operation it was until I walked it with you all."

6.7.1.5.2.2 Dissemination

The project effort concluded with a final formal presentation of the maps to all the stakeholders, as well as State representatives who oversee animal evacuation and sheltering. Their goal is to make maps based on the decisions that came about through this effort for fairgrounds across the State. In addition to the guidelines supplied in this paper, we have compiled a field guide checklist resource to support communities that wish to implement the project with their own teams. These are accessible at <http://www.cs.colorado.edu/~palen/AnimalEvacuationMaterials>.[1]

6.7.1.6 Conclusion

This project reports on a participatory design activity conducted with stakeholders at two county fairgrounds in Colorado. The project was aimed at supporting the needs of the public and of CART teams to provide efficient and accurate information about animal evacuation through easy-to-use, customized-to-evacuation maps. The project allowed stakeholders to review their animal evacuation and sheltering procedures, reflect on their practice, and collaborate on an activity beyond the scope of their usual training or deployment operations.

I saw this project as an opportunity to learn more about how emergency responders work together, and how they might be able to better communicate information to the public in ways that can support effective decision making in evacuation. In addition to the creation of maps for each fairgrounds site, this project provided both stakeholders and researchers with valuable insight into the ways responders can prepare themselves and the public for animal evacuation.

This project demonstrated that it is possible to provide the public with an information resource that might support good decision-making in evacuation. The maps aim to fill the information gap experienced by the public related to knowing where to go (the fairgrounds) and how to access support for evacuating their animals in an efficient way. The maps are yet to be used in an evacuation, so it is not

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[1] This marks the end of the reprinted publication, as described in Section 6.7.

possible to determine their effectiveness in fulfilling this aim. The second aim of this project, to create a collaborative relationship-builder for stakeholders who work in animal evacuation, was successful.

Following the completion of this project, I was encouraged to look at developing the design of a second intervention, which informs RQ5. This second project details the development of my proof-of-concept prototype of a digital repository for the information contained within the various paper forms associated with animal evacuation. It was imagined that the repository would be located "in the cloud" and would allow near-realtime reporting to officials and volunteers who need information about the status of animal evacuation sites in Colorado. An outline of this second project, the proof-of-concept prototype of the Animal Evacuation Management Tool, follows.

6.7.2 Information support tool 2: Proof-of-concept prototype of the Animal Evacuation Management Tool

As outlined earlier in this chapter, information collection at evacuation sites in Colorado relies on paper-based forms. Often even *before* an animal arrives onsite, paperwork is initiated. Information about an animal's owner, location, contact details, and so on are all recorded on Intake Forms which are then filed in binders at the barn managers' offices. In addition, each animal's stall also has a paper Stall Care Card that allows those working onsite to record the animal's food, water, exercise and stall cleaning.

I explored the creation of a prototype of a digital tool that could collect the information held on these paper forms, and provide near-realtime reporting to officials and volunteers both on- and offsite who needed to access the information at any time.

6.7.2.1 Aim of the project

The Animal Evacuation Management Tool (AEMT) was designed as a proof-of-concept prototype. This project aimed to explore whether technological support could be produced to support the information collection and management needs of people working at animal evacuation centers, as well as offer more efficient reporting on all aspects of the animals on site to the EOC during an evacuation and afterwards.

I believed this prototype would be minimally invasive for onsite workers, but would likely provide better information support to those working at higher levels, such as at Incident Command onsite, and at EOC centers offsite. I also hoped that it would relieve the information seeking on the ground that was required. I surmised that such a system would also benefit workers onsite, with a "trickle-down" effect of less demand on them for information from the EOC. To ensure a minimum of disruption to the work done in evacuation, I approached the task with the intent to transfer the information *already collected on the paperwork* to a digital repository. It is important to note that this prototype was not designed to replace the paper-based forms already in use, nor adjust the way work was being done. This decision was made to minimize disruption to the teams who see paper-based forms as structurally important to their organization and work.

6.7.2.2 Early exploration of prototype development

From the earliest stage of the project, I decided to leverage the positive relationship I have with the user base and their willingness to give feedback at each stage of development (Vredenburg, Mao, Smith & Carey, 2002). As a proof-of-concept, the prototype was not designed for deployment, however, it needed to be robust enough to clearly convey the potential for such a tool to volunteers, officials, and potentially any software developer who might wish to work further with the results.

As I explored the idea of developing the prototype, I used informal methods of gathering feedback from prospective users, both CART volunteers and officials. In short, but regular, communications with CART members who work at different sites, and with officials, I asked broad questions about the perceived usefulness of a digital tool for recording information about animals in evacuation. From this earliest stage, there were differences in enthusiasm. The officials I spoke with were enthusiastic to see how the tool might develop, but some CART members said they did not feel it was necessary. These varying levels of enthusiasm may indicate different levels of technological experience among those I spoke with. Despite this mixed reception, I moved forward with the prototype.

6.7.2.3 Prototype development and iterations

I envisaged the tool to be a content management system back end, with a mobile application for data gathering. At first, I focused only on the development of a mobile interface, imagining a user walking around the site entering data from Stall Care Cards as well as the Intake Forms that were held in the barn managers' offices. I used paper-based workflows to reflect the information recording stages across Animal Intake, Animal Movement, Animal Care, and Animal Release.

Once I was confident that I had articulated the majority of the four workflows, I proceeded to developing a medium fidelity mobile prototype. The home screen from this stage of design is shown below (Figure 32).
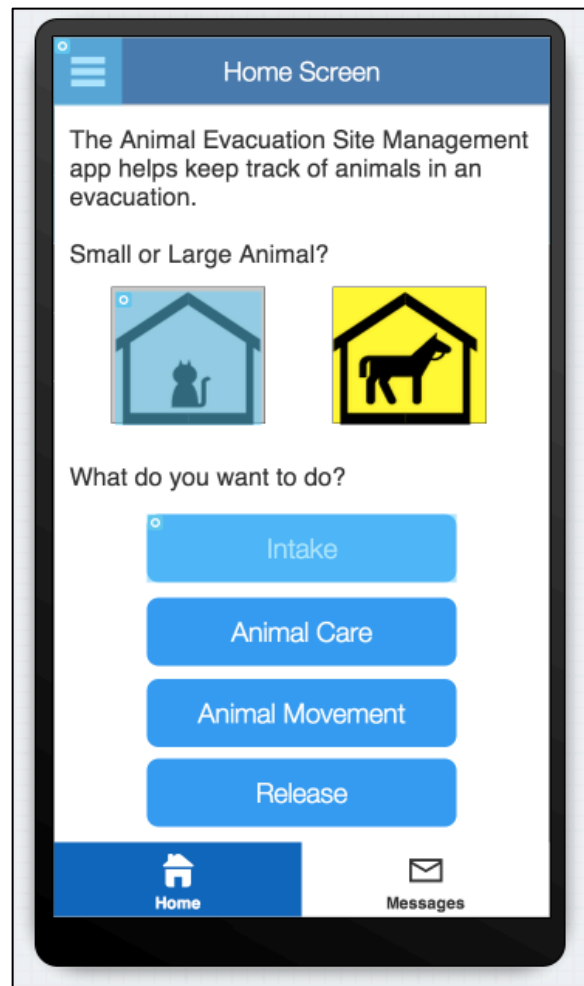

Figure 32: Medium fidelity mobile prototype design.

To gather feedback from a cross-section of officials and volunteers working with animal evacuation across Colorado in a timely manner, I created a video screencast showing how the medium fidelity prototype might be used across all the information recording stages. I uploaded it as an unlisted video to YouTube and emailed a link to the video to my contacts at the State level, and to officials and volunteers at Jefferson County, Douglas County and Elbert County, with a request to email me feedback. I did not prompt them about specific elements, but rather wanted, instead, to obtain a general sense of whether they felt such a tool might be valuable, and what gaps they thought might exist.

One of the officials showed the video to a group of interested Emergency Managers from Colorado at a state-wide meeting and collected their input, which I added to the feedback from the other contacts. Feedback included concerns about the challenges in accurately entering information in a digital form rather than on paper, and positive responses related to the potential for automating alerts to the Barn Manager if an animal had not received care for a threshold number of hours. Respondents said they liked to think this might be a way of helping organize information about lost and found animals, and where they were located. Officials at upper levels focused on the *potential* for such a tool on their information flows and work management, while volunteers who work onsite typically saw the tool as perhaps being useful, but moreso as being "another step" to incorporate, which they felt was unnecessary unless there were direct benefits to be had, such as reuniting animals with owners in a more timely manner.

6.7.2.4 High fidelity prototype

I used the online survey tool, SurveyGizmo, to create a high-fidelity prototype. The front page of the design is shown as Figure 33. The survey question interface was adjusted to reflect the information fields officials indicated they would find most useful, and which were already being collected on various paper forms. The inbuilt survey logic and cloud-based reporting capabilities through Excel downloads and graphs allowed the prototype to perform as a fully functional tool would. In addition to collecting text data, this final prototype allowed photographs to be uploaded into the system, addressing the feedback received on improving the information flows around reuniting lost animals with owners.
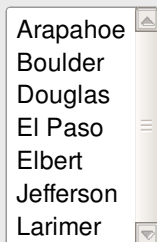
Animal Evacuation Management Tool

Colorado State Animal Evacuation Management Tool

Caring for animals in evacuation

This tool supports the information management of animals in evacuation sites throughout Colorado. Your accurate entry in a timely manner keeps this information up to date.
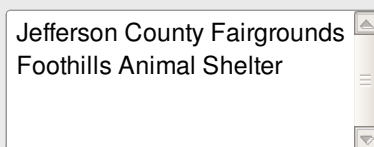
1. Please select your county *

> Arapahoe
> Boulder
> Douglas
> El Paso
> Elbert
> Jefferson
> Larimer

LOGIC Hidden unless: Question "Please select your county" #1 is one of the following answers ("Jefferson")
2. Select evacuation site. *

> Jefferson County Fairgrounds
> Foothills Animal Shelter

Figure 33: High fidelity prototype using SurveyGizmo.

Both State and local officials were enthusiastic and indicated the tool, if developed, would save a significant amount of time following up, synthesizing and checking information both during an evacuation event and afterwards. A test of this final prototype at a CART exercise/training day in Jefferson County was planned for October 18, 2014.

In emails prior to the exercise day, two of the volunteer CART leads for Jefferson County shared concerns over the "disruption" the prototype might create adding they did not have anyone available to do the data entry. The Sheriff's Office reassured them that the prototype test would not be a responsibility of the volunteers, but that information from the paperwork as it sat in the barn manager's office would be entered by worker from the Sheriff's Office, and by myself.

On the day of the exercise, information from the paper forms was entered into the prototype. As soon as the exercise was complete, reports in the form of graphs and a downloaded Excel file of information entered was generated for officials, providing details of the number of animals at the site and veterinary status, and a spreadsheet that included the list of animals and details for their owners, or where they were picked up if the owner information was not known.

6.7.2.5 Final prototype design feedback

Feedback following the field test was instructive. For example, one official shared:

> *"It's very difficult in the heat of the moment to say, 'we've got 250 horses at the Fairgrounds and we've got 16 dogs at Table Mountain Animal Center.' If I had the ability to pull some sort of report in realtime, of what's been logged in, that would help me and it would certainly help [the State EOC or the Dept. of Agriculture]." (C. Zinanti, December 23, 2014).*

The same official shared her challenges in post hoc reporting on an evacuation, expressing an interest in supporting claims for financial reimbursements from the State and FEMA:

> *"I report on… the volunteer hours, the staff hours, the equipment that we used, the types of animals that we impounded [sheltered], what the dispositions were, you know, what I spent money on out of my budget, then I estimate what the cost to my budget was...With the current process we have now, this is a very time-consuming and arduous thing to do, to try and pull all these numbers together. So if we had them in your system and I could print out a report, it would make everybody's life much easier." (C. Zinanti, December 23, 2014).*

The volunteers working onsite as part of the CART were less receptive to the prototype. On the day of the exercise, the CART leads were not happy about the tool being tested, even though they were not visibly compromised by it. For example, one volunteer expressed concerns over the security of information once it is entered into a digital system, instead of being managed onsite with paper.

Numerous reassurances were necessary from myself and from officials that the prototype was not something the CART volunteers needed to integrate into their workflows for the exercise.

It would appear that the prospect of a deployed tool such as the Animal Evacuation Management Tool would "make everybody's life much easier" did not include CART volunteers working on the ground. Even in an *exercise scenario*, with a *prototype* rather than a fully working product, CART members were reluctant to embrace even the *idea* of an information support tool. This highlights the differences between the layers of animal emergency responders and the information needs and agendas of each layer.

6.7.2.6 Project outcomes

This project underscored the importance of recognizing the work done by these teams as *practice* rather than *process* (Dourish, 2004). The prototype aimed to gather information from the paper forms in the background, after information had been written down and while the paper was in a static place (e.g. the barn manager's office or stuck to a stall). However, the complexity of information gathering, management and reporting is far richer than processes and the paper forms supporting them might indicate.

At the end of the project, enthusiasm for the prototype was expressed most strongly by upper level officials who, in all likelihood, would not be onsite during an animal evacuation. Those officials were interested in fast information gathering and reporting that would, as one said, "save hours a day" in making phone calls to find out information from each site while an evacuation was happening, and would assist in creating post hoc After Action Reports to support applications for financial reimbursement from the State and FEMA.

However, even the *prospect* of the prototype was viewed suspiciously by lead volunteers working onsite. This conundrum reflects those seen by researchers studying the introduction of Electronic Medical Records (EMR) rather than paper-based records in the medical domain (Park, Lee & Chen, 2012). Reflections on these similarities follow.

6.7.2.6.1 Similarities to experiences in introducing digital Emergency Medical Records in hospitals

As research on the development of Emergency Medical Records (EMRs) has shown, the benefits provided by using a digital tool to collect data for secondary purposes may negatively impact the efficiency of work at the primary point of work (Pine & Mazmanian, 2014). An investigation into this possibility, and questions over the perceived value of the tool to CART workers onsite, were explored through the development of the prototype.

This project highlighted the error in developing a tool based only on surface evidence of what might be helpful. The prototype aimed to see if filling the information gap that exists between workers onsite and the information needs of officials working offsite would smooth the collaborative work. However, the assumption this would be the case elevates the importance of the *flow of information* over the *practice of work*. This reflects Voida, Harmon & Al-Ani's (2012) review of the use of social computing technologies by volunteer coordinators. In their work, Voida et al. describe the mismatch between the assumptions of designers who focused on building social tools to keep volunteer recruitment high, while the *real* need expressed by volunteer managers was to foster and engage in community building with *existing* volunteers. I explore how CART members in animal evacuation reacted to such an intervention below.

6.7.2.6.2 Reluctance of on-the-ground responders

The leading volunteer members of the Jefferson County CART were reluctant from the outset to include the tool in their exercise day. For them, their paper forms support their work well enough. To underscore their concern, they raised a few smaller issues they felt might be present, including the potential for errors in transferring information into a digital repository:

> *"We are just trying to keep our system as simple as possible because over-complicating things and creating too many redundancies has only lead to problems that we've worked so hard to avoid. For example, we can foresee a volunteer in a hurry accidently selecting the wrong option when it's much less likely for a mistake to be made when something is written in by hand" (Respondent, October 13 , 2014).*

The potential for errors in entering information in such a system has been experienced in introducing EMRs (Ash, Berg & Coiera, 2004; Hardey, Payne & Coleman, 2000). Errors are also made when information is handwritten on paper forms, but these can be erased or adjusted easily. For example, when we tested the prototype system at the exercise day, there were multiple transpositions on the paper forms that confused the stall number with the rump tag number, which had been corrected with penciled-in arrows on the paper form. The situated practice (Pine & Mazmanian, 2014) of recording information on paper allowed for correction more easily than a digital system might. The practice of teams working on the ground includes adjusting information as it is recorded, and afterwards if corrections are necessary. The paper forms support that need.

6.7.2.6.3 Lack of information to support insights at higher levels

Officials not working directly with the animals on the ground—i.e. Directors of Emergency Management and Animal Control—were cognizant of their time-consuming information needs while an evacuation was occurring, as well as after a demobilization of an evacuation site. The officials used this project as a platform to thinking creatively about the information problems they face. For example:

> *"I'll call up and say, 'do you remember what time such and such left the staging area' and they'll say 'Oh I think it was about, maybe it was about 8pm' so if there was a way for them to do it on their cell phones … I'm hoping to issue all the volunteers at some point over the next year with an ID card with the Sheriff's logo and our J-CART logo, and then they could either swipe in and swipe out, or do it on their phone." (C. Zinanti, Dec 23, 2014).*

The official reflected on other information demands not "seen" by the CART members, such as the need to report on volunteer hours, resource use and other expenditure after an event:

> *"Some of the haulers, they see less value in the check-in and check-out form, so… I have to call after the fact and people have to try to remember what their mileage was when they quit and exactly what time they checked out…they just don't do a good job of it." (C. Zinanti, December 23, 2014).*

6.8 Conclusion

Paper forms are not "passive" repositories for information (Coeira, 1997). The reluctance to move from paper to digital formats does not reflect user inflexibility or poor design of technological interventions. As found by Heath and Luff (1996), the introduction of technological support tools, even those that seemingly *replicate* the information collection purpose of paper forms, may fail to support the complex social and collaborative organization of teams. As Dourish (2001) has identified, workflow technologies (in this case, both paper and the digital prototype) provide a structure upon which the activity of an organization is made visible, and thus accountable.

Furthermore, every piece of information recorded in an animal evacuation is used by different people in different ways, which can cause challenges, and this has also been identified in research on Electronic Medical Records (EMRs) in hospitals. For example, a Stall Care Card records the water level in a bucket, which is useful for a volunteer on the ground, who needs to know when it was last filled; but this same information might also be used to substantiate a defense in a legal claim about that animal's dehydration after the event (Reddy, Dourish & Pratt, 2001; Schmidt & Bannon, 1992).

Just as EMRs have been shown to improve patient safety, increase information access and decrease time spent maintaining patient records (Chaudhry, Wang, Wu, Maglione, Mojica, Roth, Morton & Shekelle, 2006; Fitzpatrick & Ellingsen, 2013), we can see a digital tool designed for animal evacuation sites such as the prototype explored in this project might have a similar effect. However, as has been experienced with EMRs, it will not be a seamless adoption. Developing such an intervention without attention to the practice of work onsite in animal evacuation risks the tool being ignored by volunteers who may be unwilling to incorporate it into their practice.

Use of a participatory design process might assist with adoption of such a tool, but it is not a guarantee the system will be embraced (Bossen, 2011). Again, similarities are seen in the introduction of EMRs, such as an increase in errors and inaccuracies (Ash, Berg, & Coiera, 2004; Pine & Mazmanian,

2014), and the lack of informal supporting information on scraps of paper that operate as "information bridges" to create better in situ knowledge between workers (Chen, 2010) are similarly likely to be realized with the introduction of an information support tool for animals in evacuation.

While information flows are *connected* to flows of work, they are not one and the same. The socially embodied nature of information, its transfer and interpretation calls for a greater appreciation of the situated practice of work, which can not be shown through procedural information flows (Suchman, 1987). Additionally, we are reminded that even if a paper-based system is flawed, the introduction of a digital alternative carries its own burden, even if it succeeds in improving some elements of recording of information (Heath & Luff, 1996).

Designing technologies to support people working with animals in this safety-and time-critical domain calls for an understanding of elements affecting and affected by the work, and anticipating ways the introduction of a digital system might also influence that work (Feufel, Robinson & Shalin, 2011; Park et al, 2012). There is a need to understand the motivations of responding volunteers, and to appreciate the challenges they experience as they work with each other onsite, and how they share information and work with officials offsite. It is important to understand the flows of the work, the rhythms of collaboration (Rosner, 2012), its temporal patterning (Egger & Wagner, 1992) and the ways and times information is gathered and accessed if we are to design tools that truly support the information needs and collaborative work that surround animal evacuation.

6.9 Reflections on the Research Questions

I will now reflect on how this study addresses the research questions that guide the body of this dissertation. Study Three answers RQ1, RQ2, RQ4, RQ5 and RQ6. By working alongside volunteers and officials in animal-focused emergency response, I was able to observe the impact that onsite information and the sharing of that information offsite had on the ways in which work was done. Through my extended engagement, I identified information gaps and used social collaborative tools across two projects that aimed to help information collection and management, and to "smooth the work." This study

helped make explicit the practice of work in animal evacuation, and pointed to implications in designing tools that might support this work. Below are the ways in which Study Three has answered the research questions.

RQ1 What kind of information gets collected about animals; how is it gathered, managed and used?

Study Three shows that information about animals in evacuation is collected by officials and volunteers from the earliest stages, even before the animals arrive at an evacuation site. Information about the animals is handwritten on paper forms and is reported to others via telephone. We also see in this study that the information written down at each stage of evacuation reflects what is considered to be "enough" by the person collecting it at that point in time. The written down information is often incomplete, may be incorrect, and may eventually be disposed of. This method of collection and management of information on the ground constrains its usability to officials working offsite during an evacuation, and the usefulness of it in post hoc reporting.

RQ2 What kind of information about animals affected by emergency appears in online and offline areas?

This study focused on onsite information collection around animals in evacuation. This study reveals a disconnection between the information about animals that is collected by workers directly engaged with the animals on the ground, and the accessibility and usability of that information by officials offsite.

RQ4 Who uses the information gathered, and in what ways do they use it?

The information is most often used by those working directly with animals, while the evacuation is in progress. The physicality of the paper-based information collection and management limits the ability of responders who are not onsite to use the information during an evacuation. This limitation means that officials working offsite must rely on telephone communications to find the content of the paper forms individually, and then they must collate and synthesize that information across evacuation

sites to work out where additional resources are needed. After the fact, officials must spend time reviewing and revising the many forms to create their After Action Reports that support applications to the State and FEMA for funding reimbursement.

RQ5 In what ways does the information flow impact the work done in animal-centered emergency response?

This study made explicit the subtle tensions that exist within the practice of workers concerned with animals in evacuations. This study shows how paper forms play an integral role in the identity of the volunteers on the ground. However, the limitations of paper forms include restricted information access by those working offsite, both during an evacuation and after a site has demobilized. This limited access results in greater effort and time for officials who seek general information across a site, let alone specific information in cases such as animals without identified owners.

RQ6 Is it possible to use social collaborative tools to improve information flows around animals affected by disasters?

The two Information Support Tool design projects explored the complexity of attending to the information needs of people concerned with animals in evacuations. In seeking to smooth the work at animal evacuation sites through the use of collaborative tools, we must appreciate the practice of work being done across all actors in the network, from the public through to volunteers working at evacuation sites, and officials working offsite. It is possible to use social collaborative tools to support information flows, as was seen in Project One. However, any intervention is likely to have an impact on the practice of work being done. This will, in turn, have an effect on relationships, authority and control.

CHAPTER 7. Conclusions

This dissertation identifies the ways in which information is collected, managed and shared about and around animals in disasters, in both online and offline arenas. This research makes explicit the practice of cooperative work involving people working with animals in disaster and the role of information management within that practice. It also explores ways in which collaborative information technologies might be used to improve information flows and accessibility, with lessons for further work in this area. This work then also informs the larger question posed in Section 3.1, regarding what the problem of animal management in disaster response reveals about the challenges of information management in disaster generally speaking.

To conclude this dissertation, I will present the contributions this research makes to our overall understanding of the spatial, informational and, often, emotional complexities of animal management in disaster response; its contributions to CSCW; emergency management practice and policy; and our understanding of human behavior in disaster writ broadly.

7.1 Contributions

Information gaps are a hallmark of disaster. *Lack* of information, *changing* information, and *disparity* of information all combine to create ill-structured problems that are complex and difficult to solve. This research makes a broad contribution by making explicit the important roles of volunteers, both "trained" and "untrained," in disaster response. Responders, both official and volunteer, may not have the best information, and it is hard to know whose information is most current. This means that people at all levels of disaster response must modify their intersubjective understanding as they do the work, so they can work together with a common foundation to identify and address problems that need solutions (Augier, Shariq & Vendelø, 2001).

7.1.1 Analyzed expertise and how it is key to innovation in disaster response

These studies have explored the nature of expertise and its application to a specific problem, that of animal welfare within disaster response. The studies highlight the need, in the uncertain and emergent

environment of disaster, for expertise as a resource to be *sought and valued* across a community, rather than managed.

This dissertation underscores the importance of expertise in response, and highlights that expertise is embodied knowledge that is held within all kinds of responders—whether they are professional or volunteer, including people working as "trained" volunteers as well as "spontaneous" volunteers. Expertise is a type of knowledge developed within a specific cultural, social and cognitive environment, but which can be applied in different contexts (Fitzpatrick, 2003). This application includes emergent situations that call for *improvisation*—something experts are uniquely and creatively able to do (Normark & Randall, 2005). Previous literature has focused on expertise being held within an *individual* (Stahl, 2006, p.306), and the studies in this dissertation certainly provide empirical evidence that support this.

This dissertation underscores the role of individual expertise as a valuable resource in disaster. For example, we see individual expertise in the form of a graphic designer applied to the problem of lost and found pets following Hurricane Sandy in Study One, resulting in standardized flyers and album covers. The expertise of Frank, the "expertise concierge" in Study Two was applied to ensure that the correct type and combination of equine expert volunteers were brought to the horse evacuation. Finally, in Study Three, we see Community Animal Response Teams leveraging individual expertise in caring for different species of animals. In all these cases, these domain experts applied their knowledge individually to effect change.

7.1.1.1 From individual to shared expertise

Beyond the role of individually held expertise, across these studies we see opportunities for experts to *collaborate* and apply their knowledge *together* to discover a higher level of benefit in addressing the unusual and emergent challenges of disaster. Stahl's theory of building collaborative knowing (2006) supports the assertion that bringing *experts* together provides a foundation for *shared expertise*. Just as Stahl (2006, p.304) has said that a new level of understanding of a topic can be achieved

through group engagement *that can not be attributed to any single person*, and Bereiter (2002, p.283) has described the ways groups of people in problem-solving meetings often achieve a solution that can not be shown in the "bits and pieces making up the discourse," so we can say that *shared expertise* is an *emergent* type of knowledge, which comes about through the social collaborative engagement of a group of experts. This idea is also supported by Nonaka, Toyama and Nagata (2000), in their emphasis on the creation of knowledge as resulting "through the dynamic interactions among individuals and/or between individuals and their environments."

Individual experts are able to apply their domain knowledge to a new environment, and innovate a solution in ways that novices do not (Chi, Glaser & Farr, 2014, p.xviii). Experts see problems more deeply, and ask more questions than novices (Miyake & Norman, 1979), exploring the parameters of the problem widely, qualitatively trying to discover a solution (Chi, Glaser & Farr, 2014, p. xix). Application of *shared expertise* to new and unusual problems such as those made explicit by disaster provides an *unparalleled* opportunity to, firstly, solve the problem, and secondly, provide an heuristic opportunity for deepening the expertise of the individuals who are each part of the collaboration, through developing and modifying their intersubjective understandings *as they solve the problem*.

Knowledge must be built within a context (Fitzpatrick, 2003), and each person involved in each of the three studies in this dissertation has their own understanding of the context they were active within. In Study Two, even those equine experts not *physically* engaged with the offline evacuation of the horses "saw" the event transpire online, and gained understanding that affirmed that the evacuation was not only *possible*, but *plausible*, ultimately adding to their own knowledge base and expertise. So, in both the online and offline efforts shown in this research, each expert expanded their individual expertise through the experiences gained by being part of each of these emergency response activities.

This emergent resource of shared expertise is the same as that discovered through the collaborative problem solving by a team of NASA experts who were faced with the Carbon Dioxide filtering problem experienced during the 1970 Apollo 13 mission. In that mission, with the lives of three astronauts at risk, an oxygen tank exploded, damaging the Service Module and leaving the Command

Module without power or oxygen. NASA decided to abort the planned moon landing and instead focused on bringing the astronauts safely home. The astronauts were instructed to move into the Lunar Module, which was to provide their transportation back to earth. However, there was a need to develop two carbon dioxide removal devices to support the requirements of life for the three astronauts. Using "an ingenious combination of suit hoses, cardboard, plastic stowage bags, and Command Module canisters—all held together with a liberal application of gray duct tape," a team of NASA experts on earth improvised the building of a device that would adequately filter the dangerous levels of carbon dioxide, using items the astronauts would be able to access in the spacecraft (Compton, 1989; Cortright, 2012).

The Apollo 13 story highlights the ways shared expertise is triggered in a similar way to those shown in the three studies in this dissertation. An emergent, unexpected and unusual problem is identified, and is solved through the combined work of experts who stretch beyond their ex-ante knowledge to improvise, using whatever resources available. None of the experts described in this dissertation held sufficient knowledge to solve the problem on their own (Augier et al, 2001), yet their intersubjective knowledge and combined experience allowed the problem exploration and solution-seeking to be done with a common foundation. This ensured the experts were able to follow each other's lines of thought (Augier et al, 2001); a factor we see in Study Two, in particular, as the equine experts adapted and applied their domain expertise together, with minimal need for communication beyond that which was required for each of the tasks at hand.

I have described the ways in which an expert considers a "problem" and how the expert will explore and consider its parameters. An additional consideration is to reflect on the way an expert engages with the material resources available to them in addressing the problem. This presents another avenue for us to understand the experts' ability to innovate solutions in disaster.

7.1.1.2 Innovative use of materials by experts: Lenticular resources

In disaster, limited access to resources constrains the ability of people to attend to the needs of a community. However, we know that experts are able to explore problems broadly, and innovate with the

materials available to them. I argue here that to experts, resources are *lenticular*. To explain this further, the lenticularity of materials can be described as having a "multiview user interface," where things appear differently from different points of view (Matusik, Forlines & Pfister, 2008). Typically, lenticular images are used for the design of simple 2D animations, such as those on baseball cards, or role-playing cards, where an image may be viewed at some angles and not others (Matusik et al, 2008). Related work has described supporting cooperative work through providing personalized information to each viewer of a single screen (Matsushita, Iida, Ohguro, Shirai, Kakehi & Naemura, 2004). This is very similar to the idea of boundary objects posited by Star (2010). The two concepts share many commonalities as they are, to my mind, both "temporal, based in action, subject to reflect and local tailoring" (Star, 2010). It is the lenticular qualities of boundary objects which make them liminal.

Further to this, we can say that a user's view of these objects determines their affordance (Norman, 1999), and that the user's experience, background and expertise then informs the potential use of a resource *for each user*. That is, the affordances of the materials available are visible to the expert in ways that are not visible to the novice. For example, in the Apollo 13 example provided above, the experts were able to innovate using resources that were not created for the purpose they adapted them to. This was a complex problem. The collaborative work of experts, working with a limited range of resources, *did not* make the problem easier to solve. Instead, the emergent, shared expertise of experts focused on an unusual problem provided an array of opportunities to use each resource, individually and together. However, if *novices* had been tasked with the challenge, it could be argued that the affordances of the materials would be unlikely to be identified and leveraged in a similar way. The problem in that case might have been deemed unsolvable.

The same can be said of the resources used in the studies in this dissertation. In Study One, the affordances of a Facebook Page were seen to be able to be turned toward supporting the cooperative work of reuniting pets with owners in the aftermath of Hurricane Sandy. It is interesting to consider whether the expertise at play in this study is one of animal advocacy or whether it is discovered in the use of the social collaborative technology of Facebook, or more likely, both. We see that whatever the case, it is the *shared*

expertise of the users and administrators which creates the successful organization of the Page; the identification of different roles and notation behaviors; and the emergent task of matching pets.

Similarly, in Study Two we see an innovation in the use of social media to "cast a net" and attract the interest of equine specialists to the needs of the Ranch. In Study Two we see innovative uses of Facebook with an effect on both online and offline action. The experts' online innovation created Facebook Groups aimed at raising money for the Ranch through donations and auctions. Offline, the experts' innovation brought together human and material resources to effect the physical evacuation of the horses. Finally, in Study Three the use of paper wristbands by the Brand Inspector supported the need to make information explicit and thus smooth the way for animals to be released from the fairgrounds with their owners. The wristbands alleviated the tension around ensuring large animals had received their brand inspections without directly challenging owners. This innovation on the part of the expert Brand Inspector allowed Community Animal Response Team volunteers and animal owners to streamline their work.

7.1.2 Identified information flows and impacts on cooperative work at animal evacuation sites, with implications for design

Informal, immaterial aspects of the practice of work are just as important as formal, documented procedures. Additionally, information of all kinds is necessary to make good decisions, and limiting information constrains the ability of decision-makers, no matter how experienced or highly trained they are. As shown in Figure 34, the people charged with making the *largest* number of decisions as to the provision of resources, directives on mobilization and demobilization, and creating the After Action Reports are also those who have access to the *least* amount of information, both during an evacuation and afterwards.

The greatest amount of detailed information in animal evacuation is accessible in places where micro-tasks are done, such as in barn areas where volunteers are focused on managing each animal individually. However, the information written down at these points reflects the volunteers' need to

support and track their *own* work in the time it is being done. As a result, some information about the animals is not recorded, or is recorded on paper that is disposed of, or on whiteboards, which are erased when a site is demobilized. One example of the effect this kind of loss of information has, is to consider the veterinary notes written on whiteboards in the barn area, which are erased at the end of an evacuation. Notes about veterinary care are useful for officials at the Emergency Operations Center during and after an evacuation event, in reporting on the status of animals onsite and the care they received, and by whom. However, this information is lost because of the format it is recorded in, due to the people who record the information not seeing the relevance of the information beyond the temporal bounds of the evacuation itself.

There is not only *less* information available at higher levels, it is also highly *quantified*. It is difficult to communicate the depth of information when limited by paper and telephone, and when working within the constraints and pressures of time. Information becomes quickly decontextualized, and this makes identifying insights at higher levels difficult. As the information becomes simplified in this way, it does not matter how well trained, experienced, sensitive or mindful officials at the EOC and Federal levels are. The lack of contextual detail needed to support good decision-making and planning is difficult to identify, or worse, simply non-existent.
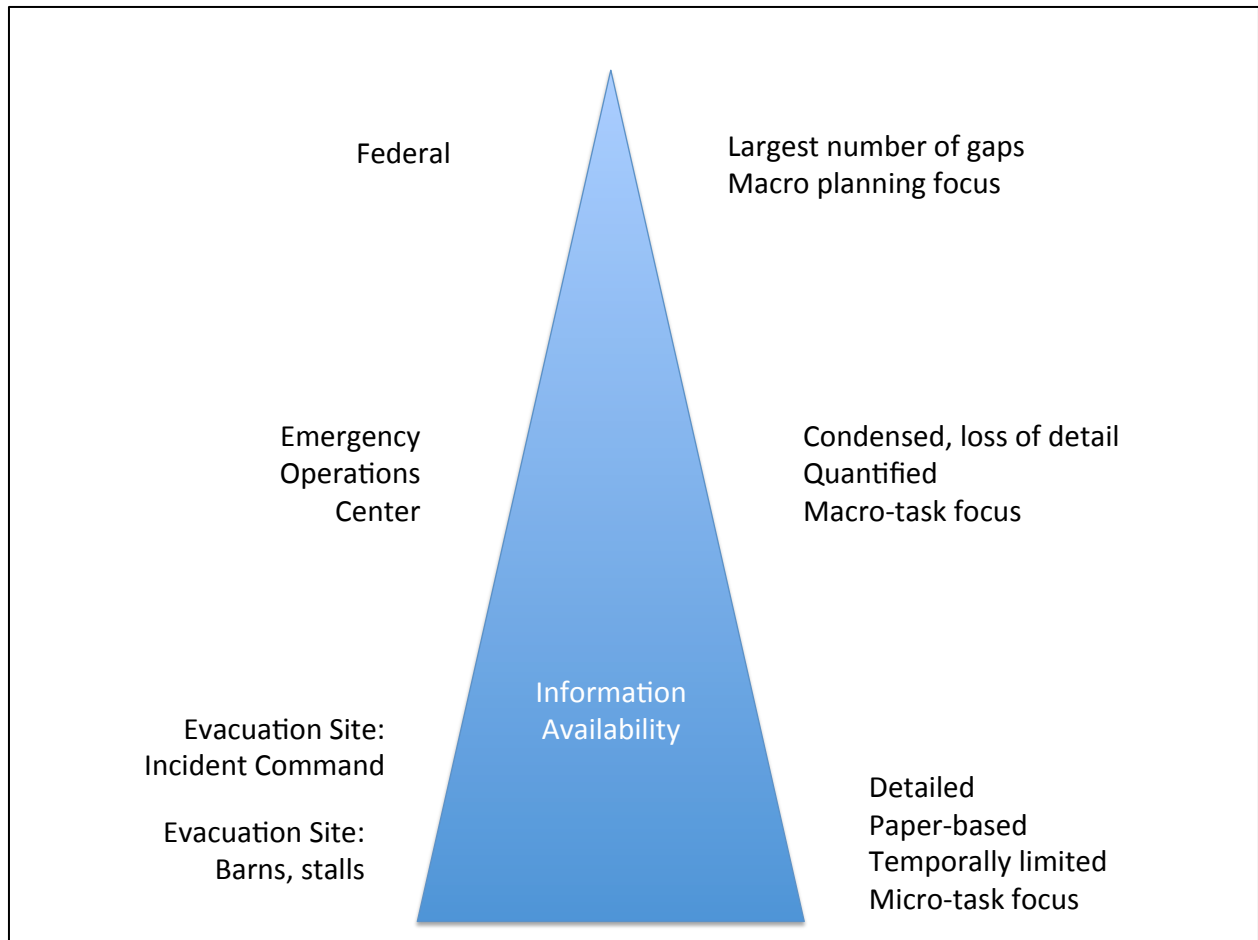
Figure 34: Information availability across animal evacuation.

To streamline the availability of information at different levels, and to provide an opportunity to explore the information *in depth* at all levels, Study Three shows that we can use social collaborative tools to support information collection, management and dissemination to those who need it. However, pursuing such an intervention must inclusively recognize the *practice* of responders at each level.

I note here that the use of the term "intervention" is intentional and specific. Information flows have an impact on work practice. Changing or adding information collection tools also have an impact on work, and might be considered a negative influence by workers, *even if* the tools that are introduced are not intended to change the flow of work, and even if the information collected *improves* the information support to those working beyond the temporal and spatial confines of an evacuation response.

Being cognizant and inclusive of the practice of workers at every level is necessary to ensure that an intervention is adopted and used as intended, without having a negative influence over the practice of work.

7.1.3 Identified information gaps in communicating with the public

Disasters are by definition riddled with unstructured and complex, unusual and emergent problems that need to be solved. A core aspect of these unstructured problems is the lack of information about what needs to be solved. The three studies in this dissertation show the range and breadth of information gaps, and their effect on the work done, as well as the effect information gaps might have on decision-making by the public.

Information seeking by the public might influence their willingness to evacuate promptly, and where they go when they do evacuate. There is an opportunity to improve this information provision using social collaborative tools. This dissertation explored one way of filling some of these information gaps by creating maps to help make explicit the information required to support good evacuation decisions, using methods and detailed instructions that can be replicated by officials and Community Animal Response Teams in any location.

The pervasiveness of social media means the public can seek and share information quickly and with great attention from anyone around the world who is interested in the same topic. The perception of *control* of information is no longer solely under the governance of officials in disaster response, and this revelation is often seen as threatening to officials. However, efforts to "control" information are misguided. Instead, a focus on increasing the provision of *good information* to the public is enough to support good decision-making. Additionally, the public *wants to share* good information with others using social collaborative tools. If officials make good information available efficiently, then, in all likelihood, it will be shared. This dissertation has demonstrated opportunities for officials to create good information in easily accessible formats that fill information gaps *before* an evacuation happens. As part

of their preparation activities, officials can continue to seek out these kinds of information gaps, and determine ways to fill them with increased levels of information.

7.1.4 Examined affordances and limitations of paper-based information collection and management as part of the emergency response network

It is true that "paper is woven into the very fabric of work" (Sellen & Harper, 2002, p.17). This dissertation has demonstrated both affordances and limitations of the use of paper-based information collection and management. It has been estimated that 83% of paper used in business environments are forms (Sellen & Harper, 2002, p.27), and it would appear that a similar scenario exists in emergency response at animal evacuation sites—a location that one might consider less supportive of paper-based information management.

In a world of technological hubris, it is easy to find fault with paper-based information management systems, especially when they are used in an environment that is dirty and subject to inclement weather such as those of animal evacuation sites. Certainly, there are many problems with the paper forms and the ways they are used in animal evacuation, but these problems are not nearly as obvious as one might assume.

Forms impose a fabricated rigidity on information. They structure and classify data in ways that may not represent truth or intent. Forms therefore simplify data collection, but they do not do it in a way that attends to the needs of *all users* of the information. The forms used in animal evacuation are not, however, passive repositories of information. They act as an underlying structure for the work of Community Animal Response Teams, and this dissertation has made visible the ways in which paper is critical to the practice of work in this space. Any digital intervention that seeks to support information flows and cooperative work in emergency response must do better than to replicate the kinds of decontextualized, structured formats that forms have so far provided. Any digital tool must look to support other aspects of work practice, such as informal note-taking and ability to revise and correct information over time. We must also consider the ways that the high level of verbal communication onsite

supports the work being done, beyond the straightforward transfer of information a verbal conversation might hold. For example, through relationship building between volunteers and mutual awareness of the workflow.

7.1.5 Examined relationship between online and offline information and impacts on cooperative work

Little research has been done that considers the online and offline arenas as operating together. Instead, researchers have focused on one domain or the other, and explored topics and behaviors within them. This dissertation, therefore, makes a contribution by providing insight into how cooperative work is done in each arena, as well as how information collection and management occurs in those spaces. Furthermore, this research demonstrates ways the availability of information in each of these spaces is being shared, *or not*, across the arenas, and their effect.

7.1.6 Demonstrated opportunities to improve flows of information using collaborative technologies

Lessons from Study Three demonstrate that there is an opportunity to continue to develop the work done in Projects One and Two, and to produce Information Support Tools that aid in filling information gaps in disaster, by leveraging social collaborative tools. This dissertation has explored initial ways this could be achieved, and has made evident the need to include officials and volunteers (both trained and spontaneous) across evacuation in their development. Both Projects demonstrated the need for better understanding of the flows of information in evacuation between levels, and at different stages. As officials and volunteers worked together, these gaps became evident. The aim is not to simply provide tools as ways of addressing information gaps. Rather, it is to do so with the premise of *supporting the work at every level and stage* of response.

In addition, future explorations of the potential to improve flows of information using collaborative technologies might also include animal owners as part of the exercise, to gain insights from those not familiar with disaster and evacuation, and to best understand how to communicate specific but nuanced directions to decision-making animal owners in an inclusive and supporting way.

7.1.7 Demonstrated opportunities for policy-makers in emergency response

This dissertation has many lessons for policy-makers in emergency response. Below I highlight three main areas for attention by policy-makers, followed by one area of immediate concern, where policy *must* be updated to meet the needs of animal owners.

7.1.7.1 Highlighted the need to incorporate the expertise held by spontaneous volunteers in response

Even though spontaneous volunteers have always been present in disaster response, they remain "problematic" for officials. The tenet of disaster response is to act in ways that support human behavior, but knowing what to do with the ever-present Spontaneous Volunteer appears to remain a challenge, with little attention being paid to their use. Coinciding with officials' inability to include spontaneous volunteers in disaster response efforts, this dissertation underscores that officials do not have all the expertise needed to attend to community needs in a disaster, nor do they have good ways of attracting relevant expertise for specialized needs, such as those affecting animals.

With the prevalence of social collaborative tools providing greater access to communicating with the public in disaster, let us recognize that expertise will often be found in spontaneous volunteers. Spontaneous volunteers must not be tasked only with mundane, functional chores, but instead they must be seen as potential helpers with expertise that can be leveraged to attend to the problems that are ill-structured and emergent, realized in disaster.

It might be argued that the success of the National Incident Management System (NIMS) framework in addressing the needs of people in disaster and providing resources where they are needed proves its effectiveness. For example, successful evacuations of companion and service animals alongside their owners is now happening. But this early success might breed complacency, and risks drawing attention from the aspects of official response to the needs of animals and their owners that remain lacking (Weick & Sutcliffe, 2007, p.52-53).

I am careful to note here that I do not privilege spontaneous volunteerism over official organization and processes. The studies in this dissertation show that self-organization can be productive,

efficient and successful in attending to the needs of disaster, but so too can formal organization. Blending and appreciating the aspects of each which best meet the emergent and changing problems of disaster will move disaster response forward across the entire community.

7.1.7.2 Highlighted the need to embrace and train for flexibility

Flexibility and deference to expertise go hand in hand (Weick & Sutcliffe 2007, p. 133). Officials must temper the need for officially recognized training with the reminder that resources are few in disaster, and that officially trained people "burn out" over the course of a disaster response, which is never predictable in intensity or timeframe. Officials must encourage and investigate ways to incorporate the resources that appear "in the moment" of disaster; of gathering situational awareness in ongoing ways; and of training people to be *flexible* in the information they know, its application, and their willingness to *adapt* to the needs of people across the time and space of an evacuation.

Sanctioned volunteers are subject to multiple and frequent training courses, exercises and engagements. There are many procedures with good rationale, yet often we see information limitations incurred as a result of following these procedures *to the letter*. If we do not include training that celebrates innovation and flexibility in context, we risk training people to be forever novices, with each strictly adhered to process being "the way things are done," rather than experts with a more broad understanding of the nature of disaster, and the ability to innovate their response. As Klein (2009, p.13) has said, "we put too much effort into reducing errors and not enough into building expertise."

This issue is not new. To explain, I call on another example of coordinated work from NASA. The inflexibility which is characteristic of people who work "by the book" rather than trusting their expertise and innovating to scope and attend to a problem was highlighted by the Columbia Accident Investigation Board. "NASA's culture of bureaucratic accountability emphasized chain of command, procedure, following the rules, and going by the book. While rules and procedures were essential for coordination, they had an unintended negative effect. Allegiance to hierarchy and procedure had replaced deference to NASA engineers' technical expertise" (Gehman 2003, p.200). Weick and Sutcliffe (2007)

argue that this *inflexibilty limits opportunities to defer to experts*, and limits the ways experts can come together to solve problems. This then ensures that emergency response operatives are *less resilient*, because they are less able to expand, contract and be flexibly attentive to the needs of the community in disaster as they emerge (Weick & Sutcliffe, 2007, p. 80-81). Finally, the by the book approach leads to people in the system becoming exhausted. Furthermore, the result is that when any flexible approach is used, it places the responsibility for it in the hands of individuals rather than having individuals working within *a culture of flexibility* within the system itself (Weick & Sutcliffe, 2007, p.134).

7.1.7.3 Highlighted the need to make practice explicit across and between all levels of response

The three studies in this dissertation showed information gaps between officials and volunteers at all levels. These gaps reflected ways in which people at each level do not see the work being done outside their own area of interest, even though the information they each collect and work with has influence over the work done at other levels. There is a clear need to share the practice of work at each level and stage of evacuation with others in the evacuation network. This will assist in overcoming the limitations of information experienced at higher levels, and will help in awareness of operations on the ground. This would then lead to greater insight, development of expertise, and greater innovation and flexibility in practice across all stages and levels.

7.1.7.4 Recommendation for immediate update to policy

Finally, I wish to highlight an area for immediate concern. The implementation of the PETS Act (2006) appears to have improved evacuation decision making by owners of service and companion animals. While no empirical research exists on the *direct* effect of the Act, the number of animals reported by officials to be included in evacuation anecdotally and in After Action Reports, such as those reported in Study Two, show that people are actively taking advantage of the support of public transportation and sheltering to evacuate with their pets.

Evacuating and caring for the welfare of small animals is logistically and financially manageable. It is relatively easy to ensure that owners of companion and service animals are supplied with leashes,

crates and logistical support to evacuate using normal transport and with minor sheltering adjustments. However, policy continues to ignore the needs of people with large animals. While it may be logistically very difficult to evacuate large animals, and there are far fewer people available who are knowledgeable about their management and care across the community, other ways of supporting the welfare of large animals in emergency, such as the provision of hay drops and monitoring the animals that remain in an affected area over the period of the disaster to provide accurate reports to owners would be greatly beneficial.

Again, I state that this problem is grounded in an information gap. In Study Two we saw the tension surrounding the lack of information and the disparity of information available to the Ranch owners. We saw this information gap have an effect on both the identification of the problem to be solved, and on the sense of immediacy the Ranch owners felt. We also saw how a lack of expertise can lead to negative outcomes (the death of the stallion), and how this might not be reported to officials by owners who are distressed but aware there is nothing to be done to fix the situation. The consequences of inattention and inaction around the plight of large animals in disaster are lost in the larger schema of the event itself, but the effect is still horrendous in both emotional and financial ways to owners.

Legislation attending to the needs of large animals in disaster has been concerned mainly with Disaster Assistance Programs that cover insurance losses and financial compensation *after* a disaster (United States Department of Agriculture Farm Service Agency, 2014; Kristi, 2013), rather than supporting the needs of large animals and owners *during* a disaster. Attention to the creation of an addendum to the Stafford Act similar to that of the PETS Act (2006) will support decision-making in disaster, and will improve outcomes for large animals and their owners.

7.1.8 Demonstrated opportunities to use social computing tools as part of practice

The National Incident Management System (NIMS) aims to bring together people from many different response organizations to work together under a single crisis framework. Part of official training calls for officials and volunteers to recognize they will likely be working with and for people they have

had limited involvement with before, in roles that report to people from different fields. When working in the NIMS framework, it is necessary to not only recognize that the *structure* of the organization, made up of emergency responders from various teams, is different to their usual roles and responsibilities in non-disaster times, but also that the work being done across the organization is fluid, and has different concentrations at different times in the response.

The introduction of digital tools calls on officials to recognize that "knowledge lies less in its databases than in its people" (Brown & Duguid, p.121). It is valid and timely to include social computing tools as part of the practice of emergency responders. Improvements in collection, management and dissemination of information to all people affected by, and responding to, a disaster will be a likely result. In investigating the ways these tools can contribute, the recognition and inclusion of expertise across all aspects of animals in evacuation and disaster is vital for success.

Disasters are dynamic events, characterized by information gaps and limited resources to attend to sudden, emergent and changing problems. Sociology of Disaster and Crisis Informatics literature, along with Computer Supported Cooperative Work literature more broadly, provide foundation for exploration of the practices, communications and cooperative work that are part and parcel of disaster response. However, as this research shows, in looking at implications for design using social computing technologies, we must look further and deeper to ideas of expertise and lenticular resources to better understand how people are *already* converging and innovating in disaster, both online and offline; and how we might be able to support and expand those efforts.

We have an opportunity to encourage these responsive communities of shared expertise using social computing tools, integrating their efforts more directly into disaster response. Furthermore, I invite officials, trained volunteers and spontaneous disaster responders alike to appreciate the wealth of critical knowledge, experience and nuanced understanding each already has, and could apply to some of humanity's most trying circumstances.

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