When Worlds Collide: The Importance of IS Alignment for Effective Disaster Recovery

Abstract

During disaster recovery, agencies, NGOs and support organizations persist with traditional command and control systems to develop situational awareness and manage the recovery process. Over the last decade, however, we have seen the rise of self-organizing systems involving communities and individuals in recovery, through their use of smartphones and social media platforms. Both of these approaches represent two contrasting technological, organizational and structural world-views of ‘citadels’ and ‘webs’. These world-views underpin a complex array of disaster recovery information systems, often supplying poor quality information for recovery managers and communities, which produce less than effective decisions on resource utilization. This paper outlines findings from a one-day research workshop that focused on how to better connect and align both the citadels and webs of disaster recovery. In doing so, we wish to lay the groundwork for a future research agenda for the production of effective situational awareness in disaster recovery.

Keywords

Alignment, Extreme Events, Disaster Recovery, Social Media

Introduction

When disaster recovery stakeholders adopt information systems (IS), we see no major alignment of technological, organizational or structural approaches to the use of IS or any cohesive approaches to the sharing of information to assist collaboration, cooperation and coordination between stakeholders (Dufty 2012; Dean 2015; Metha et al. 2017). There is also no systemic approach to producing ‘situational awareness’ for disaster recovery and this also contributes to a less than effective use of resources during this phase of a disaster (Cavallo 2014).

In his seminal paper on inter-organizational behaviour during a disaster, Turner (1976) states that such behaviour often exhibits “rigidities in institutional beliefs, distracting decoy phenomena, neglect of outside complaints, multiple information-handling difficulties, exacerbation of the hazards by strangers, failure to comply with regulations, and a tendency to minimize emergent danger” (Turner 1976, page 378). Nothing much has changed since then.

Collaborative management of organizations, people, systems and ICT infrastructure is needed for effective disaster recovery efforts. Over time, we have become more aware that disasters are escalating and cascading. In the modern world, where people are much more closely linked both locally and globally, a
disaster may have compound effects, many more dispersed and diverse stakeholders, and many and more systems and communication channels for response. Despite the best efforts of government agencies, NGOs and community groups, effective disaster recovery remains an enormous challenge and a major cost to government, NGOs, insurers and the community (Deloitte Access Economics, 2013). Failed recovery efforts can easily set off a cascade of crises and unintentional deaths as witnessed in many tragic extreme events from 9/11 in 2001, the Black Saturday Bushfires in 2009 to Hurricane Harvey in 2017.

In this paper we firstly discuss the lack of systemic approaches to disaster recovery highlighting the two differing organizational world-views of command and control ‘citadels’ and emerging empowered self-organizing ‘webs’. We then explore where these two world-views collide, interact and cause difficulties in the alignment of IS technology, organization and structures for effective disaster recovery. The paper then describes the findings of a one-day research workshop involving experienced domain practitioners and academic researchers who worked together to build a ‘Dynamic Picture of Disaster Recovery’. Finally we suggest a way forward and research agenda for a more effective IS alignment during recovery when these two world-views collide.

A Lack of Systemic Approaches to Recovery: How Worlds Collide

During recovery from an extreme event like a major storm, heatwave, bushfire or flood, the whole community may be both physically and psychologically affected and/or impacted (Bunker et al. 2015). There are also many activities that need to be coordinated or otherwise dealt with by ‘support agencies’ which may include temporary and long term accommodation for evacuees, managing their distress, dealing with their personal needs, including pets, medicines, communications, food, clothing, etc. There is an extraordinary reliance in the recovery phase of a crisis on organized charities, volunteers (who may give up their jobs for days or weeks), community facilities (e.g. council and registered clubs) and also the generosity of private individuals and businesses. People may need to locate and contact friends, neighbors and relatives who may have been separated, or volunteers who may also be looking to connect with their own families and friends (Bird et al. 2013; Rogers et al. 2015). All of these stakeholders and their interactions in the recovery process represent a complex socio-technical system that is under pressure to use available resources to achieve optimal recovery outcomes for the community.

There is a lack of systemic approaches to disaster recovery, however, that are contributing to overall disaster costs and resource utilization. The Australian Productivity Commission (2015) published a report on Natural Disaster Funding Arrangements (http://www.pc.gov.au/inquiries/completed/disaster-funding) recommending that "Australian Government post-disaster support to state and territory governments (states) should be reduced, and support for mitigation increased". This recommendation was partly due to the ever-increasing financial impost on governments at all levels during the recovery process. Deloitte Access Economics (2013) indicated that the financial burden of disasters ran at $6 billion in 2012 increasing to $12 billion per year by 2030 and then to $23 billion per year by 2050. More effective and systemic management of recovery efforts, therefore, is a key to lowering overall recovery costs.

It is important in our current environment, therefore, to evaluate how public safety agencies, NGOs, utilities providers, community groups and individuals use technology, to organize and create structures in order to obtain and use information to manage recovery processes during a crisis or disaster. The two main approaches to support these activities are command and control hierarchies or ‘citadels’ and empowered (self-organizing) networks or ‘webs’ (Star and Levine 2006; Handy 2007).

From an agency, NGO and organizational perspective, traditional command and control organizations develop situational awareness during disaster recovery through creating a common operating picture (COP). The Prevent, Prepare, Respond and Recover (PPRR) protocol provides a common strategy and a backdrop for the development of this COP. Most emergency agencies use their own currently proven processes, technologies and information systems to optimize outcomes and get value for money during recovery. In recent times, however, it has been acknowledged that communities have a greater role to play in emergency management (including recovery) due to the emergence and adoption of smart devices and social media communications channels by individuals, and the opportunity this provides for building overall community disaster resilience (Dufty 2012). In a recent study looking at social media models for use in disaster management Mehta et al. 2017, made the observation that there is a requirement for “an
organizational structure that avoids any barriers between passive information monitoring and active user engagement” (page 561). In research conducted by Sakurai and Kokuryo (2014), problems and issues are highlighted that emerge when citadel systems are pushed to failure during major disasters. In conclusion to their work, they discuss the critical need for a resilient disaster IS infrastructure based on the smartphone as the foundation technology, through the application of a “frugal” IS design approach.

**Citadels**

The technological, organizational and structural attributes of command and control systems (or citadels) include that they: are familiar and comfortable i.e. developed from existing operational systems capabilities; have a centralized view of information and its use (‘mainframe’; ‘Industrial Age’) i.e. command and control approaches assume a centre of control; need to be planned i.e. as a COP draws from existing operational systems then its architecture needs to be carefully planned and implemented; are expertise based i.e. need experts and technical systems staff to operate and use them; are linear in nature and use i.e. separation of phases of knowledge→decision→action; require advocacy, directives, and the exertion of power and control to ensure their effective use i.e. someone needs to own them and assume responsibility for their creation, management and use; have standardization and efficiency objectives i.e. a common picture or situational awareness which encompasses knowledge→decision→action; have a value chain and asset management orientation i.e. systems which focusing on managing a chain of activities and government assets as they relate to recovery; and are metric driven i.e. drive measurable outcomes and government accountability.

This worldview produces processes, and the adoption of technologies and systems that are utilized with varying degrees of success and effectiveness (Bunker and Smith 2009; Levine and Woody 2010; Bunker et al. 2015) in the various phases of a disaster.

For example, Bunker et al. (2015) highlight lessons learned from the 9/11 Terrorist Attacks (2001), Hurricane Katrina (2005) and the Black Saturday Bushfires (2009), which show that all phases of disaster management suffer from: incompatibility of local responses together with a lack of central global management; a lack of centralized oversight and sense of common purpose at a local level resulting in poor resource management; ‘Paralysis’ of government agencies not wanting to be seen as complicating and over-reacting to the disaster or wasting resources; and little coordinated oversight of individual agency ‘command and control’ structures, processes and systems that prohibit the effective sharing of situational awareness at a central or local level.

These commonly recurring issues have a profound impact on the recovery process highlighting that coordination, communication and collaboration, when central disaster management capabilities and local recovery effort converge, are often either compromised or inadequate. More recently, this was clearly highlighted in the case of official response efforts to Hurricane Harvey (2017) where the general public posted requests for assistance to social media rather than using the 911 emergency phone number (Rhodan 2017). Emergency services agencies were limited in their ability to respond to social media posts, for amongst a number of critical issues, they had difficulty in verifying the authenticity of the requests.

**Webs**

In recent times we have seen the emergence of systems that underpin ‘self-organizing’ communities in reaction to the real (as well as perceived) lack of government action in times of uncertainty when a disaster is unfolding and recovery efforts are underway (often at the same time).

Developments in technical systems such as open innovation tools and social media platforms (e.g. Facebook and Twitter), mapping (e.g. Ushahidi and Google) and wiki and mash-up technologies have enhanced communication, collaboration and location of people, places and resources, while facilitating self-organizing capability on an unprecedented scale (Shahid and Elbanna 2016). Nowhere is this more evident than in the domain of disaster recovery.

There is growing need for individuals and groups (spontaneous volunteers) to ‘take matters into their own hands’ to develop situational awareness, self-organize and assist in recovery efforts enabling many-to-many communication for coordination and collaboration (Mingers 2002; Mingers 2004; Shahid and Elbanna 2016).
We have seen these self-organizing socio-technical systems become major participants in, and facilitators of disaster recovery operations in many recent disaster events where self-organization of citizens supported and supplemented government efforts. For example, during the Wenchuan Earthquake 2008 in remote China, friends and relatives saved more than 95% of people, with only 4% saved by emergency services (Yandong 2010).

The technological, organizational and structural attributes of empowered self-organizing network systems include that they: are less familiar and comfortable to their users i.e. developed ‘on the fly’; are products of ‘internet’ and ‘knowledge age’ technologies i.e. have been enabled by recent developments in personal computing and social networking technologies; are driven by a strategic conversation but developed through self-organization i.e. individuals and communities become engaged in recovery activities and want to make a ‘valued contribution’; create knowledge i.e. are dilemma driven (respond to a given situation or problem) and are open (anyone who wants to use the system and participate can); synthesize knowledge→decision→ action i.e. systems are developed iteratively; have porous boundaries i.e. these systems are organic, fluid and changeable; are used for inquiry (intention/communication) and influence (connection) i.e. they support networking and self-organizing activities; are nimble, customizable and support creativity and speed; support value webs (of participants and system users); are relationship orientated (a goal of the system can be to build coalitions); and have less obvious metrics associated with them (if any) i.e. they do not drive measurable outcomes for accountability purposes (although people may be held accountable by the network).

With the advent of social media and small low-cost mobile devices self-organizing communities and individuals are injecting themselves into the recovery process with little knowledge of the nature of command and control technological, organizational or structural IS recovery approaches (Levine and Woody 2010).

While genuinely attempting to render assistance in the recovery process, these self-organizing networks have, sometimes been misguided, inappropriate and dangerous due to their lack of alignment with coordinated government, NGO and community views of recovery activities. (Bunker et al. 2013). We have now reached a critical stage where we need to develop a workable technological, organizational and structural alignment between these two worldviews of ‘citadels’ and ‘webs’ in order to lay the groundwork for the effective development and use of IS for situational awareness in disaster recovery.

Therefore we ask:

- What are the structural, cultural, information and process mechanisms that may provide better alignment between citadels and webs?
- How do these relate to the recovery phase of disaster management?
- How do we use this knowledge to design effective approaches to adoption and use of IS for situational awareness in disaster recovery?

**Methodology and Research Design**

To provide answers to these research questions we followed a Design Science research approach involving expert practitioners and academics in a workshop to ‘Build a Dynamic Picture of Disaster Recovery’. This workshop was designed as an IS change intervention (Gregor and Hevner 2013) to disrupt, challenge and then re-conceptualize our ‘mental models’ of disaster recovery. The format was adopted as a ‘live’ research method with elements of: 1) imprography - as our workshop also had structured and ‘freewheeling’ activities; 2) collaboration - as it brought together academics and practitioners to work to co-create outputs; and 3) creativity - as the imprographic nature of our approach allowed for workshop participants to put ideas and suggestions on the table without ‘fear of failure’ (Tarr et al. 2017). The resulting picture was then used to highlight requirements for a systemic approach to the disaster recovery phase, in order to advance a relevant and rigorous IS research agenda.


2 Somewhere between improvisation and choreography.
Workshop Location, Date and Timing: Sydney Australia, August 27, 2015 from 9am-5pm.

Purpose: A mapping of detailed technical, organizational and structural attributes of recovery, specifically focusing on alignment problems between recovery citadels and webs.

Structure: 1) A 3 hour morning session of background presentations by practitioners and researchers; followed by 2) A 3 hour afternoon session of facilitated co-development dedicated to ‘Building a Dynamic Picture of Disaster Recovery’.

Participants: 30 practitioner and academic participants with experience in: emergency services; law enforcement and justice services; industry; government emergency co-ordination; utilities; government finance; geospatial information management; risk management; and disaster recovery research.

Research Team: Two senior researchers, one post-doctoral researcher and a PhD candidate.

Workshop Structure: Morning Session - A series of background presentations by experienced practitioners, to brief the group on: connected communities, private sector involvement, health impacts and public safety agency support of disaster recovery. During these presentations the four members of the research team took detailed notes and speakers also made their presentation notes available for analysis.

Afternoon Session - Workshop participants were asked by the research team to identify emerging and probable future technical, organizational and structural conditions and alignment issues in disaster recovery. Participants were divided into groups and asked to brainstorm their ideas on post-it notes for 1 hour. All groups were then brought together to categorize their ideas into clusters (1 hour), and then these clusters were further organized (1 hour) into a framework (see Figure 1). In summary, our afternoon structured development activity involved brainstorming, analysis, and synthesis of ideas.

Expected Research Outcomes: By conducting this research workshop we sought to: deepen our understanding of the structural, cultural, information and process mechanisms that control the alignment between hierarchical command and control organizations (agencies, NGOs etc.) and networked self-organizing groups (communities and individuals) to build better theory in relation to these mechanisms; better understand the range of alignment problems that exist in the recovery phase; develop more effective pathways for obtaining information about the disaster recovery (a rare commodity) and develop access for practitioners to more effective pathways to working with the academic community. Our objective was to prioritize alignment problems and highlight solution requirements to support effective adoption and use of IS for situational awareness in disaster recovery.

Figure 1 Brainstorming and Categorizing Ideas at the Workshop

It must be noted that there are a number of existing technological systems, which claim to meet the needs of government, NGOs and communities during crisis recovery. These systems, however, often fall short (Levine and Woody 2010) and do not overcome the ‘fragmented’ nature of recovery efforts (Bunker et al. 2015).
Discussion & Findings

This workshop presented us with a unique opportunity to understand critical issues which impact technological, organizational and structural attributes that are essential to the alignment of citadels and webs (and the IS that they adopt) to improve disaster recovery outcomes. This has also enabled us to co-develop a research agenda with experienced practitioners and researchers from other institutions.

Key Findings that Emerged During Workshop Sessions

From the outset, there was widespread agreement by workshop participants that to more effectively align citadels and webs, a new definition of recovery was required.

Defining and enacting recovery was no longer the sole province of government and large organizations (command and control citadels) and any definition of recovery must now include reinvention and inspiration for communities and towns affected by a disaster to prosper (expressed by self-organizing webs). Recovery was no longer about restoration or returning to a prior state; rather, recovery goals were expanded to achieve a revitalized future. The related topic of enabling resilient communities was also of special importance.

In order to better align the worldview of citadels and webs, and support more effective collaboration, coordination and co-operation between them during disaster recovery, participants determined that the recovery process and its components were best understood and represented as a transformation from Relief (a command and control activity driven by the citadel technological, organizational and structural world view); to Revitalization (a collaborative, co-operative and co-ordinated activity that is underpinned by the complex interaction of technological, organizational and structural worldviews of both citadels and webs).

A framework of entities, areas and component parts that facilitate the move from Relief to Revitalization were identified through facilitated and interactive development within group discussions across the afternoon session of the workshop. Participants also highlighted a number of key issues that directly impact and enable a Relief to Revitalization transformational perspective on recovery including:

• Currently no shared picture of recovery exists;
• Both government (citadel) and community (web) perspectives are essential and must be represented in a way that fosters understanding between the two;
• Language must emphasize collaboration (not control) if communities are to feel a part of the recovery efforts;
• There is a lot of evidence from previous disaster recovery efforts that connected communities collaborate;
• Life can never be the same again after a disaster or extreme event. The term ‘recovery’ is inappropriate rather ‘revitalization’ is a more apt description of events;
• Dealing with the psycho-social impacts of a disaster are just as important as dealing with physical damage;
• Establishing infrastructure ‘in a box’ capabilities is needed. The ability to quickly replicate critical aspects of infrastructure and get them up and running, is essential to the restoration of a state of normalcy and confidence;
• Vulnerable individuals are often more impacted due to personal and resource limitations. Developing ways and means of assisting people who fall outside of standard recovery processes is an area that requires special attention;
• Governments must work seamlessly with privately owned providers e.g. utilities, hospitals, and water authorities. Fast restoration of essential services is critical to public confidence and public health; and
• Recovery needs to be viewed from multiple perspectives of our families, friends, neighbours, villages, religious institutions and regions.
Post Workshop Analysis of Research Notes and Workshop Materials

Post workshop, our research team further synthesized and refined workshop outputs and our notes which highlight the following key areas (See Figure 2 below):

- **Outcome** – recognizing opportunities to assist those people and groups affected within the community; how to implement improvements to the current situation; how best to restore normal operations and functions within the community; and what ‘looking to the future’ might look like;

- **Principles** – how do we best understand what is ‘proper’ action during a disaster recovery operation versus what is determined to be ‘normal’ conditions; and how we can best encourage and support individual and community long-term adaptation to a new environment;

- **Community** – how can we effectively deal with the social trauma and frustration that result from a disaster event; how do we identify and support individuals and groups (at risk) that fall outside of the standard recovery processes and procedures; how do we assist groups and individuals to adapt to the new ‘normal’ environment; how do individuals and communities evolve (post event) and what can be learnt from this;

- **Action** – how can we most effectively re-build, restore, restructure, reconstruct and reconnect communities and the individual lives and livelihoods that are impacted and affected by the disaster event. How do we effectively deploy resources and human actors to complete recovery processes;

**Figure 2 Transforming Recovery**

- **Social Fabric** – how do we define and provide emotional support and mechanisms for problem solving; how do we define safety nets (resource-based and emotional); and what are mechanisms for collaboration and community development. How do we encourage and support economic recovery, restore communications capability and the general social domain (stability) and effectively allocate budget funding to the restoration of the social fabric of a community;
• **Infrastructure/Services** – how do we use priority mechanisms to restore: utilities; roads; health services; banking and finance functions; schools; community centres; waste services; piping and recreational facilities; and

• **Governance** – how do we build communities that are more resilient to disasters and are more sustainable in the long-term; how do we develop partnerships between disaster recovery stakeholders; how do we encourage and support community leadership, the ability for a community to ‘bounce back’ after a disaster as well as the development and support of stakeholder networks to underpin the governance structures.

**Conclusion and Future Research Agenda**

Many efforts are underway to tackle the technological problem of disaster systems alignment within Australia e.g. RISER\(^3\), however, research on approaches to disaster recovery systems’ organizational and structural alignment remains largely ignored, and where research is evident it is disjointed and fragmented.

At a time when disasters and extreme events are on the rise, it is clear that most recovery efforts are prone to failure, underestimation of costs, and unacceptable time delays in the restoration of normal operations and activities. As late as February 2017, six years after the Japanese Tsunami (2011), 123,000 out of 340,000 people were displaced\(^4\). In late 2017 we were still seeing recovery efforts in progress for disasters such as Hurricane Katrina (2005) and Queensland Floods (2010/2011). In New Orleans, the 9th ward of the city is still largely uninhabitable and not rebuilt. The Red Cross has also documented many on-going recovery efforts within Australia that were commenced as far back as the Victorian bushfires of 2009\(^5\).

While we have witnessed the rise of self-organizing systems and community ‘webs’, we are also aware that Australian government agencies have been dedicating resources to incorporating social media tools and platforms into general operations and the management of disasters and crises as diverse as floods, bushfires, earthquakes and terrorist bombings (Campbell 2011; Bunker 2011; Ehnis and Bunker 2012; Ehnis and Bunker 2013; Bunker et al. 2015). This use of social media by government occurs across many portfolios: engineering, communications, agriculture, animal management, health, transport and defence at local, state and federal levels as well as internationally\(^6\). In recent years Sahana has been somewhat effective in China, Pakistan, Philippines, Peru, NZ (Christchurch Earthquake 2010/11), and New York (Hurricane Sandy 2013) in collaborating efforts of volunteers, NGOs and government organizations. Within the open innovation platform and tool development space, there have also been many development activities, for example Ushahidi\(^7\) and Digital Humanitarians\(^8\).

Our workshop brought together experienced practitioners and academics to ‘Build a Dynamic Picture of Disaster Recovery’. In completing this activity we were able to represent disaster recovery as a transformation from relief to revitalization. We also now have a deeper understanding of seven key technological, organizational and structural attributes that are essential to the alignment of citadels and webs and the IS that they adopt and use that include: Outcomes; Principles; Community; Action; Social Fabric; Infrastructure/Services; and Governance. These attributes should be effectively explored and considered by the research community to ensure better alignment and more effective IS development and use for disaster recovery situational awareness when both world-views must co-exist and interact (Venable et al. 2011). This is especially important when considering responses to events where situational

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\(^3\) [http://riser.net.au/](http://riser.net.au/)


\(^6\) [Current examples include: NSW Police EyeWatch (http://www.police.nsw.gov.au/about_us/structure/operations_command/major_events_and_incidents_group/project_eyewatch/the_eyewatch_model); Queensland Fire and Emergency INCSnap (https://ansibleww.com.au/case-study/queensland-fire-and-emergency-services-incsnap/) and international cooperation in local disasters by Sahana Software Foundation (https://sahanafoundation.org/about/); as well as within volunteer organisations attended by the UN and Red Cross.](https://www.usahidi.com/)

\(^7\) [http://digitalhumanitarians.com/](http://digitalhumanitarians.com/)
awareness for effective communication, collaboration and co-ordination in disaster recovery, is a required outcome (Bird et al. 2013)

In addition to this focus our workshop findings also indicate that further research should investigate how to: develop a shared picture of the event or phenomenon from multiple perspectives; use language to develop the picture that reflects a state of collaboration between all stakeholders during an event or in response to a phenomenon; learn collaboration lessons from connected communities; deal with psycho-social impacts of the event or phenomenon as a matter of priority; provide infrastructure ‘in a box’ capabilities to quickly focus on and recover from the event or phenomenon; and identify and assist vulnerable individuals who often fall outside of normal responses to a given phenomenon.

Acknowledgements

This research was made possible with the support of the Interoperability for Extreme Events Research Group http://sydney.edu.au/business/research/ieerg at the University of Sydney Business School.

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