

# **DISASTER RESILIENCE AS A COMPLEX PROBLEM: WHY LINEARITY IS NOT APPLICABLE FOR LONG-TERM RECOVERY**

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## **INTRODUCTION**

Despite considerable research into developing effective systems for achieving disaster resilience after a major disaster (Blakely, Birch & Anglin, 2011; Vale & Campanella, 2005), there is an ongoing gap between the purpose of long-term disaster recovery and actual implementation. We will suggest that this is because, unusually, the nature of the disaster recovery process changes over time. It develops from being a complicated set of interrelated, urgent but essentially predictable problems in the short-term response phase, into a complex systems problem. In this paper we will first show that the disaster literature assumes a linear progression from short-term to long-term recovery as part of a well-documented disaster life cycle. Second, we suggest that this is based on a set of assumptions about the disaster recovery process which are potentially both limiting the possibilities of building a disaster resilient community and explaining current problems being experienced by those involved in disaster recovery worldwide. We then use data from Japan and Christchurch to offer evidence of the need to change some of the elements of the long-term recovery model.

## **DISASTER RECOVERY AS A COMPLEX PROBLEM**

Theoretical and practical approaches to disaster recovery have been developed to ameliorate immediate response, longer term recovery and potential prevention. Disaster literature in the sciences focuses on the uses of science to either prevent disaster or inform policy-based responses post disaster; however effective communications between the scientific community and policy-makers are missing, as discussed in the recent UN World Conference on Disaster Risk Reduction (Walch, 2015). In the social science fields, theoretical and practical approaches have been developed to support longer-term policy towards disaster resilience, which is about the two extremes: bouncing back from stress and being able to adapt (Fisher, 2015; Manyena, 2006). One such approach, disaster life-cycle models, reflects agreement in current theory that a disaster triggers a crisis response cycle (Ritchie, 2004).

The cycle, usually portrayed as a linear model, commences with rebuilding, redeveloping and renewal to support effective recovery (Blakely, 2012); it ends when the residents or users of an affected area resume their normal lives and mechanisms have been established to lessen the effect of future similar disasters (Muskat et al., 2014). The majority of the existing disaster recovery literature focuses on the short-term phases and technical responses (Muskat et al., 2015; Nakanishi, Matsuo & Black, 2014; Vale & Campanella, 2005). It is assumed that there will be movement from one part of the cycle to the next but, in fact, the move to long-term disaster recovery has proved to be less than automatic (Muskat et

al., 2014). It is logical that the different phases need dissimilar approaches and strategies for resilience development. However, it emerges that little is understood about what triggers those involved in a specific disaster context to ‘transition’ into new approaches that should lead to long-term recovery and resilience strategies. Recently the United Nations Office for Disaster Risk Reduction (UNISDR) suggested a need ‘to facilitate the link between relief, rehabilitation and development’ in the Sendai Framework for Disaster Risk Reduction 2015-2030 because there was not the seamless expected progression; however, a detailed description of the link is yet to be provided (UNISDR, 2015).

There is no agreed set of disaster terminology across the literature but a review reveals that there are distinct stages in the literature (Henderson, 2004; Vale & Campanella, 2005). In this paper we use *Relief* for the immediate phase after the disaster, *Rehabilitation* for the temporary settlement phase and *Recovery* for the long-term phase. What is apparent is that there is clear differentiation between the short-term and the long-term recovery phases, with very different activities being undertaken.

Recent challenges to assumed linearity suggest that the move from short-term rescue and relief to longer-term recovery and resilience development is not inevitable; instead Muskat et al. (2015) propose a ‘transition’ period between the short-term and long-term phases of recovery, arguing that the nature of the problem changes over time. Initially, regardless of the context, there will be a complicated set of problems related to survival, infrastructure, health etc., which can be solved with relatively routine solutions. A complicated system can be understood through its structural decomposition – that is, through the segmentation of the whole system into disjointed structural parts and their relations, and the further subdivision of these parts into smaller subparts and their relations; there are many positions, routines and processes that can be recognised and reconfigured without actually changing their nature. A common example is sending a rocket to the moon. Plans, process, formulae or recipes are critical and necessary to solve a complicated problem but they will need to be applied by people with high levels of expertise in a variety of fields. Learning from one event can be applied to the next event as the nature of the element does not change; thus sending one rocket increases assurance that the next mission will be a success. In some critical ways, rockets are similar to each other and because of this there can be a relatively high degree of certainty of outcome (Glouberman & Zimmerman, 2002). The key is that “*complicated problems originate from causes that can be individually distinguished; they can be addressed piece-by-piece; for each input to the system there is a proportionate output; the relevant systems can be controlled and the problems they present admit permanent solutions*” (Poli, 2013: 142). This clearly fits the initial stages of a disaster. The exact nature of the disaster will differ but the need to rescue, feed, shelter, communicate etc. is well understood and becomes a series of complicated routines applied by excellent crisis leaders (Sapriel, 2003; ‘t Hart, Tindall & Brown, 2009). However, we suggest that once such technical solutions have been implemented, the problem changes, to become a complex set of policy related problems that will need very different approaches in both design and adoption. We suggest that adopting linear conceptions of disaster recovery might actually inhibit, rather than effectively support, long-term, disaster recovery.

A complex problem results from networks of multiple interacting causes that cannot be individually distinguished and to do so is often to lose or change the understanding that was in place (Poli, 2013). A complex problem cannot be addressed in a piecemeal way, it must be addressed as an entire system. Small inputs may result in disproportionate effects; the problems they present cannot be solved once and forever, but require to be systematically managed and typically any intervention merges into new problems as a result of the interventions dealing with them; and the relevant systems cannot be controlled – the best one can do is to influence them. Complex problems occur within a system, which is made up of

interconnected, interdependent elements that work together in a nonlinear manner and produce feedback loops (Anderson 1999; Van Beurden, Kia, Zask, Dietrich & Rose, 2011; Simon 1996; Boal & Schultz 2007). This sounds like long-term recovery where the nature and extent of the problem differs for each disaster as a whole and for each stakeholder affected by it; there are many, potentially conflicting goals and objectives. Moreover, each disaster response often leads to unexpected consequences. In each case, however, the problem is still complex. This leads to the proposition that a key reason for ongoing failure to develop effective long-term recovery processes is the need to recognise this unusual situation where a problem changes from complicated to complex over time and that there will need to be a specific transition from the short-term phase to the long-term phase rather than an automatic progression.

We are not the only people to suggest that a long-term approach necessitates a different methodology from traditional policies and is not, therefore, facilitated by current disaster risk management practices (Comfort et al., 2004; Kemp, Loorbach & Rotmans, 2007), but the framing of the problem as a move from one form of problem to another is new. The proposition for this paper emerged from careful analysis of case studies developed in both Japan and New Zealand. It was apparent that, in both cases, the move to effective longer term recovery was proving challenging and so we re-analysed the data asking the question: “what aspects of the interactions between the different recovery stakeholders explain why the transition to long-term disaster recovery is slow”. We will present evidence that there were concerns with the progress of the recovery and offer confirmation that the re-development and growth transition will not be automatic. Further we identify some areas and ideas and, for success: both the processes and the people involved will need to be actively managed.

## METHODOLOGY

This paper is based on learnings developed from building two sets of case data. In each case the studies were exploratory study designed to gain some insights into different aspects of disaster, in particular the recovery stage. The first research case was the magnitude 6.3 (ML) Christchurch Earthquake which occurred on Tuesday, 22 February 2011, severely damaging New Zealand's second-largest city and killing 185 people. The earthquake caused widespread damage across Christchurch, with significant liquefaction producing around 400,000 tonnes of silt. The second case was the Great East Japan Earthquake and Tsunami when a magnitude 9.0 earthquake hit Japan on 11<sup>th</sup> March 2011. An area of more than 507 square kilometres was inundated with a total death toll of 15,890 (2,589 still missing as of March 2015). The case concentrated on one of the most devastated areas Miyagi prefecture, including Ishinomaki, Kesenuma, Minamisanriku and the prefecture capital of Sendai and Tokyo.

In both cases the original research timing was designed reflecting the Crisis Recovery Cycle; it was anticipated that the initial relief and rehabilitation phases were over after 18 months to 24 months. In each case the exploratory nature of the research which was seeking in depth understandings of a particular phenomenon (Goulding, 2005; Yin, 2014; Stake, 2006), combined with the relatively small research population size, a qualitative interviewing approach was adopted (Carsten, Uhl-Bien, West, Patera & McGregor, 2010; Creswell, 2014; Patton, 1990). A purposive and snowball sampling frame was adopted. Interviewees were recruited from related authorities in recovery, urban planners, small business, volunteer organisation and residents. 55 participants were interviewed on a range of topics related to longer term disaster recovery.

The first analysis of each case was done using open coding (Silverman, 2013) in order to look at all the issues raised for each phase of the disaster recovery in terms of the roles of

both volunteers and other stakeholders affected by the disaster. Each transcript was read several times to develop an understanding of the range of realities related to the phenomena. We then used phases of recovery as the analytical lens to group the ideas that emerged during the open coding. Groups of codes were clustered temporally (i.e. in phases), thematically in terms of the topics (i.e. governance, recovery, community, policy development etc.), and around stakeholder groups (i.e. volunteers, government etc.). This led to axial coding (Strauss and Corbin, 2008) looking for the connections between category groups. Of particular interest were areas of commonalities and differences with other participants, accepted literature or the official documentation.

The secondary analysis for this paper was undertaken in order to consider what was in the transition stage. Core themes suggested as barriers to transitioning to effective long-term recovery were identified from both cases. Three areas stood out as having the greatest potential impact: the inclusion of new actors; the development of new social capital, and the use of co-production with the local community.

## FINDINGS

### **New and Developing Actors**

Initially in Japan four traditional groups of actors took leading roles in the disaster recovery: Government (including national Government, regional government (Miyagi prefecture) and local councils), Non-Government Organizations (NGOs) (international and national volunteer organisations, e.g. Peaceboat), residents and local businesses. Predictably, they were formally assigned to undertake immediate rescue and relief. As time progressed from relief to rehabilitation, new local groups developed working with community, often led by local leaders. Rehabilitation began to move towards recovery; at this stage the influence of governmental groups declined; volunteer groups gained more influence; and new leadership groups and collectives were formed. Residents and business owners agreed that the new volunteer groups were perceived as demonstrating high initiative, forming groups through organizing, initiating collaborative events and developing 'ideas from the outside' to refresh thinking on how the community could be rebuilt. In addition, strong, cohesive groups of residents formed new collectives, which initiated activities to bring individuals out of lethargy, depression and isolation. Whilst recognizing the important governmental role in the industrial and infrastructure renewal, the government was seen as failing in its service the community; specifically there was little collaboration with both resident groups and volunteers and strong critique. A new leadership group emerged with social entrepreneurs contributing to the social and individual development of the region, investing in small business ideas and supporting community growth. These businesses include local food restaurants, homestays in fishing villages and a story teller taxi service.

In Christchurch a similar pattern emerged with Government (including national Government, and local councils), Non-Government Organizations (NGOs) (international and national volunteer organisations), the Defence Force, residents and local businesses all involved. However, there was concern that as time had moved on, those involved had not and that recovery had continued to be top-down, strongly centralised and not reflective of wider community opinions.

Theory about solving complex problems shows that how individuals behave and interact has a direct impact on whether policy interventions are successful (Head, 2008). Thus a lack of community involvement and agency may explain the lack of effective long-term disaster recovery because, although new infrastructure may be built, the necessary behavioural changes to support disaster preparedness will be less likely to develop.

## **Social Capital**

The critical importance of social capital in assisting disaster recovery is widely recognised in the literature (Allen, 2011; Chamlee-Wright & Storr, 2011; Dynes, 2005; Hawkins & Maurer, 2010; Murphy, 2007; Nakagawa & Shaw, 2004), but less is understood about how these various types of social capital contribute to (or hinder) long-term recovery (Aldrich, 2012a; Nakanishi et al., 2014). In Japan after the 2011 disaster, pre-existing community was completely dispersed due to loss of lives, limitation of available and safe land to construct temporary housing and the system that was applied to allocate temporary housing units to residents. However, a new social network emerged among residents through activities (such as morning tea and exercise) in the common space of temporary housing and events driven by volunteer groups. This has enabled the creation of new social capital which might be able to support recovery. This could be evidence that disasters may motivate previously unconnected individuals to undertake collective action creating endogenous social capital, both bridged, bonded and linking, where there was none before. However this is still a challenge where appropriate leadership, ownership, participation and information sharing need to be in place in a proper organisation (Ueda and Shaw, 2016). In terms of the developing roles of volunteers their role as actors can be seen to integrate the long-term disaster system, supporting the development of new bridging capital. Once the social capital is growing it leads to the community seeking more involvement. In Christchurch, in particular this was leading to calls for greater levels of inclusion in the decision making processes.

The challenge in the complex long-term recovery, in terms of social capital, is that the newly formed social capital might be affected; for example by relocating residents to new/repaired houses or if residents need to move outside of the disaster area (for employment and study etc.) after a certain period of time after disaster. This, in turn affects the recovery of society no matter how the physical infrastructure is rebuilt.

## **Co-production**

In the immediate post-disaster phase, the majority of aid provides emergency goods and materials to repair houses and restore essential infrastructure; consequently, a centralised top-down form of crisis leadership is appropriate. However, recent research indicates that, over time, the leaders of the recovery and local community members can become disconnected, such that the community feel ignored (Muskat et al., 2015). When governments and leaders continue to steer recovery in a centralised top down manner, it does not reflect how the community expects to be treated in the later stages of the disaster recovery. Both the Japanese and Christchurch case data demonstrated that community members were becoming key resources in the recovery process, sometimes taking leadership. Co-production is where value is co-created by two or more stakeholders to ensure the appropriateness and usefulness of knowledge, processes or outcomes created (Alford & O'Flynn, 2012) and analysis of both cases showed calls for more inclusion in the form of co-production of both recovery policy and implementation.

The co-production concept developed out of situations where both the consumers and the providers of a service undertook efforts to produce the good or service together in a way that would improve the quality and increase the likelihood of effective outcomes (Humphreys and Grayson, 2008; Parks et al., 1981). This matters because during post-disaster recovery, personal values and motivation play important roles in framing how citizens respond to the decisions being made by the governments and other stakeholders who are designing the blue prints for the future (LaLone, 2012; Shannon et al., 2014). If there is not an appropriate level of co-production and there is less traction with the community, the case data showed increasing tensions between the different stakeholders and less effective long-term recovery.

An example is the failure of the Japanese seawall project (Kesenuma city seawall study group, 2012). The seawall project proposed by the local government (under the guidelines of the national government) caused a controversy not only because of the idea to build a seawall of 5.0m to 14.7m in height along the coastline that needs to be maintained for at least 50 years but also, and mainly, because of the entirely top-down process. The general view of the community was that the prefecture should have involved residents from the very beginning of the planning process, before they created the plan. As a result of the conflict, the residents established a “seawall study group” and organised sessions with invited lecturers, including the prefecture officer, city council, mayor, an assembly member and academics from various fields so that they can examine the plan. The residents group suggested alternatives and these were shared with the government to amend the plan. This corroborates that co-production is important to gain community buy-in, harness innovation ideas within the community, and to increase the capacity of post-disaster recovery and associated enhanced preparedness for next disasters.

## **IMPLICATIONS AND CONCLUSIONS**

From our analysis it appears that we can identify some elements required for transition. All three elements identified in the data as affecting the potential for transition are based around system actors. It is also clear that the results of the different interactions of system elements will lead to emergent, often unexpected results (Gharajedaghi, 2006; Leveson, 2011). This makes it unlikely, for example, that having the same recovery plan in place five years on will be effective as the context, the actors and the purpose will have moved on. With the complex nature of the disaster recovery it seems more realistic that the initially adopted plan becomes no longer rational in 2-3 years period (as evidenced in Japan and New Zealand), and the integration of co-production is rather organic in designing recovery as it will, therefore, bring the agreed and valuable outcome. We propose that the transition that involves this process would be essential for sustainable disaster recovery and needs further research as it is currently missing in disaster research.

This paper proposes a period of ‘transition’ that facilitates the progress towards long-term recovery which needs to be set up and managed in a different way to the immediate responses. No community can be sustainable without achieving a recovery once it is affected by a disaster. Short-term responses such as rescue, relief and reconstruction of affected built environment enable the return to a normal life. However, there is a limitation for communities to be stronger to future disasters if the process of recovery stops at the completion of rehabilitation. For communities to enhance the preparedness to the future disasters, there is a need for an integrated approach – long-term recovery that is linked with sustainable development.

Long-term disaster recovery is a different problem to short-term response being a complex system which needs the actors within it to work together to achieve the espoused goals. This is the reason that ‘transition’ needs to be recognised for a successful recovery and, once recognised as an issue, analysed in terms of what it is made up. We do not claim that the elements are the only aspects of transition, or even the most important, but from our data we do suggest that they are a good place to start in terms of undertaking more research into this area.

## **REFERENCES AVAILABLE FROM THE AUTHORS**