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Disaster resilience as a complex problem: Why linearity is not applicable for long-term recovery

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ABSTRACT

The paper proposes that a reason why long-term disaster initiatives fail is the adoption of a linear, complicated problem based approach rather than seeing recovery as a complex system. The argument is that initial post-disaster responses are complicated with a subsequent transition to a complex problem. Transition is proffered as a missing link between short-term responses (rescue and relief) and long-term disaster recovery. Case data from Japan and Christchurch suggests that three system elements influencing potential transition are: the actors and their purpose; new forms of social capital and a move to greater co-production with community. Influencing these effectively will support enhanced traction to achieve the move to long-term recovery.

1. Introduction

In 2013 alone, 22 million people were driven out their homes by flood, hurricanes and other hazards (NRC, 2014). Incidences of disaster and the scale of disaster risk are continuing to increase, mainly as a result of the growing exposure of people and assets to natural hazards through increasing urbanisation (Gleeson, 2013; Trainor and Subbio, 2014; World Bank, 2014); external shocks, including natural disasters and dramatically increased poverty and insecurity (Beck, 2009; DFAT, 2014; IPCC, 2014). Effective disaster preparedness, community and country resilience, and reduced disaster risk have never been more important (Manyena, 2006), yet many disaster recovery initiatives are not as successful as might be anticipated (Pearce, 2003; Muskat et al., 2015).

Despite considerable research into developing effective systems for achieving disaster resilience after a major disaster (Blakely et al., 2011; Vale and 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 show that the disaster literature assumes a linear progression from short-term to long-term recovery as part of well-documented disaster life cycles (Blakely, 2012; Hernantes et al., 2013; Muskat et al., 2015; Ritchie, 2004). Linear progression in the literature is described as almost automatic change from short-term responses to long-term recovery phase with same actors and management (Blakely, 2012; Hernantes et al., 2013; Muskat et al., 2015; Ritchie, 2004). However, we will demonstrate that a step change or transition point between short-term response and long-term recovery is necessary, albeit that this will involve social challenges, different actors and new approaches. As such, this questions the assumed linearity of the existing models. Further, we will suggest that existing disaster life-cycle models are 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 will use two cases of earthquakes in Japan and Christchurch, New Zealand to offer evidence of the need to change some of the elements of the long-term recovery model. 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 t of silt. The second case was the Great East Japan Earthquake and Tsunami when a magnitude 9.0 earthquake hit Japan on 11th March 2011. An area of more than 507 km^2 was inundated by

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unprecedented tsunami waves with a total death toll of 15,890 (2589 still missing as of March 2015). The case concentrated on one of the most devastated areas Miyagi prefecture, including Ishinomaki, Kesennuma, Minamisanriku and the prefecture capital of Sendai and Tokyo.

We will then conclude by theorising that long-term disaster is distinctive in its characteristics from other parts of the disaster lifecycle and that adopting a complexity approach will enable new perspectives to be developed. Three areas are highlighted as offering potential areas for study: social capital development post disaster, the changing role of community and key actors over time and the potential for co-production to increase long-term recovery traction.

2. Disaster resilience 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). Consequently, a systematic search within the social science literature of the terms “disaster management” and “disaster recovery” created an initial scoping structure. Within this we then sought literature that focused on recovery management, governance and with longer term perspectives.

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 (Cohen et al., 2013; 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, frequently portrayed as a linearly-structured conceptual model, commences with rebuilding, redeveloping and renewal to support effective recovery (Blakely, 2012) or adopt four stages of mitigation, preparedness, response and recovery (Hernantes et al., 2013) as an automatic cycle; 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., 2015). The majority of the existing disaster recovery literature focuses on the short-term phases and technical responses (Muskat et al., 2015; Nakanishi et al., 2014; Vale and Campanella, 2005). It is implied in the literature 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., 2015). 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 our review reveals that there are distinct stages in the literature and, as indicated above, the phases will move from one to the next over time (Henderson, 2004; Vale and Campanella, 2005).

Table 1 identifies several terms used in the literature often interchangeably but clearly differentiating between the actions required after the disaster and the different requirements later. In this paper we use terms as per the Sendai framework *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. There is often a fourth stage, often called pre-disaster or preparedness listed as well which is about reducing the risk in future disasters (Asghar et al., 2006; Berke et al., 1993; oplos et al., 2001; Comfort et al., 2004; Henderson, 2004; Nakanishi et al., 2014). However, although difficulties are recognised with the differing phases of recovery in terms of traction with the community, appropriateness of responses and the potential for mitigation of future disasters (see for example Cozzolino, 2012; Kovacs and Spens, 2012), there is still a widespread assumption that there will be progress over time.

Recent challenges to assumed linearity suggest that the move from short-term rescue and relief to longer-term recovery, a change of actors 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 problems change 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 disjoined 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 and 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 et al., 2009). However, we suggest that once such technical solutions have been implemented, the problems change, to become a complex set of policy related problems that will need very different

Table 1
Examples of disaster terminology in the literature.

Short term		Long term	Example authors
Relief	Rehabilitation	Recovery (Development)	Sendai framework, UNISDR, 2015–2030
Emergency phase	Rebuilding (Temporary settlement phase)	Recovery (Permanent settlement phase	Asghar et al. (2006), Henderson (2004), Nakanishi et al. (2014)
Response	Recovery	Mitigation	Berke et al. (1993), Christoplos et al. (2001), Comfort et al. (2004)
Response	Redeveloping Rebuilding	Renewal	Berke et al. (1993)
Rehabilitation	Reconstruction	Mitigation	Lizarralde et al. (2010)

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