Implementing a disaster recovery programme: a demolition and debris management perspective

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Abstract

The timeliness and quality of recovery activities are impacted by the organisation and human resourcing of the physical works. This research addresses the suitability of different resourcing strategies on post-disaster demolition and debris management programmes.

This qualitative analysis primarily draws on five international case studies including 2010 Canterbury earthquake, 2009 L'Aquila earthquake, 2009 Samoan Tsunami, 2009 Victorian Bushfires and 2005 Hurricane Katrina. The implementation strategies are divided into two categories: collectively and individually facilitated works. The impacts of the implementation strategies chosen are assessed for all disaster waste management activities including demolition, waste collection, transportation, treatment and waste disposal. The impacts assessed include: timeliness, completeness of projects; and environmental, economic and social impacts.

Generally, the case studies demonstrate that detritus waste removal and debris from major repair work is managed at an individual property level. Debris collection, demolition and disposal are generally and most effectively carried out as a collective activity. However, implementation strategies are affected by contextual factors (such as funding and legal constraints) and the nature of the disaster waste (degree of hazardous waste, geographical spread of waste etc.) and need to be designed accordingly. Community involvement in recovery activities such as demolition and debris removal is shown to contribute positively to psychosocial recovery.

Keywords: disaster recovery, disaster waste, disaster management, human resourcing; public participation

1. Introduction

Recovery activities are impacted by the organisation and human resourcing of the physical works. Activities on the critical path to recovery, such as demolition and debris management, must be effectively implemented to minimise delays in the recovery and rebuilding process and ensure quality outcomes. The aim of this research is to assess the suitability, constraints and implications of different implementation strategies for disaster waste management activities.

Recent natural disasters such as the 2010 Haiti earthquake (Booth, 2010), Victorian Bushfires 2009 (Brown et al., 2010), Hurricane Katrina 2005 (Luther, 2008) and the 2004 Indian Ocean tsunami (Basnayake et al., 2005) have all generated volumes of waste which overwhelmed existing solid waste capacities and required extraordinary management approaches. Disaster debris can impede rescuers and emergency services reaching survivors; inhibit provision of lifeline support; pose a public and environmental health hazard; and hinder the social and economic recovery of the affected area.

Implementation strategies of post-disaster waste management are often aligned with different stages and types of debris clearance works, and can be categorised as:

1. Private property detritus (non-structural debris) clearance to kerbside or to central collection facility.
2. Waste collection and disposal (includes collection, temporary staging areas[1], recycling and disposal).
3. Major repair debris management (i.e. debris resulting from major structural repair work).
4. Full demolition and associated debris management.
5. Reconstruction waste management [not covered in this paper].

Basic implementation strategies for clean-up operations can be divided into the following categories:

1. Collectively facilitated works
    a. Centralised contracts (portions of debris management works allocated to large contracting firms or organisations – private or public).
    b. Pooled labour forces (portions of debris management works carried out by individual labourers managed as a collective - paid or unpaid).
2. Individually facilitated works (debris management works carried out at an individual / household level – contracted or self-managed).

[1] Temporary staging facilities are commonly used in disasters. They are sites where mixed waste can be brought or sorting before onward transportation to end-use management (recycling or disposal) facilities.

2. Methodology

Qualitative data has been gathered from literature and interviews with professionals involved in disaster waste management for five international case studies. For this analysis the qualitative data was first interpreted to gain a general understanding of the implementation strategies (centralised contracts, pooled labour forces or individually facilitated works) for demolition and debris management works (see Section 3). Second, the impacts of the implementation strategies on recovery were analysed: timeliness; completeness; environmental; economic; and social. A list of implementation strategy attributes which contributed positively to each aspect of the recovery were listed (see Section 4). The discussion section (see Section 5) considers the overall suitability of implementation strategies in various disaster situations and contexts.

3. Case studies

3.1 2010 Canterbury Earthquake, New Zealand

On September 4, 2010, at 4:35am, a magnitude 7.1 earthquake rocked the Canterbury region of New Zealand. Fortunately no one died, however, a significant number of commercial and residential properties and infrastructure were damaged. Commercial structures affected were largely unreinforced masonry buildings. Mixed building type residential properties and infrastructure were primarily damaged by the extensive liquefaction that occurred. In January 2011 the government estimated up to 3000 Canterbury homes were uninhabitable (Heather, 2011). Debris management from repair of minor damage was carried out by individual property owners. Due to the large numbers of claims and need for coordination of works with suburb-wide land remediation, the national natural disaster insurer EQC and private insurance companies engaged project managers to manage the recovery works (including demolition and debris management) under centralised contracts.

3.2 2009 Victorian Bushfires, Australia

The February 7, 2009 Victorian Bushfires cost 173 lives, affected more than 430 hectares of land (VBRRA, 2009) and over 3000 properties. In affected areas the fire caused almost total destruction leading to large numbers of displaced persons. The National and State governments elected to pay for, and facilitate through a centralised contract, the demolition and debris removal of all affected properties. Overall the clean-up was a success. All properties received the same demolition and debris removal services and the process was completed within six months - leading the way for the reconstruction. Some affected persons, however, felt that the labour and contractors should have been sourced from the affected community – some claiming their exclusion reinforced the victim mentality and contributed to mental health problems (Brown et al., 2010).

3.3 2009 L'Aquila Earthquake, Italy

On April 6, 2009, L'Aquila, Italy, experienced a 6.3 magnitude earthquake. The earthquake killed 314 people and displaced approximately 70,000. The predominantly masonry buildings were heavily damaged – approximately 22,000 were rendered unusable (Dolce, 2010). In Italy the government provides full funding for national disaster response and recovery. The funding provided by the government allowed for a centralised approach to debris management. The majority of the waste management works (including community drop-off centres, demolition, temporary storage and recycling) have been carried out by state or locally appointed contractors. Management of debris resulting from major structural repairs and minor repairs were the individual property owner's responsibility – major repairs were generally carried out by contractors while individuals dealt with detritus removal.

3.4 2009 Samoan Tsunami

The 2009 Samoan Tsunami hit the South Eastern corner of Upolu Island on September 29, 2009. The tsunami killed 143 people (Samoa Logistics Cluster, 2009) and affected 4389 people (Ministry of Health, 2009) – with many of the impacted communities choosing to permanently relocate inland. Disaster response and recovery was primarily implemented through a mix of central government and non-governmental organisations. Primarily waste was collected and segregated at the affected site by pooled labour from the community (both paid and unpaid) and contractors were employed to collect and transport the waste to the disposal site or recycling depot.

3.5 2005 Hurricane Katrina, United States

Hurricane Katrina hit the states of Louisiana, Mississippi and Alabama on 29 August 2005. As a result of heavy rain and a levee breach around 80% of New Orleans was flooded in 3-12 feet of water (Cook, 2009). Over 1800 people died and over 600,000 residential properties were affected – 77% totally destroyed. Large numbers of residents evacuated and some had still not returned in 2009 (Brookings Institute, 2009). The US, then and now, has well established debris management processes including implementation strategies. Generally clearance of private properties is carried out by individual private property owners and placed on the kerb for collection by local authority or FEMA appointed contractors. Demolitions and resultant waste management are also the responsibility of the individual home owner or their insurer / appointed contractor. However, due to the large scale of the event, the high public health risk from toxic flood sediments and the large number of displaced persons, FEMA funded and facilitated all debris removal and demolition on private properties. The works were carried out under centralised contracts in line with standard debris management procedures.

3.6 Summary

Table 1, below, summarises the implementation strategies used for the different waste management activities for each case study.

Table 1: Case study disaster debris management implementation strategies summary

	2010 Canterbury Earthquake	***2009 Victorian Bushfires***	***2009 L'Aquila Earthquake***	***2009 Samoan Tsunami***	***2005 Hurricane Katrina***
1. Detritus removal	1. Individual	1. n/a	1. Individual	1. Individual / pooled labour	1. Individual / collective
2. Collection and disposal	2. n/a	2. n/a	2. Central contract	2. Central contract	2. Central contract
3. Major repair debris	3. Central contract	3. n/a	3. Individual	3. Individual	3. Individual
4. Demolition and debris	4. Central contract	4. Central contract	4. Central contract	4. Individual	4. Central contract

4. Analysis

Five key impacts were assessed: timeliness; completeness; environmental; economic; and social. The attributes are shown in Table 2 below. This list was then used to qualitatively assess the overall suitability of the three main implementation strategies for disaster debris management (see Discussion, Section **Error! Reference source not found.**).

Table 2: Positive attributes associated with successful implementation of demolition and debris management.

	Positive implementation strategy attributes[2]
Timeliness	• Expedient management of debris. • Limited / manageable number of organisations involved to reduce delays. • Monitoring of whole waste management system including identification and mitigation of bottlenecks. • Targets exist for completion times • Pre-arranged contracts for fast mobilisation post-disaster. • Appropriate prioritisation of works. • Legal and/or regulatory bottlenecks are identified and mitigated (including property access, waste ownership and contractor certification). • Efforts to maximise available workforce (e.g. use of community, expediting contractor certification) • Motivated work force (e.g through payment of volunteers, use of local labour).

[2] Note that many of the attributes have several impacts, for example unnecessary delays are likely to have environmental, economic and social consequences. Here, for brevity, attributes are only mentioned once.

	• Efficient use of limited resources including equipment and personnel.
Completeness	• Avoids double-ups or omissions. • Consistency of service (extent and quality) across all organisations. • Personnel and equipment are not taken away from core duties (for example municipal waste collection). • Approach matches nature of disaster waste (e.g. scattered waste following the Samoan tsunami made an individual property owner response inappropriate). • System does not rely on public participation where population is absent or ill-equipped to deal with the waste. • Good communication and collaboration between waste handling personnel, contractors, waste facilities and local and regulatory authorities.
Environmental	• Reduces potential for environmentally unsound management of waste including contractor certification, monitoring, guideline provision, access to waste management facilities etc. • Minimises monitoring requirements (on stretched regulatory authorities) • Encourages environmentally beneficial practices including recycling and reuse (on or offsite) • Environmental management of entire waste management stream (from prioritisation to collection and disposal). • Personnel experienced in waste / environmental management. • Personnel with vested interest in appropriate waste / environmental management. • Minimises rogue contractors
Economic	• Allows for economies of scale (e.g. reducing costs, improving recycling economics). • Minimises double handling. • Stimulates local economy (e.g. use of local services, recycling revenues). • Minimised profiteering / price gouging.
Social	• Public health threats are mitigated for all waste handlers, in particular where public participation is expected. • Clean-up personnel are trusted. • Allows for personal property salvage. • Empowers affected persons to participate in their own recovery. • Builds social resilience for future disasters. • Clear communication with community. • Community acceptance of programme including speed of implementation. • Encourages use of local labour and waste management facilities. • Does not place unreasonable burden on impacted community (e.g. having to manage hazardous wastes).

5. Discussion

The choice of implementation strategies (collectively or individually facilitated works) is impacted by a number of factors including disaster impact (e.g. degree of hazard in the waste, the dispersion of the waste, the number of displaced persons). Institutional factors such as organisational structures, legal constraints (such as property access and waste ownership) and funding provision also influence possible implementation strategies. The following discussion looks at each implementation strategy and discusses the benefits and draw backs, based on the attributes in Table 2 above, of each strategy in different disaster situations and contexts.

5.1 Collectively facilitated works

As shown in Table 1, in the case studies looked at here, generally collection and disposal and demolition debris management have been carried out using collective approaches. The cases here have all had funding systems which allowed for a collective approach. As discussed in previous research by the authors of this paper (Brown et al., 2011 in print) debris management implementation strategies are closely linked to funding mechanisms. Recovery funds are primarily either held by or distributed to individuals, or they are held / managed collectively. The nature of the funding will often limit which implementation strategies can be used. For example, where a disaster recovery system relies on market insurance at an individual level, collective systems such as centralised contractors and pooled labour forces are less likely. However, the 2010 Canterbury Earthquake response is an example of where large insurance companies have seen the need to manage their claims and the works as a collective.

There are many benefits to a collective approach. First, directly facilitated programmes essentially take the risk of cost overruns away from individuals. Cost overruns are a possibility following a disaster where: price gouging is possible (Jordan, accessed 2010); there is limited time to make detailed cost estimates; and where markets prices are likely to vary over the duration of the recovery. Second, economy of scale can be achieved through coordination of works, synergy of waste transportation, and negotiation of high volume service contracts. Third, quality assurance of works can be better affected using a centralised approach, thereby minimising potential for adverse environmental or public health effects. It was alleged that immediately following the Canterbury earthquake some demolition operators were under-quoting demolition jobs and illegally dumping debris. Centralised contracts can simplify monitoring requirements and avoid this. Fourth, coordination, timing and prioritisation of works can be better directed and controlled. This is particularly important in business areas where other businesses can be disrupted by demolition activities. In Christchurch the demolition of a historic building in the central city took approximately 11 weeks and severely disrupted traffic flows, pedestrian access and nearby business trading. Fifth, collective facilitation generally allows for awareness and management of the entire waste management system. For example, a collectively managed system may be able to better forecast when additional facilities are required (such as temporary storage sites or recycling facilities) to process disaster debris. Individually facilitated works, on the other hand, rely on use of existing systems and forecasting of future needs may be difficult particularly where there are privacy issues (e.g. under private insurance schemes).

Some disasters necessitate collective responses. Where the disaster impact causes mixing of wastes between properties and into public spaces, determining clean-up responsibility and ownership prior to waste removal is not practical. The Samoan tsunami is an example of this. Light traditional housing materials and household items were transported hundreds of meters by the tidal surge.

There are also some challenges associated with collective management of wastes. Legal issues around waste ownership and property access need to be addressed. Prior to debris removal by

contractors following the Victorian Bushfires, every property owner was required to authorise property access and ownership of all waste materials (other than personal items salvaged) to the contractor. This approval may be hard to gain where the population is absent, such as following Hurricane Katrina. Many houses there had to be condemned by the local authority in order to gain entry rights and ownership of waste materials. Some communities felt that the waste materials or value of recovered materials should remain in the affected community. In Samoa, for example, some communities preferred to manage the waste themselves to retain the value of the recyclable materials.

From an environmental point of view, having a collective contract for debris removal, disassociated with repair and reconstruction works, limits the potential for reuse of building materials on site for us in rebuilding. Reuse and/or recycling of disaster damaged houses is also linked to psychological benefits (Denhart, 2009). It should be noted that the conditions of some funding mechanisms (e.g. private insurance) may not allow for such a practice anyway.

Collective responses can get carried out faster but perhaps with less consideration than ideal. A number of recent examples illustrate where a more considered and slower response might have been better: adverse health impacts resulting from the 2001 World Trade Centre collapse clean-up (9-11 Research, accessed 2011a); destruction of evidence during the World Trade Centres clean-up (9-11 Research, accessed 2011b); accusations of government corruption following the Wenchuan earthquake, China, where some bodies were allegedly bulldozed with the building rubble (Demick, 2009); and loss of personal property during debris removal by overzealous volunteers following the 1995 Kobe earthquake (Atsumi and Yamori, 2008).

5.1.1 Collective works human resourcing

Demolition and debris management activities involve a range of tasks requiring skilled and non-skilled labour and common and specialist equipment. Consequently, collective waste management initiatives can be resourced a number of ways. Primarily these are: by engaging a private contractor to manage all the works; or by engaging and managing a labour pool – likely to consist of skilled and unskilled individuals who may be paid or unpaid. Several considerations need to be made when designing an implementation strategy.

Private contractors are generally an efficient method of carrying out a large work programme, and if managed correctly have the capacity to make use of local labour forces. Ideally contractors would have waste management expertise; however, in many cases this is not possible. The contractor managing debris following the Victorian Bushfires was a large construction firm (Brown et al., 2010). In the US, however, there is a growing industry of disaster debris management specialist contractors which can be mobilised quickly (Fickes, 2010).

Some communities, however, resent large contractors being used for debris management, as most originate from outside the affected area. First, some communities and experts have expressed concerns over the quality (in particular with respect to environmental outcomes) of

the waste management works. Allen (2007) cites the lack of local knowledge and lack of care for long term impacts of debris management activities by non-local contractors as a concern. Second, where non-local contractors are brought in, jobs, and the associated economic benefits, are being taken away from the affected area, as observed following the Victorian Bushfires (Brown et al., 2010) and as demonstrated by Haas et al. (Haas et al., 1977). Third, some have cited the adverse psychological effects of not participating in their own recovery, also observed following the Victorian Bushfires (Brown et al., 2010).

While community participation in disaster recovery planning is a well recognised ideal with many benefits (Sullivan, 2003, Phillips, 2009) including empowering communities and mitigating potential mental health issues, the benefits of physically participating has been less well researched. Parallels can perhaps be drawn to the psychological benefits of general volunteerism, under the assumption that the benefits still apply to disaster affected persons. The major benefits of volunteering in a disaster recovery situation include decreasing psychological distress and depression, improving mental health and drawing people away from inappropriate means of coping (Phillips, 2009). Respondents to a study on community recovery after the 2003 Canberra bushfires in Australia noted that 'having a sense of control and acceptance and engaging in meaningful activities' aided them in their recovery (Camilleri et al., 2010). Participation in recovery activities also has the potential to build capacity within the community. From a manager's point of view, community participation potentially provides a large and cheap work force.

Community participation is constrained, however. Significant public health hazards require specialist persons and equipment and in some cases individuals do not understand this. For example, many people volunteering their services following the World Trade Centre collapse September 11 were turned away due to the potential risks and specialist skills required to work on a crime scene holding human remains. Many of those turned away reported leaving feeling frustrated (Phillips, 2009). Protection against liability is also a concern. Many States in the US address this through Good Samaritan laws (Phillips, 2009). Some communities also do not wish to participate. Lawther (2009) observed indifference in the wake of the Indian Ocean tsunami in the Maldives where locals were unwilling to participate either due to private recovery / livelihood efforts or dissatisfaction with proposed payrates. Lawther also identified general risks of relying on volunteers including negative impacts on quality and cost.

Even if non-local contractors are used, there is a possibility of using local labour as subcontractors. This option is perhaps a good compromise between the cost and time secure option of private contractors while maximising community participation.

5.2 Individually Facilitated Works

Table 1 shows that detritus removal from private property (in these case studies), is generally the responsibility of individual property owners. As well as the legal issues (property entry and waste ownership) mentioned in the previous section, this is generally the most expedient and

cost effective way (for government) of clearing of debris from private properties. However, there are situations where this approach is not so effective. First, individual responses are less efficient where debris management requires specialist equipment and/or personnel. For example, if there is a significant public health threat (as discussed in the following section) individual's would either be required to engage a specialist to carry out the work (potentially creating a resourcing bottle neck) or as Allen (2007) observes, those that cannot afford to pay contractors may put themselves at risk. In New Orleans, following Katrina, the standard expectation of individual property owners to clear detritus had to be revised in light of the high level of contamination in the flood sediments. FEMA elected to facilitate a central contract for this work. Also if the level of destruction is high and/or the nature of the waste is heavy and/or requires specialist equipment (such as the fallen masonry buildings following Haiti (Booth, 2010)) an individual property approach may be cumbersome. Second if the population has been largely displaced, such as following Hurricane Katrina (Cook, 2009), they cannot be relied upon to clean-up properties. Third, if waste has been transported due to the disaster impact to other properties and into public spaces (e.g. Samoa), then individual waste ownership and responsibility is difficult to assign and waste is likely to go unmanaged.

Also, as shown in Table 1, debris management from major repairs are generally carried out at an individual level. This is largely due to the funding mechanisms available and the timing of the works. The majority of funding for major repair (and associated debris management) was granted to individual property owners for self-management of the works. Thus a centralised system was not necessarily possible (except in Canterbury where collective management of individual claims was implemented). Because of the long time period and geographical spread over which repairs may be carried out, a collective waste management system may not be as cost effective or logistically feasible as it is for detritus removal and/or demolition debris management. In addition, there is logic in capitalising on the synergy between debris management and repair works (as discussed above).

6. Conclusions

Generally detritus removal activities and debris management of major repair work are individually facilitated. Debris collection, demolition and disposal are best carried out collectively. As the case studies have shown, however, the suitability of implementation strategies is highly dependent on many contextual (in particular funding and legal constraints) and environmental factors (disaster size and nature). Many of the case studies discussed here significantly altered established approaches to disaster responses because existing systems were not seen as appropriate for the scale and impact of the event. Disaster waste managers need to have flexible plans in order to determine the most suitable implementation strategies specific to that event. Institutional frameworks also need to be flexible enough to reflect the variability of disaster impact. Appropriate human resourcing of recovery works, in particular use of local labour, has many positive environmental, economic and social effects on the affected community.

It is envisaged that this analysis will assist in the improved implementation of post-disaster demolition and debris management programmes. The findings in this paper will also provide insight into the impact of recovery resourcing on other aspects of recovery.

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