

Best practice relief supply for emergency services in a developed economy

Evidence from Queensland Australia

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Abstract

Purpose – The purpose of this paper is to discuss the challenges inherent in planning and responding to disaster events in a multi-agency context where numerous governmental and non-governmental actors and agencies are involved in the planning and response phases. In particular, the authors examine a situation where a lead agency has recently been delegated the responsibility for emergency relief logistics and how it might determine and implement best practice.

Design/methodology/approach – Adopting an iterative inductive approach, the authors gather data and insights from academic literature, emergency management policies, frameworks and documents and exploratory in-depth interviews with 12 key informants who have considerable experience with the challenges of logistic preparation and response to disasters in a developed country context. The data and context are limited to developed counties, especially the state of Queensland, Australia.

Findings – The authors discuss the challenge of achieving coordinated supply chain management where mandated/lead response agencies are required to meet stakeholder and local community expectations and outcomes. From these findings, the authors offer 11 practical recommendations to assist the delivery of best practice in emergency logistics.

Originality/value – Humanitarian logistics is usually examined from a low/middle-income country perspective, yet an efficient and effective disaster response is no less important for developed economies. In this respect, the authors offer a fresh examination of the challenges of delivering best practice for emergency logistics in order to achieve expected community outcomes.

Keywords Planning, Disaster, Collaboration, Emergency logistics, Best practice

Paper type Research paper

1. Introduction

This paper considers the challenges inherent in the logistic response to disaster events in a multi-agency context within a developed economy where numerous actors and agencies are involved in the planning and response phases. In particular, we attempt to catalogue those

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practices that support rapid mobilisation and deployment of emergency supplies. The result is a matrix of 11 emergency logistics best practices that are evaluated against a framework of cost, responsiveness and resilience, as well as the desired impact on community outcomes. Successfully meeting the expectations of all stakeholders requires, *inter alia*, a clear understanding of these expectations (Jackson *et al.*, 2011), continuous planning (Perry, 2007), a clear policy framework (Reid and van Niekerk, 2008), public and private resourcing (Nogami, 2014), training and exercises (Tint *et al.*, 2015) and, perhaps most critically, tight collaboration (Kovács and Spens, 2009). Given this overall challenge, those managing such post-disaster supply chains are increasingly turning to their commercial counterparts (and vice versa) in an attempt to understand how to optimise such operations (Oloruntoba and Gray, 2006; Charles *et al.*, 2010).

In the ongoing debate over how best to manage commercial supply chains, Melnyk *et al.* (2010) argue that all supply chains reflect a balance between six behavioural drivers, namely, cost, responsiveness, resilience, security, sustainability and innovation. Further, Chopra and Meindl (2016) offer six different dimensions including: facilities, inventory, transportation, information, sourcing and pricing. However, we note that Chopra and Meindl's (2016) drivers are mostly activity based while Melnyk's *et al.* (2010) drivers are attribute (behavioural) based, and hence we opt for behavioural drivers as aspirational attributes of an emergency relief chain. This is not to dismiss Chopra and Meindl's (2016) typology entirely as the best practices identified in this research are clearly impacted by drivers such as facility location, transportation and sourcing as examples. Thus, we discuss these latter dimensions in this research with the exception of "price", as we consider cost as being more appropriate for the humanitarian context. Indeed, the balance between these drivers should, and arguably for the supply chain to be efficient and effective, must reflect conscious strategic-level decisions. While Chopra and Meindl (2016) argue for responsiveness and efficiency, there are inherent trade-offs within their dimensions. Indeed, an alternative way of reflecting this challenge is to consider the frequent reality of a finite amount of money that is available to manage the supply chain. Thus, the emergency manager must decide where and how this should be apportioned across these drivers.

While both the Melnyk *et al.* and Chopra and Meindl typologies are applicable to the humanitarian logistics context, Scholten *et al.* (2014) argue that cost, responsiveness and resilience are key to achieving the desired outcomes in emergency logistics. Ideally, if cost were not an issue, then responsiveness and resilience would reign. For example, a (relatively) low-cost option might be a single centralised warehouse with minimal holdings of long life emergency supplies, but this would challenge the need for responsiveness and resilience (Charles *et al.*, 2010). The other main alternative is to operate on a "just-in-time" basis, whereby the required materials are obtained after the disaster event has taken place, but this approach potentially compromises the need for responsiveness (Jahre and Fabbe-Costes, 2015).

Importantly, all of the above considerations are from the perspective of the relief provider. Increasingly, however, governments and relief agencies have been examining the role of the affected (and surrounding) community in a disaster event as first responders (Sheppard *et al.*, 2013), and also their expectations with respect to relief outcomes. This raises the very real challenge of both understanding and managing public expectations in the aftermath of an incident (Miskel, 2008). For example, as noted by Jackson *et al.* (2011, p. 147): "[...] during such incidents [Hurricanes Andrew and Katrina], significant needs of victims go unmet for time periods that the public views as unacceptable, [and] government efforts to address the requirements of the incident are viewed as ineffective". Furthermore, as noted by Olofsson (2011) many, if not most, developed societies are heterogeneous in nature and hence, societal expectations will not be uniform. Given this clear challenge, there has been increasing consideration of how best to meet/manage such community

expectations and, in the context of this research, specific consideration has been given to ways in which such expectations can be captured, especially in relation to the management of flooding events that frequently impact the East coast of Australia (Dufty, 2017). Thus, it is clear that, whilst “meeting expected community outcomes” in disaster responses is unquestionably a desirable aim, in most cases this must at present be considered an aspirational goal.

More broadly, much of the criticism in the aftermath of a disaster event has centred on the lack of inter-agency coordination and its impact on the achievement of what the community perceives to be satisfactory outcomes. As noted by Tiernan (2016, p. 13), communities “[...] continue to be frustrated by the lack of coordination between government services; [...] and the tendency to blame-shift across silos that citizens neither care about, nor respect”. A further key aspect of this challenge is the inevitability that multiple jurisdictions and organisations will be involved in the response to a major disaster. These are likely to include elements of agencies of the affected country at national, regional and local level, those from neighbouring countries, and multiple non-governmental organisations (NGOs) including those already operating in the country, as well as those responding to the disaster event (Tatham and Spens, 2016; Tatham *et al.*, 2017). This plethora of organisations must also integrate with the activities of the affected population whose role as “first responders” is, as yet, under-appreciated and under-researched (Ross, 2013).

That said, the inherent challenge faced by those planning for events is the very nature of the events themselves entailing a high degree of uncertainty. For our research context, cyclone, wind and flood events frequently strike areas along the coast of North East Australia (Dufty, 2017), yet the location of their impact – and, hence, those affected – cannot be predicted much in advance. As a result, and as observed by Clarke (1999), the prior capture of data to support the prevention and response processes is fraught with difficulty and, by implication, any resultant plans must be greeted with a degree of suspicion as they may, in reality “[...] have so little instrumental utility in them that they warrant the label ‘fantasy documents’” (p. 2). Therefore, in developing our understanding of best practice in emergency logistics, the researchers are mindful of the need to try to develop an approach that is sufficiently flexible and fluid that it can adapt/be adapted as necessary to meet the evolving situation. It follows from the above discussions that further strategy-driven considerations of the challenges facing those providing emergency logistics could, and indeed, should be undertaken through an analysis of the ideal and actual status of best practice in this field. In this respect, the literature and actual practices in humanitarian logistics and, more broadly, in disaster management are likely to provide relevant insights.

1.1 *Research aim and research context*

With this introduction in mind, the overall aim of this research is to:

- (1) determine best practice emergency logistics for the delivery of relief supplies in a developed economy, namely, Queensland, Australia.
Best practice is to be determined in light of the objectives and needs of the responsible organisation, in our case the Queensland Fire and Emergency Service, specifically;
- (2) those mechanisms that support rapid mobilisation and deployment of relief logistics within a system that is cost effective, responsive and resilient; and
- (3) those mechanisms that meet expected community outcomes.

These practices are drawn from the perspectives of current literature, government emergency management policies and frameworks, and those currently engaged in its

preparation and implementation. These mechanisms are considered in terms of who are the “customers” (aid recipients) and the perpetual need for inter-agency collaboration.

The specific context of this research is that, following a number of recent administrative reorganisations within the state of Queensland, Australia, there was a concern that the current system of so-called “emergency supply[1]” might not be operating optimally – not least as it was perceived that some of the institutional knowledge may have been lost as a result of a number of reorganisations. In considering this problem, those to whom the lead agency role in emergency logistics had now been delegated were fully aware of the extent of the challenge and hence commissioned this research. In particular, the need to interface with multiple agencies and various levels of government (federal, state and local), and across functional areas such as the military, fire, police, ambulance and other emergency services was stressed. To this should be added the involvement of the Red Cross and NGOs such as the Salvation Army and, indeed, those individuals located in the affected area who frequently act as “first responders”, with the concomitant increase in the challenge (Perry, 2007). As a consequence, this research is firmly focussed on emergency logistics in so-called “first world” countries, in particular, the state of Queensland, Australia.

As a result, this paper is structured as follows. First, the literature review examines the challenges of capturing the expectations of a number of disparate stakeholders and the problems of inter-agency collaboration. Adopting an iterative inductive research approach, this research then addresses both practitioner and academic sources. The next section presents the interview methodology before the results of an iterative data analysis drawing simultaneously from the review, policies and interviews are reported. We then discuss best practice for emergency logistics in both the preparation and response phases before concluding with a theoretical matrix showing how these best practices could impact the supply chain drivers of cost, responsiveness and resilience, and also expected community outcomes.

2. Overview of community expectations and collaboration

This literature and document review was derived from three main sources. Initially, a number of key documents from the humanitarian logistics discipline were reviewed including NGO practitioners’ handbooks, guidelines, etc., such as the World Food Programme (2015), Norwegian Refugee Council (NRC in Jordan) (2015) and case studies from the International Federation of Red Cross and Red Crescent Societies (IFRC) (2006, 2016a, b, 2017) and World Vision (O’Connor, 2016). Much useful information concerning emergency logistics best practice was derived from these sources.

Next an overview of the national information and logistics guidelines and practices recommended by the US Federal Emergency Management Agency (FEMA), the Australian Emergency Management Handbook Collection (Australian Government, 2017) and the New Zealand Ministry of Civil Defence and Emergency Management was developed by reviewing the documentation available on their websites. Finally, these practitioner perspectives were framed by a review of academic databases. For a broader understanding of the subject, the following review is drawn mainly from academic sources. Later, the insights from all three literature sources are then synthesised with the results of the interviews (Section 4) to form a quadrangulated view of logistics best practice.

2.1 Capturing community expectations

It is interesting and somewhat surprising to note that, while the concept of the “customer” is central to the design and organisation of commercial supply chains (Day, 1994), this idea of the “relief customer” has only recently emerged in the humanitarian field (Oloruntoba and Gray, 2009). These authors go on to define “[...] the key customers – the most important (in humanitarian terms) in the emergency relief chain are the aid users (also known as

‘victims’)” (p. 489). Indeed the importance of “the voice of the beneficiary” is clearly demonstrated in recent research by Makepeace *et al.* (2017, Figure 7), but the question remains, how do we know when we have met the customer’s (or beneficiary’s) expectations?

In an attempt to address this, Davidson (2006) develops a humanitarian logistics performance measurement framework based on four key metrics: appeal coverage, donation-to-delivery time, financial efficiency and assessment accuracy. Adding to this, Beamon and Balcik (2008) have developed a framework designed for use in a humanitarian context that comprises resource metrics, output metrics and flexibility. From a community perspective, reasonable measures might be the minimisation of negative outcomes such as: “[...] illness, injury or the loss of human life; the loss of or damage to property; and damage to the environment” (Queensland Government, 2017a, p. 2). Further, Beamon and Balcik (2008) state that one of the key performance measurement areas should focus on community involvement and empowerment. Indeed, Sheppard *et al.* (2013) argue strongly for a local community “voice” and engagement in the preparation and response phases of an event. In a similar way, Tatham and Hughes (2011) argue that the measurement of the performance of humanitarian operations should not only include operational outputs (e.g. logistics metrics), but also community outcomes, i.e. the extent to which the actual needs of recipients have been met.

While it has been argued that the beneficiaries of any relief effort cannot be considered humanitarian actors as such (Kovács and Spens, 2008), it is often the case that the local affected population are the first responders and, thus, clearly have a key role to play (Newport and Jawahar, 2003). Indeed, the affected community would unquestionably have some expectations as to the outcomes of the relief effort, both in the immediate aftermath of a disaster and ongoing. Furthermore, the members of the affected community are the ones best placed to understand their needs and, from this, demand profiles can be derived. However, as observed by Sheppard *et al.* (2013, p. 22), “[...] the ability of local populations to contribute to the logistic preparation and response processes has been considerably undervalued and underutilised”. That said, in the context of this research, an “Emergency Management Assurance Framework” has recently been developed by the Queensland Government (2014) the aim of which is to “direct, guide and focus [the] work of all entities, including all tiers of government, to achieve key disaster management outcomes for the community” (p. 8), and this includes a specific section (Component 5) devoted to public engagement (Queensland Government, 2014, p. 23).

Meeting the expectations of a community would clearly involve satisfying peoples’ immediate core needs including the provision of shelter, food, water, washing/hygiene facilities, medicines and information. With the exception of the last category, these requirements are typically achieved through the provision of emergency supplies such as blankets, tarpaulins, first aid, water containers, house repair kits, family cooking kits, generators, etc. (these “supplies” are the focus of this research), as well as through the construction or commissioning of emergency centres, temporary shelters and temporary housing (Somasundaram and Davies, 2014). From a recovery perspective, the speedy restoration of power, sewage, telecommunications, roads, commerce and community facilities (Deshmukh *et al.*, 2011) are key, together with the re-provision of normal health services and hospitals, including the care of those with disabilities and mental health (Kumar *et al.*, 2009). In essence, the aim is to get the community back to (at least a form of) normality as soon as possible whilst minimising the negative impacts of the disaster. Of course, one of the potential upsides of such an event is that it can provide the opportunity or catalyst to “build back better”. In essence, however, we would strongly argue that one way to meet expectations, and thus meet good disaster relief metrics, is to give the community a voice in the planning phase through a process of community advocacy and social justice (Dingman and Ginter, 1995).

Nevertheless, there needs to be clarity over the process for managing such community expectations because it is only once these are understood and accepted that best practice for emergency logistics, that would meet these objectives, can be derived. Whilst the researchers have not been able to identify specific literature relating to this challenge in a logistic context, it features in many other areas of public policy. Good examples are the “Community Planning Toolkit” developed in the UK (Community Places, 2014), and that from the Department of Education and Early Childhood Development (DEHECD) (2011) within the State Government of Victoria (Australia) who have developed a comprehensive Stakeholder Engagement Framework that draws heavily on the work of the International Association for Public Participation (2014).

This model argues that such engagement should be a process that reflects the stages of: inform, consult, involve, collaborate and empower. Thus, it is argued that whilst certain aspects of this approach may well be present in the QLD emergency logistics context, a formal process for delivering the end-state in which “[...] final decision-making [is placed] in the hands of the stakeholder [and] stakeholders are enabled/equipped to actively contribute to the achievement of outcomes” (DEHECD, 2011, p. 4) has yet to be undertaken. In addition, there are often a broader range of actors involved, ranging from NGOs, emergency services, commercial firms, donors and, of course, the local community. The key issue is integrating the voice of the customer and all these other disparate agencies and groups into a common operating whole (Pettit *et al.*, 2013; Tatham and Spens, 2016) and this, it is argued, remains unfinished business (Tatham *et al.*, 2017).

2.2 *Inter-agency collaboration to meet community expectations*

Drawing from the abundant commercial supply chain literature, there is a strong emphasis on, and evidence to support collaboration as key mechanisms for tight coordination (Soosay and Hyland, 2015). Discussed in terms of inter-organisational governance, these frameworks argue for a continuum of interaction ranging from market-based arms-length relationships, through to hybrid forms of partnerships, strategic alliances, joint ventures and culminating in vertical integration (Webster, 1992; Wilson, 1995). However, while Moan *et al.* (2009) and Wild and Zhou (2011) argue that commercial supply chain frameworks are not suitable for humanitarian logistics, we argue that there are relationship control mechanisms that should apply. Indeed, with so many agencies involved in relief operations, Tomasini and Van Wassenhove (2009), Sheppard *et al.* (2013), Schulz and Blecken (2010), Tatham and Spens (2016) and Tatham *et al.* (2017) all see tighter coordination as one of the most urgent issues in humanitarian logistics world-wide.

While there seems to be a proliferation of collaborative models (such as Agent Based and Discrete Event Simulations, see Krejci, 2015) and theories (such as Relational Exchange Theory, see Macneil, 1980), something of a disconnect between practice and relief outcomes remains (Bhimani and Song, 2016). Perhaps this is due to the limitations of collaboration itself? For example, Villena *et al.* (2011) note the “dark side” of collaboration where an inverted curvilinear relationship exists between collaboration and operational performance. They argue that, beyond a certain level of collaboration, operational performance actually deteriorates as opportunism encroaches. Indeed, in the relief context, the number of agencies present may far exceed the ability for any particular organisation to collaborate effectively with all. Further, Berlin and Carlström (2015) note that whilst emergency exercises are supposed to promote inter-agency collaboration, they present few opportunities to try out different strategies and, in reality, are more useful for senior managers as opposed to the operational personal. Nevertheless, without collaboration, effective responses and meeting community needs would be all but impossible as responding to a disaster almost always goes beyond the capacity of a single organisation (Thomas and Kopczak, 2005).

Two key dimensions are implicit in this need for collaboration. The first of these is that inter-organisational cooperation should extend across vertical as well as horizontal linkages (Thomas and Kopczak, 2005). This is evident in New Zealand's "Whole of Government" approach (MCDem, New Zealand, 2017) that mandates collaboration between and across government departments, military and other government organisations. Second, the key to success is that this needs to be developed and exercised in advance of a disaster event (Schulz and Blecken, 2010), not least so that the key relationships have been built and matured before they come to be tested in the stress of a disaster. The importance of this cannot be understated and is reinforced by Boin and t'Hart (2010) who state that:

"[...] effective crisis response relies strongly on pre-existing cooperative networks built and maintained painstakingly during the preceding years," this includes "[...] the forging of relationships among response agencies, as well as media representatives, external stakeholders, and a variety of experts. Once a crisis has occurred, there is usually no time to look to the right people and interact with them on a basis of trust" (p. 368).

Indeed, the importance of swiftly developing inter-organisational and inter-personal trust in the context of disaster logistics response has been particularly emphasised by Tatham and Kovács (2010). Bakker (2010) notes the impact that "time" has on temporary organisations in terms of the focus of either the task (primary), or relationship building behaviours (secondary). However, we note the differences between temporary organisations established to manage crises and those permanent agencies tasked with emergency management that will, periodically, come together for training and emergency response events.

It is no surprise that there are existential difficulties in coordinating relief efforts among agencies (Tatham and Hughes, 2011). For example, writing in the context of an international response to a disaster in an developing country, Heaslip and Barber (2016) describe the differences in operating philosophies, goals and objectives between the relief efforts of agencies (e.g. civil and military), noting the all too often resultant overlaps (and, indeed, gaps) in the logistics responses. Whilst such differences are likely to be less substantial in a developed country context, Krejci (2015) argues that humanitarian actors still suffer from "bounded rationality" in that, instead of making rational decisions that will lead to improved goal alignment among multiple actors, they generally default to a self-interested approach. Thus, humanitarian managers utilise simplified heuristics and experience to make "satisficing" decisions that introduce both bias and prejudices, and typically result in placing one's own agency's needs before the total relief effort.

Furthermore, tight coordination relies on information sharing and this can be problematic due to the poor quality and timeliness of critical data (Fisher and Kingma, 2001), and also the unwillingness to share it between agencies (Ngamassi *et al.*, 2011). These difficulties can be exacerbated by linguistic and contextual differences between international relief agencies (Tint *et al.*, 2015). Indeed, most humanitarian logisticians would say that the lack of collaboration is the most challenging issue in the field leading to suboptimal outcomes for affected communities (Kovács and Spens, 2009). Soosay and Hyland (2015, p. 621) agree noting that collaboration in humanitarian supply chains is "[...] exceptionally under-researched". Despite this, Ngamassi *et al.* (2014) examine the nature of network structures in humanitarian organisations and find that close ties, or "cliques", actually facilitate greater information exchange and, hence, collaboration.

In summary, it is argued, from an academic perspective at least, that in order to help incorporate community voices into a coherent whole disaster response agencies should place considerable emphasis on integration through collaboration. In practice, such an approach is broadly similar to that currently being used within the Queensland Disaster Management community of: people, process, organisation, support, technology and exercise (Queensland Government, 2017a). Thus, from both perspectives, it is clear that a programme of continuous improvement in relation to all elements, both in isolation but,

more importantly, as whole system, is key ensuring that the expected community outcomes are met.

Deriving a theoretical view of these challenges, we offer Figure 1 in an attempt to illustrate these linkages between drivers, collaboration and community expectations. The results summarised from the literature, practitioner documentation and interviews will be illustrated by populating this framework and this is presented as Table IV in our concluding Results and Discussion section.

3. Interview methodology

The method for this research proceeded along four dimensions. First, to frame the study a literature review was conducted, drawn primarily from academic sources, that addressed our current understanding of the broader issues of capturing community expectations so that agencies responsible for emergency logistics relief could meet these expectations. Within this review, and as summarised in the preceding section, it was clear that a key issue was inter-agency collaboration. Second, using an iterative inductive approach (Yin, 2014), interviews were utilised to gather primary data from a number of key informants. Third, these data were read, re-read and themed, and finally, analysed iteratively against a number of practitioner literature sources to triangulate best practice for emergency logistics. Indeed, as the nature of the topic is inherently practical and of significant important to governments, the analysis combined the data with reviews of non-traditional academic sources such as documents and websites from humanitarian organisations, national policy frameworks and emergency logistics guidelines/handbooks.

For the primary data gathering, we adopted a convenience sampling approach leveraging existing contacts in a “snowball” fashion to conduct a number of in-depth interviews lasting between one and two hours each. This approach was selected as the focus of this element of the research was to elicit from practitioners their perception of “best practice” in emergency logistics for the planning and response phases of a disaster without a priori prompts from literature. As a result, and in light of the relative paucity of the published literature considering such “best practice”, interviews were held with 12 practitioners based in Australia and New Zealand who are working in a range of organisations including the Rural Fire Service, the State Emergency Services (SESS), local government and NGOs (see Table I). The research team contacted 27 individuals, of whom 12 (44 per cent) agreed to be interviewed.

A simple interview protocol was developed to guide the interactions, a copy of which is in Appendix 1. However, this was deliberately kept at a relatively high level with the aim of allowing the respondents to take the conversation in the direction they thought best.

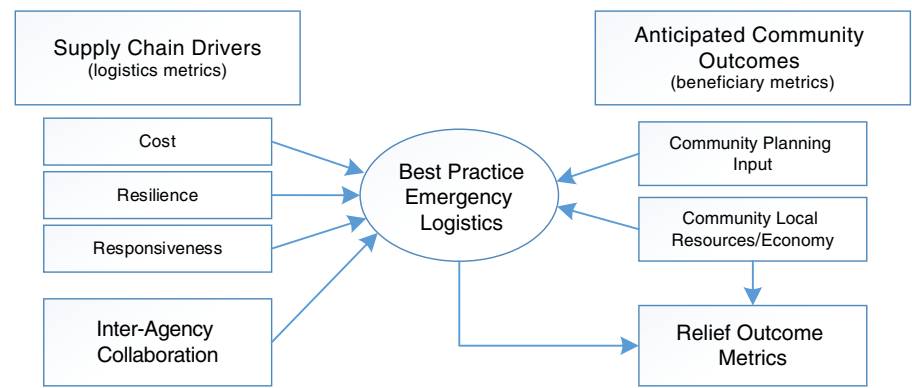


Figure 1.
Drivers and outcomes
of best practice
emergency supply

Table I.

List of interviewees

No.	Role	Organisation	Country
1	National project office with responsibility for logistics	Red Cross Australia	Australia
2	Logistics officer	Red Cross Australia	Australia
3	Emergency management coordinator	Wimmera Regional Council	VIC, Australia
4	Zone Commander RN2	Fire and Rescue	NSW, Australia
5	Director planning and environmental services	Rural Fire Service	NSW, Australia
6	Regional recovery coordinator	Hunter Valley and Central Coast Flooding (2015)	NSW, Australia
7	Region controller, Clarence Nambucca Region	State Emergency Service	NSW, Australia
8	Emergency management advisor	Red Cross New Zealand	New Zealand
9	Manager, capability and operations	Ministry of Civil Defence and Emergency Management	New Zealand
10	Controller, civil defence and emergency management	CDEM, Canterbury Region	New Zealand
11	Capability development manager	Joint Centre for Disaster Research, Massey University	New Zealand
12	Former leader of emergency logistics	Auckland City Council	New Zealand

Not least, this approach was adopted as the researchers were concerned that, by focussing on specific aspects that were identified within the practitioner and academic literature, there was a potential to overlook concerns that were of greater significance to the interviewees. With this in mind, the following paragraphs summarise both the headline questions and a number of high-level issues. Thereafter, Section 4 discusses the survey results in greater detail, supplemented by practitioner literature sources.

First, the respondents were asked about best practice in the preparedness planning and responses phases as a means of obtaining input to the identification of “best practice” for emergency logistics. To set the scene, a definitional statement drawn from the Queensland State Disaster Management Plan (DMP) (Queensland Government, 2016, p. 17) was first offered by the researchers. This was:

Emergency supply relates to the acquisition and management of emergency supplies and services in support of disaster operations such as the establishment of a forward command post, or a recovery/evacuation centre. Such supplies can be both consumable items (such as water, bedding, medical items etc), or tangible assets (such as furniture, marquees, or medical equipment etc (The full text of the DMP definition is in Appendix 2).

While the term “Emergency Supply” was understood by the respondents, most interviewees naturally defaulted to the term “Emergency Logistics” as this more accurately reflected their knowledge of current terminology within both the disaster management and, indeed, in the commercial context. It also became clear from the outset that both a more robust definition, and clarity over the timeframe of the provision of emergency logistics would be of value. For example, in relation to the latter aspect, at what point would the provision of emergency logistics be discontinued, and the normal response mechanisms reinstated. A further key implication of achieving a revised definition of “emergency logistics” relates to the target of such activities. Is the process designed simply to support those affected, or does it have a wider sphere of responsibility to cover, for example, the provision of food/water to emergency crews?

Second, the research themes focussed on the challenges faced in managing emergency logistics, how the respondents have overcome (or not) these challenges, what was missing and how the performance of the emergency sector could go from good to great. The researchers specifically asked for examples of what the respondents considered to be good practice, and any documentation or sources that they thought would be relevant. Field notes

were taken during the interviews and these were then reviewed and expanded immediately after for completeness. Analysis followed by categorising the data, reviewing literature sources again and, from this, the core themes were developed by the wider research team. The search for themes (best practice) centred almost exclusively on the research questions, rather than a general systematic inductive analysis of the interview data as would be typically expected in academic literature. This expedient was driven by the needs of the client as specified in the research contract and is not unusual for such contracted research. The development of the prospective themes was achieved by the research team (separately) reading and highlighting those aspects that could be seen as best practice. For example, some of the respondents used “supplier management” and the use of “call-off contracts” as synonyms. Later analysis of the practitioner and academic literature usually identified these as separate themes or practices, we hence followed suit. Researcher bias was minimised by the interviewers being very familiar with logistics concepts in general, and emergency logistics in particular. This created rapport and common understanding. The resulting report written for the client was then reviewed and approved by the sponsoring agency and presented to a stakeholder conference (unfortunately the responses from this presentation are confidential at the client’s request). The results of the research are presented next.

4. Results – best practice emergency logistics

Having positioned this research in the literature of relief community expectations and the issues of inter-organisational collaboration, we next address the data from the interviews and the iterative inductive analysis with practitioner, academic and policy documents. As the goal was to identify best practices that support the rapid mobilisation and deployment of emergency supplies, we have grouped these data into the two main phases of planning and response. Within these phases, we find a total of 11 logistics best practice activities and these are summarised in Table II.

4.1 Best practice emergency logistics in the planning phase

4.1.1 Planning – process and supporting documentation. First, the informants placed considerable emphasis on the importance of establishing in advance appropriate business processes and documentation in order to support the entire logistics effort (both the rapid procurement as well as the distribution of supplies in an emergency situation). They were clear that well-defined processes prevent or mitigate the need for short-term, reactive and disorganised actions that may result in higher costs and supply gaps. Such processes include clearly documented, sequential and logical steps for the acquisition and provision of emergency supplies. These should be laid out in a set of comprehensive guidelines and procedures that have been “road-tested” to ensure that there is no missing information, and that they are clear and accurate (e.g. easy to follow and without confusing language such as jargon and acronyms). This is particularly important for new, untrained, stressed or tired emergency staff as a means of minimising oversights and mistakes.

The manual(s) should be supported by tools and documents which facilitate effective and consistent emergency logistics processes (either in paper or in electronic form). One good example is the detailed “resource request” procedure found in the New Zealand MCDem, New Zealand (2017, p. 105), and the subsequent processing steps (pp. 106-107). Most importantly, the interviewees stressed that processes should not be cumbersome and rigid. Rather, in order to avoid any excess of bureaucracy, they need to be developed through consideration of the added value of each step and that, reflecting the uncertainty surrounding disaster responses, flexibility needs to be built into the system. In particular, the processes and procedures should allow for the ability to circumvent the established rules in the case of extreme scenarios (see Section 4.2.1 below).

Phase	Best practice	Definition	Sample reference
<i>Planning</i>			
1	Process and supporting documentation	Well-defined processes, clearly documented, sequential and logical steps for the acquisition and provision of emergency supplies	MCDEM, New Zealand (2017), International Federation of Red Cross and Red Crescent Societies (IFRC) (2006), World Food Programme (2015)
2	Stockpiling, warehousing and reverse supply chains	The pre-positioning of goods in anticipation of an emergency, and the recycling of relief supplies post event	FEMA (2017), Peretti <i>et al.</i> (2015), World Food Programme (2015)
3	Resource integration and modularity	The combination of resources (i.e. materiel, services and/or personnel) into flexible packages ready to be deployed to improve response times and scalability	International Federation of Red Cross and Red Crescent Societies (IFRC) (2016a), World Food Programme (2015)
4	Standardisation	A move towards standardisation for the procurement of emergency supplies, equipment, specifications and nomenclature across organisations	International Federation of Red Cross and Red Crescent Societies (IFRC) (2016b), McGuire (2015), UNHCR (2017)
5	Response framework agreements	Fixed term and price “call-off” contracts with suppliers of emergency relief items thus simplifying procurement and shortening lead times	International Federation of Red Cross and Red Crescent Societies (IFRC) (2017), Chen <i>et al.</i> (2013), World Food Programme (2015)
6	Supplier management	Achieving an appropriate approach to the management of key suppliers – outsourcing, relationship management and active supplier management	World Food Programme (2015), Thomas and Kopczak (2005)
7	Resource-sharing agreements	An a priori requirement for resource-sharing arrangements or assets that allows visibility and flexibility across responding organisations, business and the local community	Queensland Government (2017a), Boin and t’Hart (2010), UNHRD (2017b)
8	Logistics collaboration (joint procurement)	Goes beyond sharing resources to cover collaboration across a broader range of inter-organisational interfaces and logistic activities	International Federation of Red Cross and Red Crescent Societies (IFRC) (2017), Jensen (2012)
<i>Response</i>			
9	Fast track procurement	Establishing an a priori approval to depart from extant procurement procedures in extreme situations	Queensland Government (2016), World Food Programme (2015)
10	Centralised resource unit	Centralised resource unit embedded within a command centre as a focal point for all procurement and logistics	MCDEM, New Zealand (2017), Rivera <i>et al.</i> (2013)
11	Cash transfer programmes	The substitution of physical relief supplies for cash payments to disaster victims	World Food Programme (2015), Norwegian Refugee Council (NRC in Jordan) (2015)

Table II.
Summary of
emergency logistics
best practice

However, some informants suggested that, while much effort has been invested in the development of the processes, documentation and training material development, the take-up of these tools and resources has been slower to gain momentum. In other words, the processes and technological elements appear to have been developed and documented, but further investment to integrate the people component is warranted – not least as trialling the processes/technology may well show up flaws that are clearly best rectified in advance of, and not part way through, a disaster. In addition, there was a

concern that there was a degree of replication of effort as various different federal, state and local bodies have created materials targeting similar challenges, but these have been, at least to some extent, developed in isolation and without the benefit of either advice and input from neighbouring countries which face similar challenges, or the relief recipients. There was also perceived to be a potential for disconnect when a different *modus operandi* was required by each organisational level and/or organisational entity.

4.1.2 Planning – stockpiling, warehousing and reverse supply chains. Stockpiling and warehousing refer to the pre-positioning of goods in anticipation of an emergency. The resultant strategic decisions to be made in regard to stockpiling relate to the number of storage sites, their locations (typically close to disaster-prone areas and to the main transportation infrastructure in order to ensure a timely response to emergencies), the types and volumes of goods to be held at these locations, and the frequency with which they must be turned over in order to ensure that they do not degrade whilst being stored. From the perspective of the respondents it was evident that stockpiling is viewed as a sliding scale rather than a simple “yes we do” or “no we don’t”. Thus different organisations employed differing stockpiling strategies and, hence, hold differing views on what is appropriate to be stockpiled. At least in part this appeared to be driven by the function of the particular emergency management organisation.

The use of such central stockpiles is found in the United Nations humanitarian operations (such as the six global depots of the United Nations Humanitarian Response Depot (UNHRD), 2017a), and the USA where Federal Emergency Management Agency (2017) controls eight warehouses located across the mainland. Whilst stockpiled resources are commonly stored in warehouses, some organisations (e.g. FEMA’s Pre-Positioned Disaster Supply programme) make use of containers to position supplies and equipment (e.g. generators, folding cots, blankets, pillows, hygiene kits, etc.) for rapid deployment. However, due to the presence of heat/humidity in some geographic locations, such supplies may be stored for only a limited time. Nevertheless, Red Cross (New Zealand) has a large central warehouse with a set inventory of six key items (some of which are kits) that can be distributed quickly and efficiently by road, ship or air. These kits are focussed on shelter and blankets, food preparation, water collection and water storage.

Whilst the obvious advantage of stockpiling is the immediate availability of supplies and the resultant time savings in the critical first phase of a disaster event, the pre-positioning of resources requires sufficient funding in order to cover the high level of investment required. The substantial costs associated with stockpiling relate not only to the purchase of the goods, but also to their storage costs at multiple locations. However, collaborative mechanisms can be considered to reduce the stockpiling costs. Such mechanisms include joint storage arrangements supported by a “loan and borrow” system between partners as a means of facilitating the sharing of resources (see e.g. United Nations Humanitarian Response Depot (UNHRD), 2017b). In the framework of this interoperable system, partners can augment their own response capacity by borrowing supplies from other participating organisations, and arranging for the replenishment of the borrowed items at a later stage. For the lending organisation, the advantage lies in the fact that their stocks are turned over at no cost to them, an approach that is particularly helpful for those commodities that have a limited shelf-life (UNHRD, 2017a).

Importantly, the common theme which emerged is that, in the words of one respondent: “[...] the cost of maintaining great relationships is considerably less than the cost of maintaining stockpiles of goods in warehouses and generally achieves the desired outcomes better” (Interview 12, 2016). That said, because of the intangible nature of such relationship management, the potential for its efficacy to be reduced with personnel changes and the difficulty in the measurement of success, making the case for its importance can be challenging.

The reverse flows of durable goods back into the emergency supply system is not something that is often considered, but was a theme that clearly emerged in our data and was often associated with comments around cost savings. This is reflected in the inclusion of “sustainability” within Melnyk’s *et al.* (2010) six behavioural drivers outlined above. Policy decisions revolved around the options of “writing off” an item once distributed to the recipients, recovering the supplied item but then disposing of it in an environmentally responsible manner, or recovering those items that are likely to have continuing life (e.g. portable generators). In the latter example, it is likely that the recovered items will need to be refurbished prior to being placed into storage ready for the next event.

In considering the options it is relevant to note that, in an international disaster response context, only limited recycling takes place, not least as the import/export regulations of some countries penalise NGOs if they decide to remove items previously supplied to an affected country (Peretti *et al.*, 2015). Whilst clearly this does not apply in a national context, the broader total cost of ownership issues remain relevant. For example, if it is planned that an item of equipment will be withdrawn at the end of an incident, it will be necessary to monitor its location and condition, and this represents an additional burden on those managing the incident.

On the other hand, the need to dispose of items appropriately was also mentioned by the informants. As an example, sandbags once used become contaminated and, therefore, the dumping of such sandbags must be carefully considered as they can, and do, create a waste management challenge at the end of the emergency event. Another case highlighted was in the aftermath of the 2010/2011 earthquakes in Christchurch, New Zealand, where the demand for portable toilets was resolved by importing significant numbers which the emergency management team decided to procure directly. This created two issues, the first of which was getting these units serviced. Whilst the hire companies had the plant and trained personnel to manage the servicing of their own pool of facilities, they struggled to cope with the vast increase in the number of units and this required the further import of assets (trucks) to service the toilets. The other issue was disposal of surplus toilets at the end of the requirement. Given that there was little demand in New Zealand or elsewhere, in some cases these had to be dumped, thereby incurring considerable expense. However, given the location of the event and the prevalence of earthquakes, the potential requirement for additional toilet facilities could have reasonably been foreseen and planned for.

4.1.3 Planning – resource integration and modularity. Resource integration refers to the combination of different types of resources (i.e. materiel, services and/or personnel) into packages ready to be deployed in the aftermath of an emergency event. A good example of materiel/skills integration is the Emergency Response Units (ERUs) of the International Federation of Red Cross and Red Crescent Societies (IFRC) that are modular and designed for ease of integration (IFRC, 2016a). ERUs are self-contained units made of pre-packed sets of standardised equipment and supported by teams of technical specialists trained in their use. ERUs are designed to be operational in the field within a week of their deployment.

Such IFRC ERUs include those optimised to provide water and sanitation, basic health care, hospitals, base camps and IT and telecommunications. The key benefit of such an approach is that the response can be “right-sized” in relation to a given disaster, or in other words, a “plug-and-play” approach. The IFRC increasingly relies on such modules in order to be able to adapt to the specific circumstances of each disaster situation and, therefore, to increase both its flexibility and responsiveness (Melnik *et al.*, 2010). Our respondents noted that, understandably, resources tended to be configured towards the needs of the particular emergency service or response agency, making both modularity and integration with other responding organisation problematic. This highlights an essential condition for the effective use of modularity, namely, standardisation, a concept discussed in further detail next.

4.1.4 Planning – standardisation. In a similar way to integration, a key theme emerging from the analysis is the need to move towards standardisation for the procurement of emergency supplies, equipment, specifications and nomenclature. A number of organisations such as the IFRC, the United Nations High Commissioner for Refugees (UNHCR) (2017) and the UNHRD (2017b) have established accessible catalogues of standard items in which they organise emergency supplies by category (IFRC, 2016b). Categorisation has the advantages of enabling requesters/users to easily identify resources in a database, and to quickly access the specifications of each item (e.g. its unit size/volume/mass and any HAZMAT implications). These catalogues also facilitate the acquisition and the management of each type of resource by developing appropriate strategies for each category/subcategory. Such standardisation also greatly facilitates the palletisation and physical distribution of relief items, as well as interoperability and inter-agency cooperation. Table III summarises the benefits of standardisation through a common catalogue.

At a greater level of granularity, McGuire (2015) provides a detailed list of the potential information that should be included in a standard item catalogue. In addition, the core relief item catalogue of the UNHCR (2017) provides a good example of item specifications (including graphics and pictures) for the relief items most commonly used in United Nations High Commissioner for Refugees operations (e.g. tents, tarpaulins, blankets, etc.). In terms of standardisation, it is interesting to note that this catalogue lists only 13 items in total.

4.1.5 Planning – response framework agreements. For the most commonly used emergency items, framework agreements (otherwise known as “call-off” contracts or “standing offer arrangements”) may be established with a selected number of suppliers in advance of the actual disaster response operation. These lay down the essential procurement terms (price, quantities, quality, delivery timeframe, etc.) and enable emergency agencies to secure fixed prices (over an agreed period) for the acquisition and delivery of such emergency supplies. Overall, framework contracts simplify, speed up and reduce the cost of procurement (IFRC, 2017).

However, our respondents were generally agnostic over the benefits of the use of pre-negotiated agreements when compared to the pre-event physical warehousing of key commodities, whilst also recognising that there are clear benefits and challenges inherent in both approaches. Indeed, the data highlighted some limitations to framework agreements. First, there is a risk that when the agreement is activated, the supplier is found not to have maintained the necessary level of stock to meet the agreed availability/timelines (Chen *et al.*, 2013). Further, such agreements typically exist at global or national level, while there is little appetite for local agreements (IFRC, 2017). Hence, these agreements should only be for items that will have a high demand and for large quantities, not least as this provides a good economic incentive for

Table III.
Benefits of
standardisation for
emergency logistics

Item	Benefits of standardisation
1	Supports the use of a common language in regard to the mobilisation of resources
2	Creates homogeneity and reduces the overall number of items handled
3	Allows quick identification
4	Supports the selection of the most appropriate and the most cost-efficient items
5	Supports interoperability and inter-agency cooperation
6	Ensures compatibility between replacement items, equipment and spare parts
7	Facilitates sourcing and purchasing operations
8	Supports the continuity of item specifications over the longer term
9	Supports quality consistency
10	Allows economies of scale to be achieved
11	Facilitates physical distribution in terms of palletability, stowability and portability
12	Can indicate recoverability or reparability of the item after use

suppliers to maintain the necessary stocks and adhere to the agreement. Furthermore, a shorter term fixed price agreement (i.e. three to six months) would also help maintain supplier compliance as it reduces the risk of being locked into unprofitable agreements when market prices change. That said, it would also be necessary for relief agencies to regularly monitor the level of compliance by suppliers to ensure adequate response times. Ultimately, however, and in addition to any direct financial benefit from supporting these agreements, there is clear potential for much positive publicity to be gained by suppliers who can demonstrate that they are assisting the disaster relief efforts.

4.1.6 Planning – supplier management. Whatever stance is adopted in respect of the potential use of framework agreements, there remains the broader challenge of achieving an appropriate approach to the management of key suppliers (Thomas and Kopczak, 2005). From the interviews and practitioner literature there were three clear models adopted, these being: outsourcing, relationship management and active supplier management.

First, outsourcing: Red Cross NZ and Australia place all orders on the IFRC regional sourcing centre in Kuala Lumpur and do not, therefore, have a local sourcing operation. This approach also means that they raise purchase orders against known cost bases. The New South Wales Fire and Rescue Service, when in an emergency management situation and needing to source plant and equipment in addition to its appliance-centred equipment, uses a similar model and places requisitions on the local council which is then responsible for managing the procurement activity.

Second, relationship management: Auckland City Council (the largest local government body in Australasia) approaches this problem through an extensive network of suppliers which are able to be called upon when required under the umbrella of a relatively loose set of formal arrangements. This has benefits in that these arrangements tend to be more agile and responsive to changing scenarios. The major risk is, however, that when key personnel change these relationships may also change or degrade.

Third, active supplier management: many of the informants had supplier management arrangements in place with detailed supply plans, contracts and costs. In practice, these organisations had rarely needed to use these contracts as the relationships that developed as a consequence of these processes tended to transcend the formal arrangements at the time of an emergency management event. Such arrangements did, however, help ensure that an appropriate level of accountability and governance was applied.

Several of the informants suggested that, in real terms, the ideal solution was a blend of “active contract management” and “relationship management”. This combination had the potential to lead to a fast agile response with good capability, whilst still meeting appropriate probity and audit requirements. The essence being trusting relationships built over time.

4.1.7 Planning – resource-sharing agreements. Given that S.13(1) of the Queensland Disaster Management Act 2003 (Queensland Government, 2017b) states that:

A disaster is a serious disruption in a community, caused by the impact of an event that requires a **significant coordinated response** by the State and other entities to help the community recover from the disruption (Emphasis added).

It follows that there will be an a priori requirement for resource-sharing arrangements to be developed at various levels. Those participating in such systems may include local, district, state and federal jurisdictions and agencies as well as NGOs. We recommend that such agreements should also encompass the assets, stocks, facilities and personnel of the community and local businesses as well.

All of our informants emphasised that cooperation was the “sweet spot” of emergency management, especially around sharing resources, supplies and assets. Thus, whilst there may well be centres of excellence in logistics, there is no guarantee that every element of the

emergency management organisation knows where these supplies and assets are in “peacetime” – let alone in an emergency situation, which will almost certainly involve new personnel and degraded communications. With this in mind, there has been a concerted effort to build in standards at many levels ranging from ICT systems to fire hose couplings, and everywhere in between. Notwithstanding these achievements, informants suggested that legislative and lines of reporting differences between jurisdictions were unhelpful in the development of seamless integration, and therefore ironing out such differences and achieving inter-organisational resource sharing was perceived to be a continuing task that needs to be prioritised in the planning process.

4.1.8 Planning – logistics collaboration. Within the literature, collaboration and integration go beyond the previous examples of resource sharing and cover a broader range of cross-organisational logistic activities (Soosay and Hyland (2015). Examples include the development of joint procurement systems that combines the work of a number of governmental organisations and NGOs. Such pooled procurement is common in the international aid sector and is typically carried out in a joint procurement centre (such as the one IFRC operates in Kuala Lumpur) which orders a number of pre-defined resources from qualified suppliers and operates a centralised bidding system. Items suitable for joint procurement actions are those with the highest level of demand (e.g. shelter items, pharmaceuticals, etc.).

From an operational perspective, collaboration in the logistics space was seen as a very real opportunity that should extend beyond the current achievements in the preparedness phases of solution and training design, and into the delivery space (Jensen, 2012). Interestingly, one senior SESs manager suggested the “homogenised nature of logistics” lends itself to a shared services model, and so it was argued that expertise could travel well. Informants also spoke of the need to engage with the broader business community to tap into their capabilities, and it would appear that volunteer-based organisations have been more successful at this. In some cases, it was suggested that there was a clear willingness to learn from business colleagues, but a lack of clarity over how to achieve this.

4.2 Best practice emergency logistics in the response phase

Moving forward from the planning stage, this next section will discuss the approaches that are recommended for use in the immediate aftermath of a disaster event, and the associated informants’ observations. These results are grouped into three areas: fast track procurement, centralised resource unit and cash transfer programmes (CTPs).

4.2.1 Response – fast track procurement. When the required resources have not been stockpiled and are not available from other response agencies, businesses should be approached in order to purchase (either buy or hire) the emergency supplies that are immediately needed. The respondents felt that purchasing resources from local sources is usually associated with shorter lead times and lower transportation costs, as well as having the side-benefit of investing resources in the affected region. Indeed, such “local purchases” are strongly recommended in the Queensland State DMP (Queensland Government, 2016, p. 31). The data suggest that three mechanisms exist for supporting such fast track procurement: first, the standardisation of emergency supply specifications (see Section 4.1.4 above), second, framework agreements with selected suppliers (see Section 4.1.5 above), and finally an a priori approval to depart from extant procurement procedures (hierarchical approval processes) in extreme situations. This last aspect was recommended in order to achieve a swifter approach to the acquisition of urgently needed supplies. This includes, for example, defining the circumstances in which verbal quotes are sufficient and/or when it is acceptable to carry out non-competitive procurement.

4.2.2 Response – centralised resource unit. In the response phase of a disaster, the actual mobilisation of resources can be facilitated by setting up a centralised resource unit that acts as a focal point for the acquisition and deployment of emergency supplies for multiple responding agencies. Such a centralised resource unit would be responsible for the receiving and processing both routine and singular requests for resources, noting that the activities would clearly need to reflect the actions taken in the preparatory phase, such as the use (or not) of framework agreements. The advantages of centralising the emergency logistics processes are as follows:

- an easily identifiable centre of expertise and capacity in one location;
- pooled resources are managed in a more effective/coordinated fashion, and according to a set of pre-determined priorities – noting that these can (and, indeed, probably will) be adjusted as the particular disaster event rolls out;
- economies of scale may be achieved; and
- it provides a governance/accountability check that helps ensure that proposed actions have, indeed, been implemented.

When creating a centralised resource unit, emergency services should be very careful not to adopt a narrow approach to the acquisition of resources and avoid encouraging a silo approach that would undermine the benefits of centralisation. To this end, the staff working in the centralised resource unit need to approach their role not as a purely administrative one, but rather position themselves as facilitators supporting the entire relief effort. Such a unit should be embedded within the designated overall command structure and teamed with other logistics operations.

4.2.3 Response – CTPs. In recent years, one of the most discussed topics in the international humanitarian logistics literature has been the use of CTPs (also called cash and voucher programmes) as an alternative or complement to the distribution of physical goods to those affected by a disaster. Hence, the applicability of this approach in a domestic Australian context was raised with the respondents, and this elicited mixed responses. The advantages of CTPs are that they: allow recipients to purchase goods on the basis of their personal needs and priorities, the overall operational costs are lower when compared with the direct provision of goods, cash can be provided more rapidly than goods and, finally, that they support local markets and economies that have been affected by the disaster.

On the other hand, CTPs are increasingly recognised by relief agencies as just one of a range of emergency relief tools. In other words, CTPs are neither a panacea nor a “one-size-fits-all” solution, and should therefore be built into emergency responses when appropriate to the circumstances of a specific disaster. In particular, cash-based responses are suitable when the market conditions are favourable, i.e. when goods are available locally and when such cash transfers are not likely to generate inflation and/or create supply shortages. Furthermore, CTPs should be carefully implemented and monitored in order to ensure that cash is not diverted (e.g. spent on alcohol or the repayment of debts). Such misuses can be avoided by, for example, using paper-based vouchers redeemable only in participating stores and for the purchase of pre-defined resources (e.g. food). More sophisticated solutions, such as used in Syria, include the use of the CodeREADr-based technology commonly employed by airlines or event organisers to scan tickets and/or track attendance (NRC in Jordan, 2015). Using a broadly similar model, Red Cross (NZ) has provided cash directly to those impacted in the aftermath of recent disasters. The core rationale was that individuals will purchase items that satisfy their most immediate needs, and second, it ensures that local sourcing is used to aid in the economic recovery of the affected area. This cash payment has ranged from a few hundred rupees in the aftermath of the 2015 Nepal earthquake, to 3,000 dollars in Christchurch (2010/2011).

5. Discussion – best practice emergency logistics matrix

It will be recalled that the aim of this research was to investigate best practice in emergency logistics to ensure that resource management and relief measures meet the expected community outcomes of a developed economy. Discussion of this latter clause with informants surfaced a number of strongly held views. Thus, some spoke of “doing the best we can”, while others had a clear strategy for actively managing the expectations of the community as an integrated component of the emergency management process. In this regard, one respondent noted the clear differences in community expectations ranging, as an example, from a tree branch down on a front lawn in an urban centre, compared with a severe flooding event in a remote community. From the perspective of the research team, this whole area of expected outcomes requires further investigation based on the simple premise that, unless there is clarity over what “good” looks like, its achievement will always be challenged.

More broadly, in approaching this research, the team had anticipated that there would be clear differences between the management of services, commodities, consumable items and durable asset items. However, virtually all of our respondents took a scenario-based view where a whole response was considered as distinct from one that focussed on discrete services or specific classes of relief supplies. Thus, for example, the discussion would reflect the differential impact of, and response to, a flood or fire event, etc. By taking this perspective, the key sourcing and logistics differences were related to the context rather than the type of goods and services needed.

Further, governments and their policies have a large influence on best practice for emergency relief. Indeed, if democratic countries can avoid the overt politicisation of disaster events (Lindholm, 2017), then government (federal and state) must be primarily responsible for leading relief efforts, setting the framework for relief supplies and defining the policy and organisational structures. As such, the Queensland Government (2016) is well down the track of adopting a cohesive multi-agency approach towards integrating government, non-government and business agencies for emergency planning and response. In terms of relief supplies, this function is still under development and this paper illustrates some best logistics practices that would assist the Queensland Government in achieving their aims.

Hence, for governments, particular areas that would need further attention are the state of public-private partnerships with NGO relief providers and closing the gap between government departmental culture and the operating systems and culture of business and NGO relief agencies (Chen *et al.*, 2013). Further, a key to enhancing government legitimacy would be to more closely link and evaluate the preparedness inputs to their effect on performance in the aftermath of future response operations (Jackson *et al.*, 2011). Indeed, while finely pitched logistics arrangements are recommended for preparedness, they must be robust and flexible enough to cope with the exigencies of disaster events thus avoiding adverse outcomes for communities. Also, practically, governments should be more aware of the potential of social media to engage with disaster preparedness. Wukich (2016) notes that while the US Government is reasonably adept at utilising social media to spread preparedness messages and alerts, it is lacking when considering the potential information derived from the network of social media feedback from all sectors of society. Indeed, social media could be an important source of real-time demand derivation and relief supplies needs analysis that governments should more fully exploit.

As a consequence, logistics planning in practice tends to be driven by the potential risk profiles and likely scenarios in a given community or region, and the associated resilience or fragility of the resultant supply chains. In this way, a logistic response mechanism was adopted by our sample informants which, based on the experience of those managing the process, would have the highest chance of a successful outcome in an appropriate

timeframe. Hence, the basis of such logistics planning is to start with the expected outcomes of the community, in other words, how they would perceive “good”. This is analogous to the value chain approach in commercial logistics where the voice of the customer is (or should be) the starting point for the design of the supply chain and value expectations (Webster, 1992) and, indeed, is also the theoretical focus adopted in international humanitarian logistics (Makepeace *et al.*, 2017).

5.1 Linking emergency logistics practices to drivers, collaboration and community outcomes

Attempting to synthesise the literature and our findings, we offer the flowing theoretical matrix (Table IV) that shows how the identified best practices could impact the key supply chain drivers of cost, responsiveness and resilience (Melnik *et al.*, 2010; Chopra and Meindl, 2016), and also the expected community outcomes (Sheppard *et al.*, 2013). The column headings follow the logistics/community grouping of metrics as discussed by Tatham and Hughes (2011), and also includes the key concept of the level of inter-agency collaboration required to achieve these best practices (Schulz and Blecken, 2010; Tatham *et al.*, 2017). As an example extracted from the table it is expected that implementing the recommended process and supporting documentation would have: a low cost, a medium impact on responsiveness, a medium impact on resilience and require a high level of inter-agency collaboration to achieve. Similarly, for community outcomes, there should be a medium level

Emergency supply best practice	Impact of supply chain drivers on: (logistics metrics)			Level of inter-agency collaboration	Anticipated community inputs and outcomes (beneficiary metrics)		
	Cost	Responsiveness	Resilience		Planning Input	Local resource input	Relief outcomes
1. Process and supporting documentation	Low	Medium	Medium	High	Medium	Low	Medium
2. Stockpiling and warehousing	High	High	High	Medium	–	Low	High
3. Resource integration and modularity	High	High	High	High	–	–	High
4. Standardisation	Low	High	Medium	Medium	Medium	–	Medium
5. Response framework agreements	Low	Medium	Medium	High	High	High	Medium
6. Supplier management	Medium	High	High	High	Medium	Medium	Medium
7. Resource-sharing agreements	Low	High	Medium	High	High	High	High
8. Logistics collaboration (joint procurement)	Medium	Medium	High	High	Medium	High	Medium
9. Fast track procurement	Low	High	Medium	Medium	–	–	Medium
10. Centralised resource unit	High	High	Medium	High	Low	Medium	High
11. Cash transfer programmes	Medium	High	Low	Medium	Medium	Medium	High

Notes: High/Medium/Low = perceived level of impact or effort or input; “–” = no perceived effect

Table IV.
Emergency supply
matrix: potential
future state impact on
supply chain drivers,
collaboration and
community outcomes

of planning input, a low level of local resource use and ultimately a medium impact on community relief outcomes. However, in offering this summary analysis, we caution that the table is a conceptual future state view only and, thus, would need further empirical work in order to validate it.

5.2 *Emergency logistics practices for further consideration*

Overall, it is emphasised that a key challenge facing the logistician is that of obtaining the optimum balance between a stockpiling approach, i.e. the acquisition and storage of critical resources in advance of a disaster, and a just-in-time approach, i.e. the acquisition of resources as soon as actual needs have been identified during the emergency response phase. While community outcomes were a central concern, costs also loomed large. With these challenges in mind, this research offers at least 11 recommendations to assist the implementation of a system for the rapid mobilisation and distribution of emergency relief supplies. This list is by no means exhaustive, but is based on the three key behavioural drivers of cost, responsiveness and resilience mentioned at the beginning of this paper, together with the observations of our respondents.

First, there was a strong belief that the levels of inter-agency collaboration could and should be further developed. This is based on the likely premise that such collaboration in emergency logistics will lead to better community outcomes. Whilst there is no doubt that such collaboration does already take place, it would be greatly facilitated by the furthering of relief logistic best practices such as:

- (1) A common parts catalogue and the associated standardisation of items that are, typically, in high demand. Such items could be identified through an analysis of past demand patterns, and need not necessarily result in a large document/database. Furthermore, recent analysis in an international logistic response context has indicated that, in reality, it is possible to predict quite accurately the commodities needed (see Jahre and Navangul, 2011). This reduces one of the unknowns (the “what”), albeit the “where” and “how many” questions remain challenging. Nevertheless, adopting a similar approach in a national context would clearly be beneficial and would potentially mitigate the frantic (and costly) search for a short notice supplier of an item that is actually readily available in the warehouse of another organisation.
- (2) The procurement of equipment and the development of specifications that support the principles of standardisation and modularity.
- (3) A joint procurement unit and a common operating IT system or, failing that, one that is interoperable and which would facilitate inter-organisational procurement, transfers (loans) of equipment, etc. This would assist in locating a particular item, and understanding how it can be accessed and who would be responsible for its movement. This would materially support the development of a common logistics operating picture for overall command and control of the disaster response, as is currently operated by the international search and rescue community (Tatham *et al.*, 2017).
- (4) Common framework agreements that can be accessed by multiple organisations.

Second, and taking into account the proposed greater implementation of inter-organisational collaboration, further consideration of the balance between warehousing and just-in-time supply should be undertaken. In this respect, the use of containerised stock that can be pre-positioned or swiftly moved in the aftermath of a disaster (such as is employed by FEMA and, indeed, the Australian Department of Foreign Affairs and Trade) would appear to have significant merit, albeit in some regions

the meteorological conditions (such as high heat/humidity) may restrict its applicability unless mitigated by ventilation/cooling mechanisms.

Third, developing the people dimension of the emergency logistics challenge is, arguably, the highest priority. Whilst there is a clear understanding of the need for greater professionalisation, it will be vitally important to continue to progress down this path in order that there is assurance that the system(s) in place can be implemented smoothly and effectively when the next disaster event strikes. Given that disasters take place relatively infrequently in the geographic location of this research, it will be important to continue to support a training and development programme that helps to ensure that knowledge and skills are not lost during the non-deployment periods and, equally importantly, that emerging technologies such as social media are leveraged. Not only will such an approach have the direct benefit of helping to ensure that the logistic teams and associated infrastructure are ready to go, but it will also continually refresh the vital inter-personal linkages that are typically relied upon to overcome the inevitable unanticipated challenges (Tatham and Kovács, 2010).

Finally, it is believed that there needs to be a clearer understanding of the “expected community outcomes” in this area. Without clarity over the ultimate goal of the logistic process, there is an obvious potential for over- and/or under-achievement (with the associated inefficiency and nugatory resource expenditure). The aim is to achieve an optimal balance of the behavioural dimensions of cost, responsiveness and resilience (Scholten *et al.*, 2014). Therefore, we believe that, if implemented, the best practice for emergency logistics as identified in this research will materially improve future disaster responses that will meet or exceed community and stakeholder expectations.

As for limitations, we note that different regions around the world place an emphasis on different aspects of the disaster cycle, from planning and mitigation in the European Union to emergency management and response as typically seen in the USA (ten Brinke *et al.*, 2008). Indeed, while ten Brinke *et al.* (2008) note the inter-country differences of space, flood risk type and culture, they argue strongly for a more even-handed policy response and to develop strategies to ensure all phases of the disaster cycle are adequately addressed. As the literature and our title suggests, this research was conducted in a country-specific context and caution should be exercised in its generalisability beyond this. Indeed, defining best practice emergency relief supply in a global context should be an interesting area for future research.

Note

1. While the QFES used the term “emergency supply” in their documentation, the literature and all our respondents better understood the term “emergency logistics”, hence we likewise adopt this broader term for this research.

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Appendix 1. High-level interview questions to practitioners

- (1) What do you understand by the term “Emergency Supply” (ES) (otherwise known as “Emergency Resource Management”) in the context of the preparation and response to a major disaster?
 - If the response from the Reviewer does not align with our understanding of ES, then offer the following “definition”:

ES relates to the acquisition and management of emergency supplies and services in support of disaster operations such as the establishment of a forward command post, or a recovery/evacuation centre. Such supplies can be both consumable items (such as water, bedding, medical items) or tangible assets such as furniture, marquees, or mechanical equipment.

- (2) What are the challenges that you face in managing ES?

In this respect, are there any differences:

 - In the challenges you face when the goods to be obtained and delivered are consumables vs assets.
 - In the processes regarding the acquisition and delivery of consumables vs assets.
- (3) How have you overcome these?
 - What are the missing ingredients that would allow you to “go from good to great” when obtaining and delivering the right goods in the right quantity and at very short notice?
- (4) Do you have any examples of practice of which you are particularly proud?
- (5) How do you discover and meet community expectations?
- (6) Can you point me in the direction of any documentation?

Appendix 2. Definition of “Emergency Supply” extracted from the Queensland State Disaster Management Plan (Queensland Government, 2016, p. 17)

Emergency supply is the acquisition and management of emergency supplies and services in support of disaster operations. Emergency supply can include:

- resource support in the establishment of forward command posts, community recovery centres and/or disease control centres including furniture, equipment and materials;
- resource support for community evacuation centres including: furniture, bedding materials, health and hygiene products;
- bottled and bulk potable water supplies;
- temporary structures, i.e. marquee and portable ablution facilities; and
- small plant and equipment hire services.

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