HUMANITARIAN LOGISTICS: DEVELOPMENT OF AN IMPROVED DISASTER CLASSIFICATION FRAMEWORK

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ABSTRACT

To date, the majority of Humanitarian Logistic researchers have used a relatively parsimonious 2*2 matrix to classify a disaster event and its logistic impact. The aim of this conceptual paper is to develop a more detailed framework that contains 13 major elements which are designed capture a range of antecedents and emergent properties and, thereby, offer an improved understanding of the logistic impact of a potential or actual disaster event. The results will underpin future research that is aimed at improving our understanding of the Humanitarian Logistic cost drivers.

Keywords: Humanitarian logistics; logistic cost drivers; disaster classification.

INTRODUCTION

Humanitarian logistics (HL) is a fast growing area of international academic study with a broadening literature base [14] and, since 2011, its dedicated outlet – the Journal of Humanitarian Logistics and Supply Chain Management (JHLSCM). However, in common with many other emerging academic disciplines, the early years reflect the need to develop a common understanding of the core concepts, their inter-relationships and, indeed, the vocabulary and its meanings. For example, at a basic level, the challenge facing the humanitarian logistician is, arguably, the same as that in the ‘for profit’ world namely to align supply with demand in an efficient, effective, secure, resilient and sustainable way [15]. Typically, however, the responsibilities of a humanitarian logistician typically cover the management of the whole of the supply network (purchasing through to last mile distribution and even disposal), together with a range of ancillary duties such as facilities management and security. It is, thus, a significantly more complex role than the oversight of ‘trucks and sheds’ that often reflects the commercial counterpart [12]. This breadth of responsibility is reflected in the frequently quoted definition of HL: “The process of planning, implementing and controlling the efficient, cost-effective flow and storage of goods and materials as well as related information, from the point of origin to the point of consumption for the purpose of meeting the end beneficiary’s requirements.” [20, p.60]. Indeed, it is worth reflecting that there are actually only a few thousand individuals world-wide who would lay claim to the job title of ‘humanitarian logistician’ [10], and yet the annual global spend is of the order of $15Bn [17].

In practice, there is a range of natural disasters than can impact a country/region, with the highly respected CRED data base offering a taxonomy of 12 disaster types (see Figure 1) and more than 30 sub-types, to which must be added both technological disasters (e.g. rail crashes) and so-called ‘complex emergencies’ (i.e. wars, insurrections, etc). Similarly, the disaster management literature offers a number of sophisticated disaster classification systems (for example [7]), but these do not focus on the logistic implications of such events. Thus, and perhaps reflecting a Western black v white philosophical paradigm [1], many authors in the HL field have utilised the typology offered by van Wassenhove [22] in which a distinction is made between ‘slow’ and ‘rapid’ onset events, and between those with a ‘natural’ and ‘man made’ causality (Figure 2). Whilst this has the clear benefit of parsimony, arguably, it fails to capture the richness, context and complexity of such events and their logistic impact [5].

Figure 1. Taxonomy of disaster types [9, p.9]

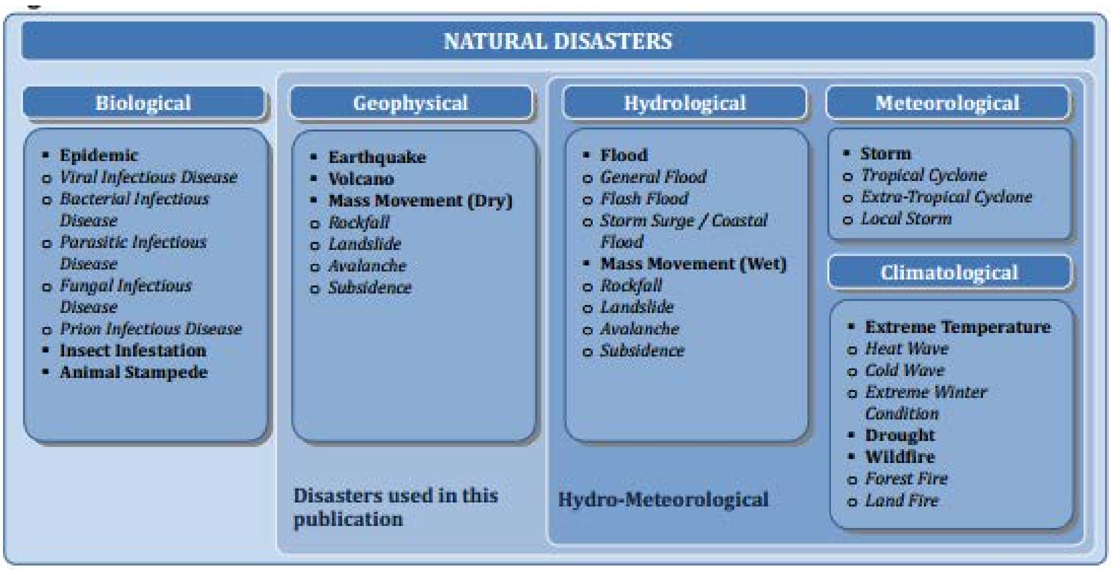

Figure 2. Disaster Typology [22, p.476]

	Natural	Man-made
Sudden-onset	Earthquake Hurricane Tornadoes	Terrorist Attack Coup d'Etat Chemical leak
Slow-onset	Famine Drought Poverty	Political Crisis Refugee Crisis

Putting aside the argument made by Quarantelli [16] and others that all disasters are, ultimately, made-made (due to the predilection of the human race to live in areas of hazard and/or to engage in armed conflict), it is considered that there is a need for an improved framework for capturing the logistic implications of such events. Underpinning this belief is the desire to develop our understanding of the logistic cost drivers as a means of improving the efficiency of the preparation/response activities without sacrificing the all important, life-saving, effectiveness dimension. Not least, our motivation reflects the suggestion by Ian Heigh (in [5]) that some 40% of the financial resources consumed by an HL operation are wasted. Whilst some initial research has been published with a similar aim (see, for example, [18] [6]), the next section of this paper aims to provide a first step towards this important goal.

Underpinning Research

The framework itself was developed following a systematic review of the literature that was based around two key HL sources: Firstly, the informal rolling bibliography[1] of the field that is published on the website of the HUMLOG Institute at Hanken School of Economics in Helsinki, Finland. This database is updated approximately quarterly and currently contains details of 508 journal and conference papers, book chapters and practitioner articles. Secondly, the structured literature review conducted by Kunz & Reiner [14] which considered 174 papers drawn from 68 academic journals. These two sources were examined, and papers that discussed the impact of various factors on the HL preparation and response challenge were extracted. To these was added a review of the disaster management literature. The resulting framework was then exposed to a cohort of experienced humanitarian logisticians as key informants, and their comments were incorporated into Table 1.

FRAMEWORK COMPONENTS

When considering the framework it is important to appreciate that although the logistic impact generally decreases as one moves from left to right, each row of the table has its own scale and there is, therefore, no direct correlation between the vertical alignment of the table entries. It is also emphasised that the Parameter Descriptors A-F are somewhat immature although, where possible and appropriate, they have been aligned with identified prior research. Importantly, it should be noted that no significance should be attached to the order of the horizontal rows – thus, it is not asserted that Row 1 (Time Available for Action) has a greater or lesser logistic impact than Row 13 (Potential for Occurrence/Recurrence).

It is also important to note that the categories offered within this approach to the conceptualisation of a disaster are synergistic with the work of key researchers in the field (for example, Quarantelli [16]), whose focus was the social – as distinct from physical – nature of the event. Thus, our framework is also designed to move away from a characterisation based mainly on the physical manifestation of the incident, but rather to highlight the antecedents and outcomes of an incident that will impact on the logistics preparation and response activities. Such use of a set of generic characteristics to describe a disaster (and, hence, its logistic impact) also follows the trend found in the different perspectives offered in the wider disaster management literature, for example Qarantelli [16] and Kreps [13]: social sciences; Born & Calfree [3]: medical; and Bammel & Rodman [2]: military.

Row 1. Clearly the logistics consequences will reflect the nature of the disaster but, although the characteristics of the particular physical event itself will have logistic implications, it is argued that the key differentiator is the speed of onset and, hence, the time available for action (see, for example, [19] which discusses the improved response to cyclones in Bangladesh that has resulted from longer warning times). The time available will differ from 'zero' (or near zero) in the case of earthquakes to '>7 days' in the case of droughts. Thus, in Row 1 of the framework the typology of disasters offered by the CRED has been related to generic timeframes. These time windows have been tentatively developed from a review of the broader disaster literature but will, inevitably, reflect average or typical warning times for each disaster type. Clearly the actual warning time(s) will depend, in part, on the country affected and the availability of the relevant sensors and broader communications systems.

Table 1 – Parameters Affecting the Logistic Preparation and Response (Source: The Authors)

Row	Parameter	A	B	C	D	E	F
1	Time Available for Action	Nil	0-6 Hrs	7-24 Hrs	1 - 7 Days	>7 Days	
	Examples	Earthquake	Storm (inc Cyclone/Hurricane	Slow Flood	Extreme Temperature	Drought	
		Flash Flood	Volcanic Eruption	Internal Unrest	Epidemic	Insect Infestation	
		Volcanic Explosion	WId Fire			Financial	
		Mass Movement (Wet/Dry)	Tsunami				
		Transport Accident					
		Industrial Accident					
		Miscellaneous Accident					
2	Disaster Size (Number Affected)	Extreme	Major	Medium	Minor		
		>1,000,000	100,000 -> 1,000,000	10,000 ->100,000	Up to 10,000		
3	Population Density	Extremely Dense	Dense	mid-range	Dispersed	Extremely Dispersed	
		>300/sq km	200-300/sq km	100-200/sq km	50-100/sq km	<50/sq km	
4	Extent of the Impact	Extreme	Very Large	Large	Medium	Sub-Medium	Small
		>500,000 sq km	100,000->500,000 sq km	10,000->100,000 sq km	1,000->10,000 sq km	500->10,000 sq km	<10,000 sq km
5	Magnitude of the Destruction	Very Large	Large	Medium	Small		
		Severe Impact on Large	Partial Impact on Region	Partial Impact on	Impact at individual property		
6	Duration of time from initial impact to when its effects cease	Over 3 months	1-3 months	4 weeks	2-3 weeks	1 week	
7	Geographic Context	City	Urban	Non-urban			
8	Topography	Below sea/river level	At or close to sea/river level	Undulating	Hilly	Mountaineous	
9	Climatic Conditions	Hot and Dry	Hot and wet	Temperate and Dry	Temperate and Wet	Cold and Dry	Cold and Wet
10	Per Capita GDP	Poorest 20%	2nd 20%	Third 20%	Fourth 20%	Richest 20%	
11	Logistics Performance Index	Lowest Quartile	2nd Quartile	Third Quartile	Highest Quartile		
12	Security Environment	Extreme	High	Substantial	Moderate	Low	Minimal
13	Potential for Occurence or Recurrence	Highly unexpected	Rare	Possible	Anticipated	Recurring/Seasonal	

Row 2. The actual number of people estimated to have been affected by the disasters is the 2nd Row. Clearly the logistic challenge will reflect the number of people who, for whatever reason, are unable to go about their normal business including those injured and displaced. Consideration was given to the additional use of a metric that captures the number of people killed by a particular event, but this was rejected on the basis that the focus of the humanitarian logistician is the provision of support to those affected by a disaster/emergency and the number affected was perceived to offer a better reflection of the size of this challenge. Furthermore, to the extent that it is possible to capture the data, this metric may be more appropriately limited to those affected by the trigger event rather than, say, casualties from a secondary phase such as an outbreak of typhoid. As before, the numeric scale is tentative, but based on an examination of the data for recent disasters.

Row 3. In addition to the total number of people affected, the population density will impact the logistic response. Thus a disaster affecting a heavily populated country such as Bangladesh (1120 persons/sq km) is likely to have a more significant impact than one is a sparsely populated country such as Australia (3 persons/sq km). Self-evidently these factors are intertwined with the geographic context (Row 7, below).

Rows 4 & 5. Row No 4 reflects the extent of the destruction caused by the disaster. This is, as yet, an immature metric but, together with Row No 5, is designed to capture the geographic coverage of the disaster as well as its destructive effect. As an example, the impact of lava flows from a volcanic explosion can be devastating, but the actual area affected can be relatively small. Contrast this with a slow flood which covers a vast area but one where many of the affected properties can be re-inhabited once the waters have subsided. Clearly, the logistic implications of these two rows will differ, but taken together they are designed to capture the 'size' of the event.

Row 6. As noted by Holguín-Veras and his colleagues [10], the duration of the disaster will have a clear logistic impact. Thus, again taking a severe slow flood as an example, this may well lead to the inundation of an area for a prolonged period, with consequential impacts on road transport networks. By contrast, a flash flood may well cause significant destruction to bridges etc, but the water subsides quickly. As a result, restorative actions may be undertaken at an early stage leading to a resumption of logistic activity.

Row 7. This Row is designed to capture the particular geographic context - by which we mean the extent (or lack) of urbanisation within the affected area. Thus, a disaster impacting a heavily urbanised area is likely to have a greater logistic impact not only due to the larger population density, but also because of associated factors such as the presence of people inhabiting sub-standard housing (who may well not actually appear in population statistics). Such people will be more vulnerable to the impact of a disaster and, potentially, less easily accessed by those responding to the event. In addition, those living in an urban context are more likely to be dependent on various forms of technology when compared with those living in a rural setting and, hence, are more vulnerable to the impacts of the loss or destruction of, for example, electric power – hence their need for logistic support will be greater.

Row 8. Clearly the actual topography of an affected region will have an impact on the logistic response. For example, the area of North East Pakistan that was affected by the 2005 earthquake is characterised by steep sided and deep valleys. The roads running along these valleys are often the only routes into and out of a population area and, thus, the destruction of the roadway itself and/or bridges etc represents a single point of logistic failure. By comparison, a relatively flat area with a road system that has multiple redundancies presents a markedly lesser logistic challenge.

Row 9. In a similar way to Row 8, the climatic conditions will also impact the logistic response. Again, using the example of the 2005 Pakistan earthquake which struck on 8 October, one of the key challenges facing the respondents was the onset of snow in the region that typically occurred one month later. Clearly, from a logistic perspective, the difficulties associated with last mile delivery will reflect this key aspect. It will be noted that the particular climatic conditions at the time of the disaster - rather than a generic approach (such as the Köppen Classification[2]) - have been used.

Rows 10 & 11. Row 10 is designed to capture both the underlying social context of the disaster area as well as the extent and sophistication of the pre-existing logistic infrastructure. It has been noted by Kahn [11] that per capita GDP is a key indicator of likely casualty rates and, by extension, it is suggested that this metric offers a high level indicator of a country or region's logistic infrastructure. In a similar way, the World Bank Logistics Performance Index (LPI) [23] (Row 11) is designed to offer a measure of the logistics "friendliness" of the 155 countries surveyed. It achieves this by measuring 6 indicators: customs, infrastructure, services quality, timeliness, international shipments and tracking/tracing and they provide a useful empirical indicator of the pre-existing logistic situation.

Row 12. The framework to date has been focussed on disasters – be these resulting from the impact of the forces of nature (floods, etc) or from the impact of technology (a rail accident) – but, of course, a further causality is that of some form of armed confrontation. Events in this category are normally referred to as 'complex emergencies' and generally this description is used to cover a broad spectrum of combat situations. Thus Row 12 is designed to capture this aspect using the taxonomy of United Nations Department of Security and Safety that is, in turn, not dissimilar to the approach of Bammel & Rodman [2]. However, it should be recognised that disasters and complex emergencies are often interlinked – for example the food shortages that have impacted the population in the wake of events in Syria 2011-2013 or, on a more positive note, the general cessation of insurgent activity in the Indonesian province of Banda Aceh following the 2004 tsunami.

Row 13. The reason for this final category is that some events (such as monsoonal flooding) are more anticipated than others. At the other end of the continuum, some disasters (such as 9/11) are generally unexpected. The resultant 'familiarity'[16] – or lack thereof – has a clear impact for logisticians. In the former case, there are multiple opportunities to develop and hone logistic processes; whereas in the latter, it is necessary to find creative ways to respond to such unanticipated disasters for which prior planning has not been undertaken.

A WORKED EXAMPLE

As a demonstration of the use of the framework to categorise a particular disaster, the following examples are offered. Using the taxonomy of Figure 2, the first (Haiti, 2010) might have been described as a 'rapid onset natural disaster', whilst the second (Sahel region food shortages) as a 'slow onset natural disaster'. The numbers reflect the Row 1-13 (above) and the letters A-F the parameters (ie the vertical columns).

Table 1. Example of the Operationalisation of the Framework (Source: The Authors)

Row	Haiti Earthquake, 2010	Sahel Region Food Shortages, 2012
1. Time Available for Action	**A. Nil**	**E. >7 Days**
2. Disaster Size	**A. Extreme**	**A. Extreme**
3. Population Density	**A. Extremely Dense**	**E. Extremely Dispersed**
4. Extent of Impact	**B. Very Large**	**A. Extreme**
5. Magnitude of Destruction	**A. Very Large**	**D. Small**
6. Duration of Disaster	**A. Over 3 Months**	**A. Over 3 Months**
7. Geographic Context	**A. City**	**C. Non-Urban**
8. Topography	**D. Hilly**	**C. Undulating**
9. Climatic Conditions	**A. Hot and Dry**	**A. Hot and Dry**
10. Per Capita GDP	**A. Poorest 20%**	**A. Poorest 20%**
11. LPI	**A. Lowest Quartile**	**A. Lowest Quartile**
12. Political Environment	**D. Moderate**	**E. Low**
13. Potential for Occurrence/Recurrence	**D. Rare**	**C. Recurring**

SUMMARY AND AREAS OF FURTHER RESEARCH

Each type of disaster occurs within a particular setting that requires an appropriate type of disaster management and logistic response. However, by focusing on the underlying characteristics (as distinct from the physical manifestation) of an event we have developed a framework that is designed to assist humanitarian logisticians better understand the variables that have the potential to impact on their work. The 13 components of the framework will interact with the HL intervention in different ways: the types and quantities of supplies delivered; the nature of the humanitarian response (for example: disaster relief v continuous aid, hostile v permissive political or social environment); the planning horizon; the critical success factors of the response (such as minimising the response time or optimising the use of available resources); operational requirements (such as the packaging decisions, the choice of transportation mode, or the customs requirements); the logistics and supply chain strategy implemented (for example the decisions regarding the distribution pattern or the use of agile or lean principles); and/or the participants in the response process (certain situations may require the deployment of military forces, negotiations with parties to a conflict, and/or the involvement of specialists, such as mine-clearance experts or civil engineers). These various elements, in turn, affect the total logistics cost as well as the cost drivers. In short, and following Qarantelli's lead [16], we suggest that a disaster classification based on the combination of a set of meaningful dimensions would assist humanitarian logisticians in the planning and execution of their role and, thereby, continue the drive for improved efficiency/effectiveness.

As indicated in the introduction to this paper, both the framework itself and also the associated measurement parameters are somewhat immature – and, indeed, the authors readily accept that they may have overlooked a key facet that impacts on the HL task. Therefore, further research to validate the relative importance of each Row of Table 1 as well as the associated measurement scale is a clear priority. However, as also indicated earlier, validation of the framework is perceived to be but one step towards the greater goal of identifying the HL cost drivers in order that these can become the focus of in depth investigation in order to improve the efficiency of the preparation and response without sacrificing its life-saving effectiveness.

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