SUPPLY CHAIN CO-ORDINATION IN CASCADING DISASTERS

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ABSTRACT

In humanitarian supply chains, the concept of co-ordination refers to both supply chain co-ordination as well as co-ordinated response across a range of humanitarian organisations. A number of systems have been developed to meet these co-ordination challenges. However, these systems do not address the complexity of cascading disasters with domino effects in disaster impact to other locations, other types of disasters, often crossing borders. Co-ordination in these types of disasters is particularly challenging. Therefore, the aim of this paper is to describe supply chain co-ordination challenges on a macro and micro-economic level, and how these can be overcome in cascading disasters. Two illustrative cases are presented, the cascading effects of floods in the European Union vs. Thailand. The cases show that in spite of existing co-ordination mechanisms in place, local entities strive to secure their own area, thus putting neighbouring regions at higher risk. Such sub-optimisation in fact enhances the potential for cascading effects in disasters. In order to overcome these co-ordination problems, the paper suggests increased cross-country efforts and a focus on business continuity management.

Keywords: supply chain co-ordination, humanitarian logistics, cascading disaster, business continuity management
INTRODUCTION

Humanitarian logistics and supply chain management is a relatively new field of research – though one that is expanding very rapidly. Whilst back in 2005, there were less than ten journal articles to be found in this area (Kovács and Spens, 2007), by now reading lists quote them in the hundreds (Kunz et al., 2012) and the most authoritative list in the area, Peter Tatham’s bibliography (Tatham, 2012), extended to 39 pages of only references by November 2012.

Humanitarian logistics is commonly defined as

“... 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” (Thomas and Mizushima, 2005, p.60).

In this, Thomas and Mizushima (2005) adapt the Council of Supply Chain Management Professional’s definition of logistics management to the humanitarian context. The adaptation to “end beneficiary” instead of “end customer” is though far from trivial as the notion of beneficiary lacks the possibilities of choice and generally, the purchasing power of a customer. Subsequently, it is the needs of beneficiaries that are met rather than any demand, and the mandates of humanitarian organisations rarely exceed the possibility to meet basic needs only.

Organisations working in disaster relief are faced with the need to organise their response to a disaster upon very short notice. Following Stewart’s (1995) logic but also the agility maxim of disaster relief (Oloruntoba and Gray, 2006), such organisations and their supply chains need to be very flexible as well as co-ordinated in their efforts. Still in the mid-2000s, humanitarian organisations were criticised for their lack of co-ordination, which then led to the implementation of a number of co-ordination mechanisms for disaster relief. One of these being the introduction of the United Nations Joint Logistics Centre, which was later integrated in the Logistics Cluster of the (UN) cluster system – see Jensen (2012) for an analysis how these worked in South Sudan. Co-ordination remains though a hot topic in disaster relief, firstly extending the view from inter-agency to supply chain co-ordination including the use of purchasing consortia (Kovács and Spens, 2011), secondly, due to increased efforts in linking disaster relief to longer-term development that reaches over the mandates of organisations, and thirdly, due to cascading disasters that trigger the need to involve a variety of actors with various mandates and geographical reach.

The aim of this paper is, therefore, to describe supply chain co-ordination challenges on a macro- and micro-economic level, and how these can be overcome in cascading disasters. The paper is structured as follows: We begin with a discussion on co-ordination in general and more specifically in humanitarian supply chains. Next, we discuss the situation of cascading disaster, thereafter we then present and analyse cases from the European Union and from Thailand. The cases illustrate two very different views on co-ordination in disasters. The case of the European Union emphasises horizontal co-ordination on a regional and macro-economic level. On the other hand, the Thai floods case illustrates vertical integration on a micro-economic level, taking the view of a retailer. We end the paper with suggestions on how supply chain co-ordination problems can be overcome on both macro- and micro-economic levels.
CO-ORDINATION IN HUMANITARIAN SUPPLY CHAINS

Co-ordination with suppliers and customers, i.e. supply chain co-ordination, is critical to improving supply chain performance. Various aspects of co-ordination have been linked to improvements in supply chain performance: Ever since Lee et al.’s (1997) introduction of the notion of the bullwhip effect, research has focused on overcoming this effect through increased information sharing in ordering and measure performance both on the individual company’s and the chain level. Zhao et al. (2002), for example, even succeed to show how advance and accurate order information can result in lower transportation costs, as it opens the possibilities for changes in modal choice and a reduction of last minute deliveries. But already in 1995, Stewart (1995) indicates how short cycle times would increase the need for greater flexibility in the supply chain, and that only an integrated and hence, co-ordinated, effort in the supply chain can lead to meeting delivery requirements. Chavez et al. (2012) further investigate the differences in supply chain performance depending on the clock-speed of industries, propagating a contingency theoretical view on supply chain management.

There is thereby a plethora of literature on supply chain co-ordination, intertwined with further concepts such as co-operation, collaboration, and integration. Skjoett-Larsen et al. (2003) avoid conceptual distinctions and differentiate between basic, developed, and advanced collaboration instead – the basic one having a transactional focus and hence, limited integration, whereas developed collaboration already identifies various areas for collaboration and exchange data, and advanced collaboration synchronises the dialogue between collaborating parties and in this, extend the view from mere data exchange. The supply chain management framework (SCMF) essentially takes a procedural approach to integration, with the three elements supply chain structure, supply chain processes and supply chain management components (Lambert et al., 1998). Back to supply chain co-ordination, Stewart (1995) emphasises the three-fold need for cross-functional, cross-divisional, and even cross-geographical co-ordination.

Supply chain structure being a central element to co-ordination, a first major distinction is made between horizontal vs. vertical co-ordination (Spens and Bask, 2002; Banomyong et al., 2009; Jahre et al., 2009). In other words, before even answering the question of the extent of co-ordination (to integration, collaboration), a first question is whom to co-ordinate efforts with. Typical for business supply chains is their focus on the governance structure and the extent of co-ordination with suppliers and customers, given that co-ordination with competitors is largely ruled out through anti-trust regulation. Non-commercial industries such as public health care or humanitarian supply chains are not restricted in the same way, allowing, or even dictating co-ordination also with “competitors”.

Horizontal co-ordination

In fact, it is in this meaning that co-ordination is usually discussed in the humanitarian sector. Co-ordination mechanisms in this sector have been set up as to oversee the joint efforts of the humanitarian community – either globally, or with respect to individual disasters. The foremost mechanism is the Logistics Cluster that, within the UN’s cluster system, supports all other thematically grouped organisational clusters with logistics expertise. The Logistics Cluster is not always activated, however, only if the severity of a disaster stipulates a need for co-ordination mechanisms is there also a need for a cluster “cell” in the disaster area. Other than that, the Logistics Cluster operates globally to set standards such as the Logistics
Operational Guide, devise templates, negotiate on preparedness-related issues with governments (including e.g. the pre-setting of customs clearance agreements), organise joint, inter-agency logistics training etc. Other co-ordination mechanisms are less formal, such as a variety of communities of practice in the humanitarian area (see Kovács and Spens, 2010), the probably most known of which is the Humanitarian Logistics Association, HLA.

The two-fold role of the Logistics Cluster – globally in the background, locally in the disaster area – is well captured in Jahre et al.’s (2009) distinction between permanent and temporary networks in disaster relief. Whilst global, permanent structures can be planned for, co-ordination in the temporary network in a disaster area is the more challenging. The type of the disaster at hand dictates which organisations may be involved in disaster relief – the two main divides being between natural disasters vs. disasters with war elements, and sudden-onset disasters vs. others that are developing slowly. The mandates of humanitarian organisations differ and are sometimes defined along these lines. For example, the Red Cross movement differentiates between the International Federation of Red Cross and Red Crescent Societies (IFRC) being involved in natural disasters vs. the International Committee of the Red Cross (ICRC) in those with a war element, and the Rome-based agencies have their own division between crop surveillance and food security on the one hand (Food and Agriculture Organisation, FAO) and emergency food aid on the other (World Food Programme, WFP). Different disasters trigger also different needs, epidemics obviously related to health care (and partly water and sanitation, nutrition), earthquakes and tsunamis to shelter before all other areas, nuclear disasters foremost in relation to health care etc. Organisational mandates are often also defined along the thematic areas of coverage. Hence which organisations to expect, and to co-ordinate with, in a particular disaster depends largely on the disaster itself.

Co-ordination mechanisms with suppliers

Contrary to business supply chains, a largely overlooked area of co-ordination in the humanitarian sector, is the actual co-ordination with suppliers and customers. As noted in the definition of humanitarian logistics, beneficiaries are not regarded customers, yet they can in fact become active supply chain members, as Kovács et al.’s (2010) case on the reconstruction in the Kosovo illustrates. Nevertheless, and even though co-ordination with logistics service providers has been investigated (Jensen, 2012), co-ordination with suppliers is an under-researched area in this context.

Recent results from Chavez et al. (2012) indicate that integration with suppliers may lead to negative effects on supply chain performance, mostly due to the rigidity it implies in resource configurations. However, co-ordination does not imply rigid integration. Kovács and Tatham, (2009b) contrast the resource configurations of military to humanitarian supply chains and conclude that humanitarian ones use flexible co-ordination mechanisms such as postponement and speculation, as well as draw on rosters of volunteers rather than employees. This enables them to react swiftly to disasters though keep running costs between them low. Indeed, one of the few mechanisms that have been studied in relation to the co-ordination with suppliers is the use of postponement and speculation strategies in the pre-positioning of stock (see Jahre et al., 2009). These strategies have been investigated from the perspective of various humanitarian organisations, e.g. the IFRC, or the United Nations Humanitarian Response Depot (UNHRD) network. Similar endeavours are under way for country-specific, often governmental organisations. The latter efforts though
rarely link to each other in a regional approach, and do not consider potential cascading effects of disasters.

Novel to the humanitarian context is the establishment of purchasing consortia (Kovács and Spens, 2011) that combine elements of horizontal and vertical co-ordination. Similar consortia exist in the area of public procurement, e.g. the Central Buying Consortium in the U.K. In the humanitarian sector, there are both purchasing consortia that specialise in some particular products, as well as more general ones. A product-specific example is the one of the International Humanitarian Hearing Aid Purchasing Programme. A more generic one is the establishment of the United Nations Procurement Capacity Distribution Centre (UN PDCD), which is though more concerned with building purchasing capacity across organisations and governments than actually procuring items.

CASCADING DISASTERS

Cascading effects can be referred to as the toppling domino effect or the snowball effect, where one thing leads to another. A recent example of such a disaster is the Japanese earthquake. The impacts of the earthquake lead to a tsunami that further lead to distortions in several supply chains. The car industry was heavily affected as was the power supply. The tsunami also found its repercussions in the following nuclear disaster. The nature of cascading is explained in disaster management literature as one event in a disaster is connected through a causal sequence to the next event (May 2007).

Some disaster types can be more likely to have cascading effects as was found in a recent study commissioned by ECORYS (Rademaekers et al., 2009). Floods in particular tent to be cross regional as well as have cascading effects. However, disaster typologies to date focus on disaster characteristics, and do not consider actual impacts nor incident evolutions of the disaster. Typical differentiating factors are the cause of the hazard – natural or (degrees of) man-made causes (van Wassenhove, 2005; Listou, 2008); or technological vs. natural hazards including geophysical, hydrological, meteorological, biological and climatological disasters vs. epidemics and pandemics (EM-Dat, 2013) – and the speed of its onset. Many disasters are though difficult to categorise in just one of these categories, as they may have several causes (Kovács and Spens, 2009) and/or be triggered by each other – as in the case of cascading disasters. Much of the attention on cascading disasters is to determine the sequence of their effects, i.e. their incident evolution, similarly to the cascade of failure analysis for electric networks (see Buldyrev et al., 2010). Without looking at the earthquake and tsunami, Funabashi and Kitazawa (2012) describe the Fukushima nuclear disaster as a cascading event. Even more importantly, the cascading disasters put a heavy pressure on the humanitarian response, as stated by the director of the UNU-EHB (German Committee for Disaster Reduction, 2011):

“The cascading effects of complex emergencies resulting from the combination of creeping changes and sudden onset disasters may cause the international humanitarian system to reach a tipping point in its capacity to provide assistance.”

The humanitarian sector is faced with new, unprecedented situation particular though these complex emergencies and though these cascading effects. The new situations will require an enhanced dialog amongst disaster responders (German Committee for Disaster Reduction, 2011). The principal of the ICF International (2009) moreover stresses the new challenges of cascading disasters. He claims that from a supply chain perspective, there are more and more interdependencies which
can be managed through enhanced information sharing in a supply chain. In other words, it is again supply chain co-ordination that is emphasised in order to manage the cascading effects of disasters.

**MACRO-ECONOMIC HORIZONTAL CO-ORDINATION FACING CASCADING DISASTERS IN THE E.U.**

European countries are faced with various natural disasters such as floods, storms, earthquakes and wildfires. “Europe is experiencing an increasing number and impact of disasters due to natural hazards and technological accidents caused by a combination of changes in its physical, technological and human/social systems” (EEA, 2011). The occurrence of different types of natural disasters varies from region to region. For example, whilst disaster profiles of America and Asia are dominated by geophysical disasters, that of the EU is mainly exposed to hydrological, meteorological, but also suffers from climatologically hazards. In fact, floods and storms show the highest frequency of occurrence as well as the largest overall economic loss (see Table 1).

**FIGURE 1: DISASTERS IN EU (EM-Dat, 2013)**

Europe has been hit by several large impact natural disasters in the last few decades (EM-DAT, 2013). Most of these disasters affect regions crossing several borders and have cascading effects. Storms and floods are the prime examples of disasters that are not limited by borders but which affect multinational regions and often cascade into other emergencies, e.g. in the energy and transport sectors. Major cross-border storms and floods include floods along the Rhine (December 1993 and January 1995), Odra (July 1997), Elbe and Danube (August 2002), the Central European Floods (June – August 2010), as well as Cyclones Lothar and Martin (December 1999) and Xynthia (February 2010).

Of these, the “Central European Floods” (summer 2010) was the disaster that had the largest regional impact within the EU during the last decade. Poland was the worst affected country, but the floods also had an impact on Austria, the Czech Republic, Germany, Hungary, Slovakia, Serbia and Ukraine. According to EM-DAT,
thirty-seven people died in these floods, while some 23,000 people were evacuated with the city of Krakow declaring a state of emergency. Poland asked for assistance from other EU nations; countries such as France, Germany, Lithuania, Latvia, Estonia, and the Czech Republic provided help. After the disaster, questions were raised over the level of communication between the Polish and German authorities, for example those in the German federal state of Saxony claimed that they did not receive adequate warning that a dam in Poland had burst. Cross-border effects were evident due to the fluvial flood, but even more importantly, they cascaded due to this dam burst. There were further cascading effects of the floods since the flooding of the Neisse River in Poland left about 5,000 residents without energy.

Cyclone Xynthia (2010) was the second largest disaster in the EU during the last decade, causing devastation in several countries (France, Germany, Spain, Portugal, Belgium and UK). At least 51 people were killed in France and six people were killed in Germany, three in Spain, one in Portugal, one in Belgium and another one in UK. Most of the deaths in France occurred when a powerful storm surge resulted in 7.5m waves, which smashed through the sea wall of the coastal town L'Aiguillon-sur-Mer. The cascading effects of the storm were the high waves and heavy rainfall that caused floods. The storm also caused major blackouts in France. Flooded railway tracks led to railway delays in France and the rail services in northern Spain were also severely affected. 70 flights from Paris-Charles de Gaulle Airport were cancelled by Air France. The third most significant disaster in Europe during the last decade were the pan-European floods in 2002 that severely affected the Czech Republic, Austria, Germany, Slovakia, Poland, Hungary, Romania and Croatia. A dam burst in Germany led also to additional flooding in the Czech Republic. Due to the floods the agriculture sector in the regions was affected by failure of crops. Moreover, there were health concerns for the population since sewage treatments plants and chemical plants where flooded. The overall economic impact of the disaster was calculated to be billions of euros. In the aftermath of the floods, EU leaders met in Berlin with the aim of creating a better understanding of how to prevent the impact of such events in the future. The EU leaders granted aid to the Central European countries which had suffered most. This outreach also to non-member countries was seen as a symbol for a thoroughly united Europe. The media commented intensely on the preparedness and the response efforts during the European floods. For example, the BBC (2002) noted: “poor planning, fragmented warning and defence systems and deforestation may have all worsened the current situation”. Whilst the Guardian (2001) commented on the events with a link to the on-going climate change debate: “If Europe's warning system is shaping up, its planning policies still betray a startling lack of common sense. Most experts agree that the climate change debate should run parallel to better planning on the ground”.

It is a significant challenge for a single country to cope with cross-border disasters without coordination with neighbouring countries in the region and across Europe. Thus, the response to a disaster in one country can either mitigate the subsequent disaster impact or it may generate unexpected negative impacts for other countries. As a result, European countries hit by a natural hazard may also be in need of regional or EU-wide disaster response assistance. With this in mind, the EU has been striving to develop collaborative mechanisms through the Commission's European Community Humanitarian Office (ECHO) for disaster response both within, as well as outside the EU. However, according to an ECORYS (Rademaekers et al., 2009) report commissioned by the European Commission on strengthening the European capacity in response to disasters4, there is still lack of proper instruments
for information sharing, a functioning structure for collaborative disaster response, a lack of decision support tools and there is even a lack of available resource (e.g. generators) in disaster response.

**VERTICAL CO-ORDINATION AND BUSINESS CONTINUITY IN THE THAI FLOODS**

The worst monsoon floods to hit Thailand in decades have crippled the country's international trade and national economy as rushing water prevented workers from reaching their offices, warehouses were flooded, and factory production stalled. The latest Thai government estimates suggested as much as 1.5% could have been wiped off GDP growth for 2011 because of the floods, which have already killed almost 300 people and affected more than two-thirds of the country's provinces. The water has cut off areas north of Bangkok, including a number of major industrial centres located near the former capital of Ayutthaya, and output has been brought to a halt. Toyota, Honda, Ford, and Isuzu have suspended most or all of their car assembly operations in Thailand during that period. This suspension has international ramifications because of the country's role as a regional automotive hub. Thailand is also estimated to supply around 60% of the world's hard-disk drives. SeaGate Technology and Western Digital Corp have been among a host of major electronics and semiconductor makers to suffer and that output has fallen because of the floodwaters, either because locally sourced parts were not available or because factories had become inaccessible. Roughly 14,000 factories have been affected by the country's worst flood in 50 years.

These types of disasters do not fundamentally change the design of existing supply chains as affected companies will focus more on contingency plans, supplier risk management, and business continuity management for their operations. The rationale behind this argument is based on the fact that the affected companies have chosen the production locations for economic reasons and that cannot easily be changed because of natural disasters. We will now turn to discuss the impacts of disasters from a business continuity perspective, looking at the case of a local retailer.

**The retailer perspective**

The retailer considered three main risk dimensions in their traditional business continuity management (BCM) model (Castillo, 2004): natural disasters, riots, and economic crises. It is interesting to note that natural disasters and riots share the same level of importance while the economic crisis is seen as the most critical risk factor. It is possible that because of the events that has occurred in Thailand, over the 5 past years, riots and natural disasters have a similar impact on this retailer’s business.

The 2011 floods represented a new challenge as retailer’s traditional BCM model (Garry, 2005) for floods only focused on locations that were usually affected by floods on a yearly basis. This meant that for flood risk, the retailer had a “single impact” BCM model, i.e., flood impact was usually limited to one store in a particular location. The “single impact” model was not able to handle the 2011 floods due to its higher level of impact, not just on the retailer’s stores but also on its suppliers and network access. The 2011 floods created havoc on the retailer’s supply chain, not only because it was the worst situation in 50 years but also because of consumers’ panic. This consumers’ panic created a massive “bullwhip effect” that increased demand to more than 10 times of the actual demand. Suppliers could not keep up with the surge in demand as they did not have the necessary contingency plans in place. The impact of the floods can be understood based on 3 key performance dimensions:
• Inventory Level: The retailer found itself in a stock-out situation due to the surge in demand and the reduced delivery capability of the retailer’s suppliers.
• On-Time Delivery: During normal time, the actual on-time delivery was assessed at 95% but during the flood crisis this KPI was reduced to 85%.
• On-shelf product mix availability: Challenging as product mix requirement varied depending on the flooding stages from before the flood, during the flood, to after the flood.

After the flood water has receded, the retailer discovered that over 830 of its stores were damaged from a total of 6,500 stores nationwide. The assessment of the retailer’s existing BCM protocols showed that even though the retailer had a clearly defined BCM model, the impact of the floods was a lot higher than expected. Resources were therefore not sufficient to mitigate, support relief, and accelerate recovery of the retailer’s national store network. Table 2 provides further insights on the implementation level of the combined BCM and HL model from the retailer’s operational perspective.

<table>
<thead>
<tr>
<th>Stage</th>
<th>Component</th>
<th>Implementation</th>
<th>Implementation level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Preparedness</strong></td>
<td>Identification and Analysis of potential risks</td>
<td>✓</td>
<td>High</td>
</tr>
<tr>
<td>(Pre-crisis)</td>
<td>Impact Analysis</td>
<td>✓</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Determining strategy</td>
<td>✓</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Planning of inter-cooperation</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>between related divisions and personnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Understanding and Training</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monitoring</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Implementation</strong></td>
<td>Analysis and evaluation of customers’ demand</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>(Under-crisis)</td>
<td>Transfer risk</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Coordination and Communication</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td><strong>Development</strong></td>
<td>Review and Control</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>(Post-crisis)</td>
<td>Development</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

The retailer’s disaster response model as assessed under the combined BCM & HL framework illustrated that all components of the integrated framework were implemented. However, the level implementation varied with a heavier emphasis on
BCM than HL components. This is not surprising as private firms usually tend to focus more on their respective BCM.

**ANALYSIS AND DISCUSSION**

The two cases illustrate very different views on co-ordination in disaster relief. In the following, we will analyse cross-country horizontal co-ordination first before turning to micro-economic vertical co-ordination.

**Cross-country co-ordination**

The EU has two main instruments at its disposal to provide a first response to disasters: humanitarian aid and civil protection. The Treaty of Lisbon sets out that “the Union shall encourage cooperation between Member States in order to improve the effectiveness of systems for preventing and protecting against natural or man-made disasters.” The European Community Mechanism for Civil Protection facilitates cooperation in disaster response among 31 European states (EU-27 plus Croatia, Iceland, Liechtenstein and Norway). The participating countries pool their resources which can then be made available to disaster-stricken countries all over the world. When activated, the Mechanism coordinates the provision of assistance inside and outside the EU. The European Commission manages the Mechanism through the Monitoring and Information Centre (MIC). The main role of the Community Mechanism for Civil Protection is to facilitate cooperation in civil protection assistance interventions in the event of major emergencies which may require urgent response actions. It is operated by DG (Directorate-General) ECHO of the European Commission and is accessible 24 hours a day. It gives countries access to a one-stop-shop of civil protection means available amongst all the participating states. Any country inside or outside the Union affected by a major disaster can make an appeal for assistance through the MIC. It acts as a communication hub at headquarters level between participating states, the affected country and experts in the field. It also provides useful and updated information on the actual status of an on-going emergency. Last but not least, the MIC plays a coordination role by matching offers of assistance put forward by participating states to the needs of the disaster-stricken country. The Common Emergency and Information System (CECIS) is again a reliable web-based alert and notification application created with the intention of facilitating emergency communication among the participating states. It provides an integrated platform to send and receive alerts, details of assistance required, to make offers of help and to view the development of the on-going emergency as they happen in an online logbook.

Since its creation in 2001, the Mechanism has been activated for disasters in Member States (like the forest fires in Portugal, floods in the Balkans in 2010 and a major explosion at a naval base in Cyprus in 2011) but also worldwide, including recent earthquakes in Haiti, Chile and Japan. The key instrument for European civil protection is the Civil Protection Mechanism (CPM) which was established in 2001.

**Combining BCM and humanitarian logistics**

Business continuity management mostly focuses on minimising the business effects of natural or man-made disruption. The BCM framework can be divided into different evolutionary stages with different operating protocols depending on business size, type of industry, location, and crisis severity. This would suggest that there is no single generic business continuity model as highlighted by Gaddum (2002), Elliot
(2002), and Gibb and Stevens (2006). However there exist similarities between BCM and humanitarian logistics albeit on a different scale.

The purpose of humanitarian logistics is to provide aids to affected areas (Beamon, 2004) and there exist humanitarian logistics deployment models which could also be of reference to BCM model development. Traditionally humanitarian logistics can be divided into 3 different stages, namely the pre-crisis stage, which requires well-organised preparation in terms of assistance, public utility, and cooperation for potential crisis; the under-crisis stage, which requires the most urgent assistance to the sufferers; and post-crisis stage, which requires the review of past crisis, the planned corrective actions, and the future operational plan in case of crisis reoccurrence. A combination of both BCM and HL could provide a more holistic framework when dealing with disruptions in general. Table 1 highlights common area between BCM and humanitarian as well as identify components specific to each field.

Table 1: Combining BCM & Humanitarian Logistics

<table>
<thead>
<tr>
<th>Stage</th>
<th>Component</th>
<th>Description</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparedness (Pre-crisis)</td>
<td>Identification and analysis of potential risks</td>
<td>Identifying and analysing the potential risk format and severity of the event that may affect personnel and organisation</td>
<td>BCM</td>
</tr>
<tr>
<td></td>
<td>Impact Analysis</td>
<td>Identifying the potential effects in case of crisis in terms of operation, personnel, and property</td>
<td>BCM &amp; HL</td>
</tr>
<tr>
<td></td>
<td>Determining strategy</td>
<td>Determining required strategies and resources in case of crisis, for instance, documents and equipment removal before crisis occurrence, under-crisis operation, and restoration</td>
<td>BCM &amp; HL</td>
</tr>
<tr>
<td></td>
<td>Planning of inter-cooperation between related divisions and personnel</td>
<td>Making plans between related divisions both inside and outside the organisation to mutually take systematic actions</td>
<td>HL</td>
</tr>
<tr>
<td></td>
<td>Understanding and Training</td>
<td>Making good understanding of related persons both inside and outside the organisation with regard to various strategies and holding the training and rehearsal for consistent understanding</td>
<td>BCM</td>
</tr>
<tr>
<td></td>
<td>Monitoring</td>
<td>Updating the information and strategy suitable for changing situations</td>
<td>BCM</td>
</tr>
<tr>
<td>Implementation</td>
<td>Analysis and</td>
<td>Analysing requirement of customers</td>
<td>HL</td>
</tr>
</tbody>
</table>

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Table:

<table>
<thead>
<tr>
<th>(Under-crisis)</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Transfer risk</td>
<td>Transferring tasks to operational supporter in order to reduce the risk</td>
<td>BCM</td>
<td></td>
</tr>
<tr>
<td>Coordination and Communication</td>
<td>Coordinating and communicating with related persons both inside and outside the organisation</td>
<td>BCM</td>
<td></td>
</tr>
<tr>
<td>Development (Post-crisis)</td>
<td>Review and Control</td>
<td>Searching for existing problems causes in the operation and comparing the actual operation with the targeted plan as well as various operation results</td>
<td>BCM &amp; HL</td>
</tr>
<tr>
<td>Development</td>
<td>Making the development and future plans based on under-crisis operational evaluation results.</td>
<td>BCM &amp; HL</td>
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Interestingly, firms often have their own BCM model which caters to their own risk. However, there is little to no linkage with regional, national or interregional disaster response plans. This gap deserves further investigation, especially as companies are both affected by disasters as well as can contribute to disaster relief (Ergun et al., 2010).

CONCLUSIONS

In humanitarian supply chains, the concept of co-ordination refers to both supply chain co-ordination as well as co-ordinated response across a range of humanitarian organisations. A number of systems have been developed to meet these co-ordination challenges. However, these systems do not address the complexity of cascading disasters with domino effects in disaster impact to other locations, other types of disasters, often crossing borders. Co-ordination in these types of disasters is particularly challenging. Therefore, the aim of this paper was to describe supply chain co-ordination challenges on a macro and micro-economic level, and how these can be overcome in cascading disasters. Two illustrative cases were presented, the cascading effects of floods in the European Union vs. Thailand. The cases show that in spite of existing co-ordination mechanisms in place, local entities strive to secure their own area, thus putting neighbouring regions at higher risk. Such sub-optimisation in fact enhances the potential for cascading effects in disasters. Stewart (1995) emphasises the three-fold need for cross-functional, cross-divisional, and even cross-geographical co-ordination. In this paper we have discussed cross-geographical co-ordination as well as a new approach to addressing cascading disasters from a micro-economic perspective, i.e. taking a business continuity approach.

The weakest level in terms of BCM and HL framework implementation were first the impact analysis which is a combined BCM and HL components and the analysis of customers’ demand. This particular component of the framework is specific to the HL field and therefore requires more focused attention from the retailer’s perspective. Unable to analyse and evaluate customers demand adequately negatively affects retailer’s logistics performance. It is interesting to note that being
able to analyse and evaluate customer demand does not fall within the BCM field because for any logistics or supply chain system to succeed there is a need to focus on meeting customers’ requirements at the onset (DeJohn, 2005).

The weak implementation of impact analysis is somewhat worrying as in order to have robust BCM protocols the disruptive nature of the risk needs to be fully assessed (Waters, 2007). Impact analysis needs to be done in a scientific manner in order to reflect the possible range of scenarios available to the retailer. This lack of impact analysis directly affected the capability of the retailer’s to respond to the disaster situation as the overall performance of its supply chain was dependent upon its weakest level of implementation. This observation is consistent with general supply chain theory where the overall performance of the supply chain is dependent upon its weakest link. Emphasis was more on its internal capability to continue its logistics operations even though it was not able to meet customer requirement.

Even meeting basic needs brings forward some of the complexities of humanitarian organisations: actual needs are not known in neither timing, quantity, location, nor cultural restrictions and requirements (cf. Balcik and Beamon, 2008). In fact a first co-ordination challenge in the disaster area relates to needs assessment, as to avoid double-counting as well as gaps when organisations send out teams to quantify needs. Both from a practical perspective as well as for modelling purposes, disaster relief thus seems a “client from hell”, as Arminas (2005) so fittingly described it. In spite of the obstacle of unknown demand, an important stream of humanitarian logistics research has succeeded in focusing on humanitarian logistics and supply chain performance. Beamon and Balcik (2008) discuss how the performance of a humanitarian programme shall be measured and problematise how the expectations of a variety of stakeholders can be met (if at all). Their discussion is encapsulated in Kovács et al.’s (2010) threefold view on performance in disaster relief:

(a) an internal view on the performance of a humanitarian organisation and its supply chain – as e.g. illustrated in Schulz and Heigh’s (2009) or van der Laan et al.’s (2009) performance management systems for IFRC resp. MSF,

(b) a network view that includes co-ordination of relief activities also across humanitarian organisations, or

(c) an external view on aid effectiveness.

Importantly, aid effectiveness is a macro-economic concept which can be measured in terms of improvements of livelihoods and the stimulation of economic growth, with little to no link to humanitarian supply chain performance. On the other extreme, John and Ramesh (2012) discuss how learning on the individual level can translate to an impact on humanitarian supply chain performance. Few studies can make the link between logistical efforts and also their macro-economic impact on aid effectiveness. A notable exception is Green et al. (2013) who evaluate also the economic implications of a water and sanitation project.

There are also other interesting aspects to supply chain performance in the humanitarian context, e.g. how the gender of the logistician impacts on performance (Kovács and Tatham, 2009a), or how sustainability considerations can be included in both the configuration of the humanitarian supply chain as well as its performance evaluation (Haavisto and Kovács, 2013). However, co-ordination in and across humanitarian supply chains speaks foremost for the network view on supply chain performance.

The humanitarian community has indeed been described as a network. Kovács and Spens (2007) listed a variety of actors that are essentially active in disaster relief,
ranging from humanitarian organisations and governmental institutions to suppliers, logistics service providers, and even the military. Jahre et al. (2009) also take the network view when contrasting permanent with temporary networks in humanitarian aid, vertical vs. horizontal co-ordination, and centralised vs. decentralised structures. All of these are of essence when discussing co-ordination in disaster relief. Yet wherever companies are not direct suppliers to humanitarian organisations or governmental actors, they are missing from being considered as part of this network.

Whilst BCM is though applied on the macro-economic level as also advocated for humanitarian supply chains by Kovács and Spens (2007), it is important to note that BCM applications rarely link to national or regional disaster response plans. In the absence of such a link between micro-economic and macro-economic responses, companies can of course contribute to disaster relief (as illustrated by Ergun et al., 2010 for Waffle House Restaurants) but fall short to be an integrated part of disaster relief activities overall. At the same time, however, an important side-effect of disasters is the one on operational and supply chain disruptions, impacting on the economic development of a country overall. We therefore call for the development of integrated mechanisms that link company efforts to national and international disaster management plans in order to effectively mitigate the cascading effects of disasters.

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