

Humanitarian supply chain performance management: a systematic literature review

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Structured Abstract:

Purpose - The main purposes of this study are 1) to identify the state of the art of performance measurement and management in humanitarian supply chains, 2) to categorize performance measurement indicators in the five supply chain phases of Gunasekaran and Kobu (2007) and evaluate them based on the evaluation criteria of Caplice and Sheffi (1995), 3) to define gaps as well as challenges in this field and give insights for future research in this domain.

Design/methodology/approach - A literature review has been conducted using a structured method based on Denyer and Tranfield (2009) and Rousseau et al. (2008). The state of the art on humanitarian supply chain performance management with a focus on measurement frameworks as well as indicators and their applications in practice is classified in three categories. The first category is the definition and measurement of success in humanitarian supply chains. The second category is managing performance, which focuses on describing and analyzing the actual practice of managing performance. The third category shows the challenges in performance management that humanitarian supply chain actors deal with.

Findings - Findings reveal that performance measurement and management in humanitarian supply chains is still an open area of research, especially compared to the commercial supply chain sector. Furthermore, the research indicates that performance measurement and management in humanitarian supply chains has to be developed in support of the supply chain strategy. Based on the findings of the literature review on performance measurement and management in the commercial and humanitarian field, a first classification of 94 performance measurement indicators in humanitarian supply chains is presented. Furthermore, the paper shows key problems why performance measurement and management systems have not been widely developed and systematically implemented in humanitarian supply chains and are not part of the supply chain strategy. Third, we propose performance measurement guidelines that include input and output criteria. We develop a research agenda that focuses on four research questions for designing, deploying and disseminating performance measurement and management in humanitarian supply chains..

Practical & social implications - The result helps the humanitarian supply chain community to conduct further research in this area and to develop performance measurement frameworks and indicators that suit humanitarian supply chains.

Originality/value - It is the first systematic approach to categorize research output regarding performance measurement and management in humanitarian supply chains. The paper shows the state of the art in performance measurement and management in humanitarian supply chains and develops a research agenda.

Keywords: Humanitarian supply chains, humanitarian logistics, performance measurement, KPI, performance management

Article Classification: A Systematic Literature Review

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Running Heads:

1. INTRODUCTION

Supply chain management is key to disaster relief operations because effectiveness, efficiency and speed in supplying beneficiaries with health, food, shelter, water, medicines and sanitation are essential in case of a disaster (Thomas and Kopczak, 2005). Tomasini and Van Wassenhove (2009) state that around 80% of the costs for relief operations consist of logistics costs in the form of procurement and transportation. The increasing number of natural disasters¹ and the resulting humanitarian emergencies put pressure on humanitarian organizations (HOs) to deliver humanitarian aid in an appropriate and cost-effective way (Thomas and Kopczak, 2005; Van Wassenhove, 2006; Oloruntoba and Gray, 2006; Kovács and Spens, 2007).

For an efficient and effective humanitarian supply chain measuring and managing performance is crucial. It is generally believed that companies applying performance management outperform those that do not, although many studies are mainly anecdotic in nature lacking more rigorous research methods (Adams et al., 2004; Neely, 2005). Neely et al. (1995) define performance measurement as the process of quantifying the efficiency and effectiveness of operation; this entails using a set of indicators to quantify two central goals of firms or organizations, the efficiency and effectiveness of an operation (Neely et al., 1995). Performance measurement is necessary to inform decision makers at the strategic, tactical and operational level (Gunasekaran and Kobu, 2007) but is also key to implement and realize strategic goals. It facilitates effective control and correction by reporting the current level of performance and comparing it with the desired level of performance (Melnyk et al., 2013). It is fundamental for inducing improvement (Kaplan, 1990; Kaplan and Norton, 1992), to inform decision-making (Gunasekaran and Kobu, 2007; Long, 1997), for simplifying communication between supply chain actors and increasing transparency of the supply chain (Gunasekaran and Kobu, 2007). Other purposes are to identify success; to identify whether customer needs are met; to identify where problems, bottlenecks or waste exist and where improvements are necessary; to track progress (show if improvements planned actually happened), and to facilitate a more open and transparent communication and co-operation (Parker, 2000; Gunasekaran and Kobu, 2007). In fact, measuring actual performance in the supply chain is crucial to identify whether an organization is on target with regard to achieving supply chain objectives.

Chow et al. (1994) indicate that logistics performance may be viewed as a subsection of the larger conception of firm or organizational performance (Chow et al., 1994). This is multi-dimensional by default because one indicator is not sufficient for measuring logistics performance. There is an extensive research base in the strategy and accounting domains that shows a positive connection between using non-financial performance indicators (such as supply chain indicators) and organizational results (Ahn 2001; Braam and Nijssen 2004; Ittner et al. 2003; Ittner 2008). Over the years HOs have encountered challenges in developing suitable and common performance indicators. Research shows that in practice 55% of the HOs do not monitor and report any performance measurement indicators, 25% only use few indicators and only 20% measure performance consistently (Blecken, 2010). The lack of performance indicators has been a long-standing problem in humanitarian supply chain management (Davidson, 2006). This is because it is simply too difficult and too expensive to establish direct linkages between an organization's annual efforts and the impact of those efforts on the organization's mission (Sawhill and Williamson, 2001). Even though performance indicators must be tailored to the missions and goals of individual institutions, neither a generic supply chain scorecard nor any universal set of indicators will work in all cases for all non-profit organizations (Sawhill and Williamson, 2001).

The added value of measuring performance in the supply chain is beyond discussion in the commercial domain and many companies have been able to reap tangible benefits from this. In fact the humanitarian sector is lagging behind when it comes to obtaining benefits from measuring performance in the supply chain. There are various critical elements that complicate measuring performance in humanitarian supply chains, including (Blecken et al., 2009; Davidson, 2006; Widera and Hellingrath, 2011; Tatham and Hughes, 2011; Jahre and Heigh, 2008):

- Nonexistence of centrally captured data from operations,

¹ For example in 2011, natural disasters killed 30.773 people and caused 244.7 million victims worldwide; economic damages from natural disasters were estimated at US\$ 366.1 billion worldwide in 2011 (Guha-Sapir et al., 2012).

- Limited information technology capacity and infrastructure,
- Chaotic environment,
- Lack of motivation for measurement in the non-profit sector,
- Potentially negative media exposure,
- Human resource issues,
- General reluctance to implement performance measurement in the humanitarian sector,
- Long-term versus short-term goals of disaster response,
- Increasing complexity of performance measurement in this sector,
- The inability of fieldworkers to capture accurate data while working under significant time pressure,
- Limited recognition of the key role of logistics as an essential part of humanitarian relief operations.

The main purpose of this study is threefold. First we aim to identify the state of the art of performance measurement and management in humanitarian supply chains. Second we categorize the performance measurement indicators linked to the five supply chain phases of Gunasekaran and Kobu (2007) and evaluate them based on the evaluation criteria of Caplice and Sheffi (1995). Third, we aim to define the gaps as well as challenges in this field and provide guidelines for future research in this domain.

This paper comprises six sections and is structured as follows. Below we investigate performance management in humanitarian supply chains by conducting a systematic literature review. In section 3 we discuss performance measurement in humanitarian supply chains. Here we compare the key findings from humanitarian literature with those in the commercial world and we assess performance measurement indicators. Furthermore we discuss the implementation of performance measurement and management as well as the challenges. In section 4 we present a guideline towards a performance measurement framework. In section 5 we identify an agenda for future research that includes four key drivers for efficient performance measurement and management in humanitarian supply chains. In section 6 conclusions are presented.

2. PERFORMANCE MANAGEMENT IN HUMANITARIAN SUPPLY CHAINS

2.1. A SYSTEMATIC REVIEW

In this research we apply a systematic literature review method to measure performance in a humanitarian supply chain. A systematic review follows a list of specific steps to guarantee that relevant studies with regard to a specific topic are obtained and to avoid bias (Denyer and Tranfield, 2009; Leseure et al., 2004). This ensures the fidelity, completeness and rigorous nature of the review (Kitchenmann and Charters, 2007; Rousseau et al., 2008; González et al., 2010). In the following sections we discuss the execution of the four main steps (planning, searching, screening and extraction/synthesis/reporting) as outlined by Tranfield et al. (2003).

2.1.1. PLANNING

In the beginning of the review we constructed a review panel that consists of researchers that are considered academic experts in the fields of humanitarian logistics, commercial logistics and performance measurement. We set manifold meetings to discuss the research questions and to analyze the gaps as well as the needs of the humanitarian supply chain sector with regard to the area of performance measurement. In September 2012 a Humanitarian Logistics Workshop about performance measurement in humanitarian supply chains was organized. 27 persons from both academic institutes and from the humanitarian practice participated and the gaps as well as our research questions were discussed to inform our literature review. Based on this we defined the following research questions:

RQ.1 What is the current status of research on performance management and measurement in humanitarian supply chains?

RQ.2 How useful are the reported indicators and frameworks to measure performance in the humanitarian supply chain?

RQ.3 What challenges need to be overcome in designing and disseminating performance measurement in the humanitarian supply chain?

2.1.2. SEARCHING

Based on our research questions we developed key terms to identify and evaluate the literature and to avoid unbiased research. Late 2012 we collected papers focusing on the following keywords: “performance” OR “performance measurement” OR “performance model” OR “performance system” OR “KPIs” OR “indicators in humanitarian logistics, humanitarian supply chains as well as emergency operations”. Hereby we achieved a low outcome of papers. Therefore we decided to extend the research keywords. In June 2013 we recollected the papers using the following subject terms in four research databases (EBSCOHOST, ABI/Informs, Elsevier and Google Scholar): ‘humanitarian logistics’, ‘humanitarian supply chains’, ‘performance’, ‘performance measure’, ‘performance measurement’, ‘performance evaluation’, ‘emergency logistics’, ‘emergency operations’, ‘disaster relief operations’, ‘performance model’, ‘performance system’, ‘KPIs’, ‘Indicators’. As articles were reviewed, other cited articles were added (the principle of ‘snowballing’). The keywords identified in those new articles were then used to create additional search strings with Boolean connectors (AND, OR, AND NOT). We determined the time period of publications from 1970 until 2012 because after 1970 the total number of natural and technological disasters has increased, especially natural disasters (Schulz, 2009). Table 1 shows the protocol used for our database search.

Table 1: Protocol for database research

Database	Scope	Date of search	Number of publications
EBSCOHOST	Title, abstract and keyword	11.-13.06.2013	354
ABI/Informs	Title, abstract and keyword	17.-18.06.2013	218
Elsevier	Title, abstract and keyword	18.-20.06.2013	452
Google Scholar	Title, abstract and keyword	20.06.2013	139
Total			1,163

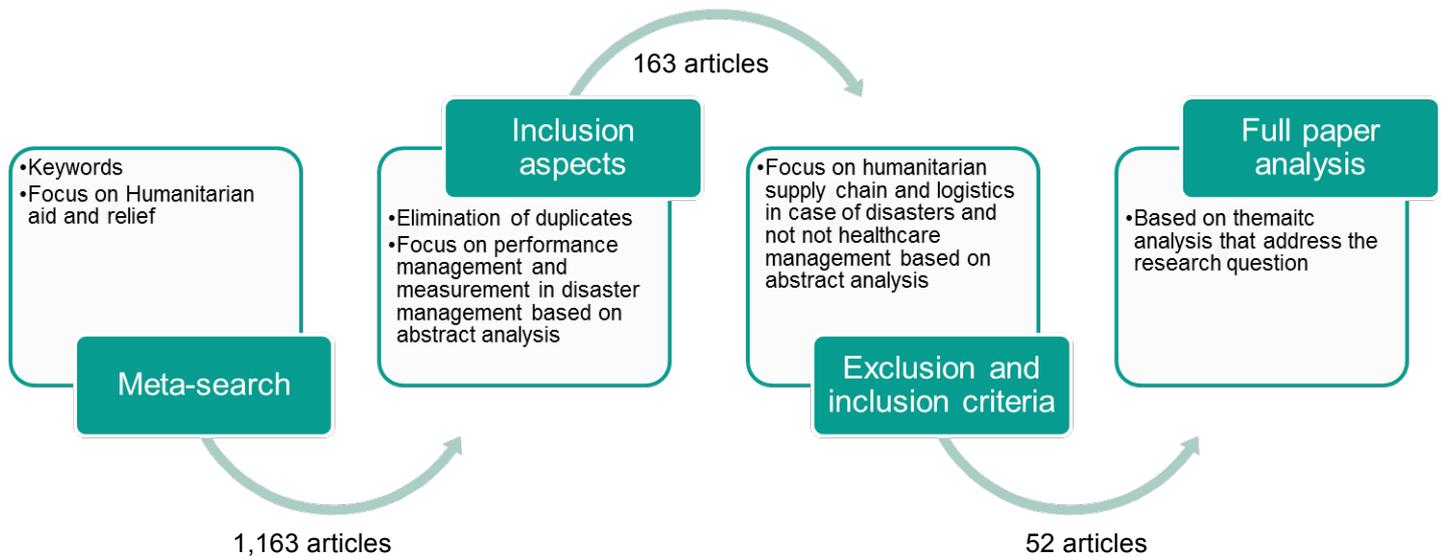
2.1.3. SCREENING

In order to ensure the fidelity and completeness and to protect the objectivity we determined criteria for inclusion or exclusion of articles as illustrated:

- Inclusion aspects: Analytical and empirical peer reviewed research articles as well as research related to performance measurement in humanitarian logistics, performance measurement in disaster management, performance measurement indicator, period time from 1970 to 2012, disaster relief operations, emergency logistics and emergency operations as well as performance management of operations relief in humanitarian supply chains. Furthermore we included one book chapter and one master thesis because of their occurrence in citations and impact in practice as well as in academia.
- Exclusion aspects: research that is out of the scope of our research e.g. healthcare management, emergency management in hospitals etc., editorial opinions and non-English articles. Conference proceedings were excluded unless a full-paper peer review had taken place and dependent on availability to non-conference participants.

During the search phase we identified 1,163 articles that address our subject terms (Figure 1). In the second step we eliminated duplicates based on titles and authors of the articles. Furthermore we deleted articles that had not been peer reviewed. Based on abstract reading we concentrated on performance measurement as well as performance management in disaster management. We excluded papers that address research areas like healthcare management. In the last step we read the full articles and collected data for our descriptive analysis. Finally we categorized the articles in two main categories: performance management and performance measurement. To address our research questions we subcategorized the findings in definition and measurement of success in humanitarian supply chains, approaches to measuring actual performance in humanitarian supply chains and challenges in humanitarian performance management.

Figure 1: Paper screening methodology (modified from Gimenez and Tachizawa (2012))



Finally 163 articles manifested all our inclusion criteria and only 52 articles (table 4) met all our inclusion and our exclusion criteria that were specified after reviewing the full papers (Figure 1).

2.1.4. EXTRACTION, SYNTHESIS AND REPORTING

We categorized and synthesized the remaining 52 articles based on the aspects mentioned in table 2. We conducted two separate analyses: a descriptive and a thematic analysis. The descriptive analysis explains the research scope, methodologies and characteristics of performance management in humanitarian supply chains. The thematic analysis highlights the synthesis of the main outcomes from the extracted literature and gives us an overview of future research and practice as well as gaps in this field.

Table 2: Categories used in extracting and analyzing data in the systematic review (based on Pilbeam et al. (2012))

Area	Category	Information
Descriptive	Year	Year of publication
	Journal/book	Journal/book in which it was published or indication of book section
	Title	Complete title of the paper
Methodology	Paper type	Identify if the paper is conceptual, mathematical, case study, literature review and/or survey
	Theoretical lens	Identify the theoretical paradigm presented in the study and from which the analysis of the data has been executed

Thematic	Sampling	If samples were used, this categories identifies: sample size, size of network, local, regional or global
	Purpose	Shared objectives
	Context	Non-governmental organization (NGO), governmental organization (GO), international governmental organization (IGO), United Nations (UN), performance measurement indicators, performance measurement framework, process, technology and at which level
	Definition and measurement of success	Performance measurement frameworks and indicators
	Managing performance	Describing and analyzing actual practice of managing performance
	Challenges	Challenges and issues in development of a performance management system, performance measurement indicators and systems.

2.2. LITERATURE REVIEW - DESCRIPTIVE ANALYSIS

In the descriptive analysis we identified the distribution of the 52 publications per year from 1970 to 2012. Figure 2 shows that the number of papers in performance measurement and management in humanitarian supply chains has increased significantly after the Indian Ocean Tsunami in 2004, and specifically in the last four years of our analysis.

Figure 2: Number of articles (in % of total) published in the period 1970-2012

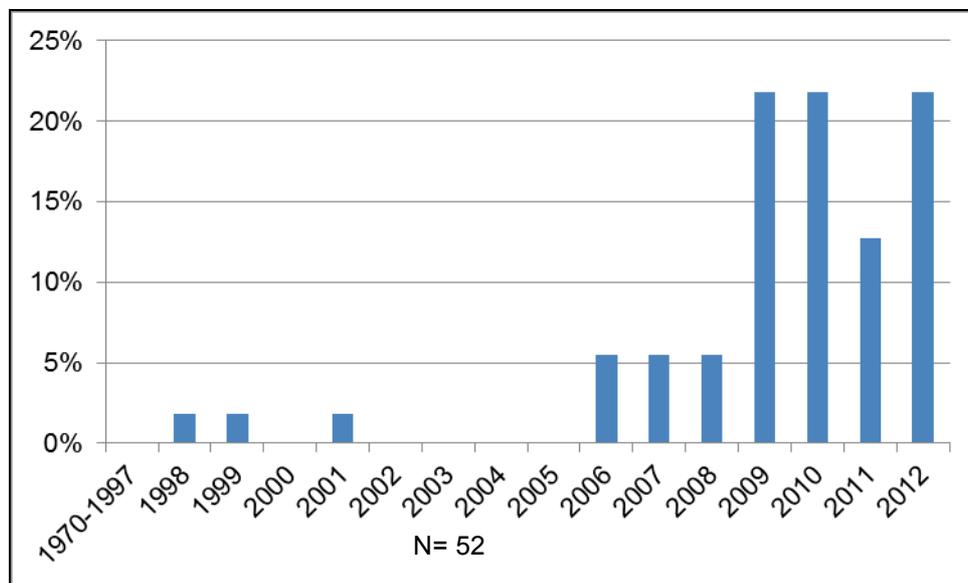


Table 3 provides a summary of statistics using a similar categorization as Altay and Green (2006). We found that 50% of the papers (26 articles) on humanitarian performance measurement and management have been published by European researchers and 36.5% of the papers come from US-based authors. The remaining articles have been published by authors based in China, Iran and Canada. We found that 30.8% have a specific focus on performance measurement indicators and 56.3% have been published in operations research (OR) related journals. Most of the papers appeared in journals that are not considered mainstream in operations research. This may be due to the variety of methods used, which are not always

suitable for specific operations research journals. The method most used to investigate the topic of performance measurement and management in humanitarian supply chains is case studies (e.g. the work of Van Der Laan et al. (2009); McLachlin et al. (2009) or de Leeuw (2010)). The novelty of the topic calls for exploratory research approaches and therefore it is logical that the majority of articles use case studies. Secondly, mathematical programming and stochastic programming are popular. Examples are Chang and Nojima (2001), who used a mathematical model to evaluate the transportation system after the Kobe earthquake in 1995, or Quiang and Nagurney (2012), who defined performance measurement indicators at the network level for the humanitarian supply chain sector. Furthermore, Medina-Borja et al. (2007) introduced Data Envelopment Analysis to facilitate an integration of indicators for evaluation. Blecken et al. (2009) focused on system dynamics approaches and used a process reference model to help humanitarian actors visualize and improve their processes as well as to identify performance indicators to measure the processes. In the area of performance measurement and management we only found one simulation study: Ertem et al. (2010) showed how to reduce the inefficiency due to errors and how to allocate resources appropriately in the procurement phase. Surveys are not very common and we expect that this is mainly due to time pressure that HOs are generally faced with (particularly in situations of a disaster), limiting willingness to cooperate on surveys.

Table 3: Summary statistics-visualization based on Altay and Green (2006)²

	All Journals	Operations research related journals ³	Main stream operations research journals ⁴
Number of articles	52		
Author nationalities			
Europe	26	19	5
USA	19	13	5
Others	7	5	1
Publication time			
1970-2004	3	3	0
2005-2013	49	35	11
Methodology			
Case studies	24	18	4
Decision Theory	2	0	2
Review	7	3	2
Simulation	1	1	0
Mathematical programming	6	4	2
Stochastic programming	4	3	1
System Dynamics	2	2	0
Survey	6	6	
Research contribution			
Application	2	0	2
Model	9	6	3
Theory	4	4	0
Performance management scope			
Performance indicators	16	9	5
Performance measurement framework	5	4	0
Performance management system to improve performance and efficiency	31	24	6

² Three publications are not subcategorized in operations research related nor in main stream operations research journals because two out of 52 articles are book chapters and one is a Master Thesis

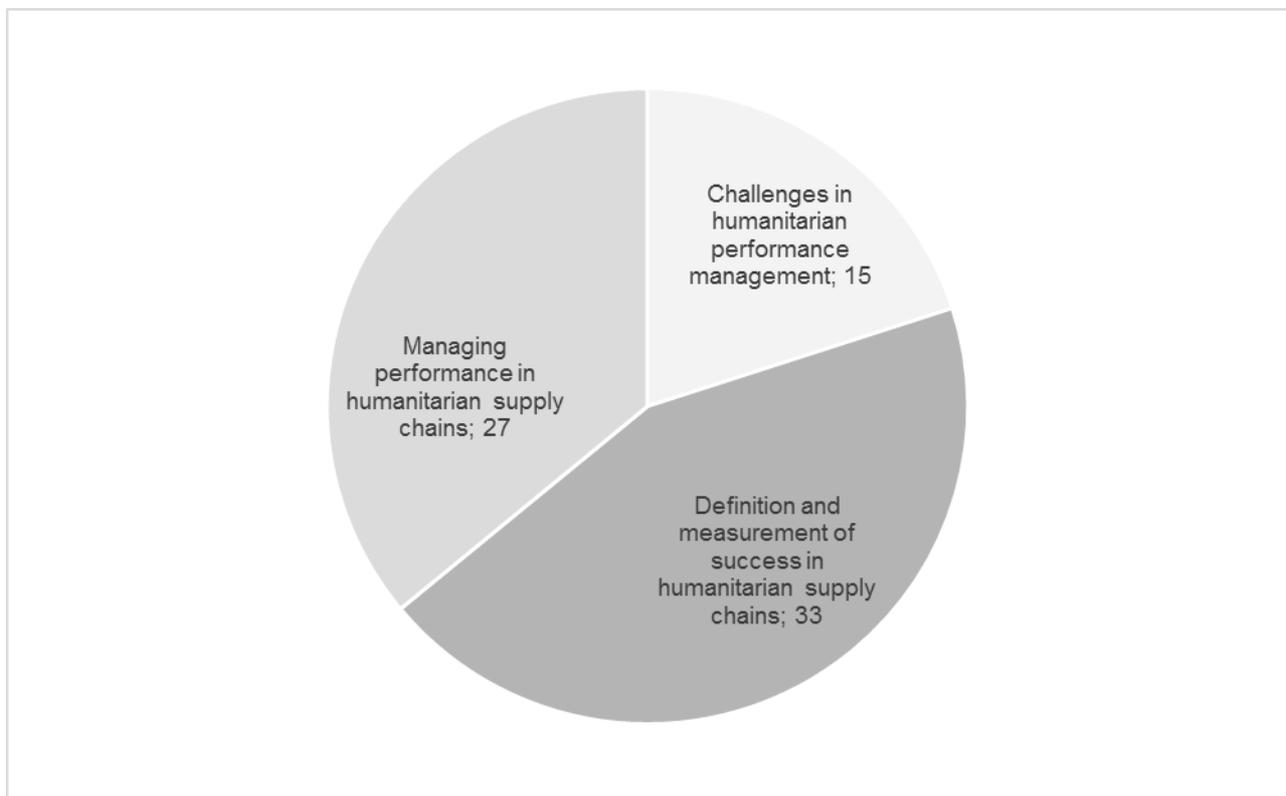
³ The definition of operations research is not clearly cut (Altay and Green, 2006); we defined 'operations research related journals' as journals that published work with the application of scientific methods but that are not declared as main stream operations research

⁴ Main stream operations research journals in our research study based on the classification of Altay and Green (2006) are i.e. Journal of the Operational Research Society, Production and Operations Management, International Transactions in Operational Research, Annals of Operations Research, Journal Global Optimization

Those papers discussing actual performance indicators typically present indicators that are only applicable to specific logistics processes and/or to specific humanitarian supply chain structures. 59.6% of the articles are targeting improvement-oriented approaches. These articles deal with improving and promoting efficiency and effectiveness in humanitarian supply chains, developing performance management frameworks and exploring manifold logistics concepts to achieve the best logistics performance. Only 9.6% of the articles illustrate the use of performance measurement frameworks to support indicator development and in particular the supply chain strategy of HOs. Most likely access to real data is hindered in such cases due to the HOs structure, the chaotic environment as well as the complexity of the humanitarian logistics structure (i.e. Pettit and Beresford, 2005; Thomas and Kopczak, 2007; Tufingki, 2006).

Figure 3 shows that most of the articles (44%) defined critical success aspects to provide an effective and an efficient humanitarian supply chain. In addition, 27 articles (36%) deal with managing performance in humanitarian supply chains. Less attention is paid to the development of indicators and frameworks. The last 15 articles (20%) introduce the different challenges that humanitarian supply chain actors are faced with.

Figure 3: Distribution of number of articles by theme



2.3. LITERATURE REVIEW - THEMATIC ANALYSIS

As a next step the articles were coded, analyzed and sorted according to the three categories: definition and measurement of success in humanitarian supply chains, managing performance in humanitarian supply chains, and challenges in humanitarian performance management. The complete articles were read to enable a judgment and categorization of the articles. Table 4 provides a thematic overview of the articles. Below we will discuss each category.

Table 4: Overview of the articles from the systematic literature review⁵

Year	Article	Definition and measurement of success in humanitarian supply chains	Managing performance in humanitarian supply chains	Challenges in humanitarian performance management
1998	Worm et al.	x	x	
1999	Ghafory-Ashtiany	x		
2001	Chang and Nojima	x		
2006	Davidson	x		x
2006	Beamon and Kotleba	x	x	x
2006	Van Wassenhove	x		
2007	Yi and Kumar		x	
2007	Medina-Borja et al.	x	x	x
2007	Moe et al.	x	x	
2008	Beamon and Balcik	x	x	x
2008	Balcik and Beamon		x	x
2008	Lutz and Lindell		x	
2009	Kumar et al.	x	x	x
2009	Kovács and Tatham	x	x	x
2009	Blecken et al.		x	
2009	Schulz and Heigh		x	
2009	Van der Laan et al.	x		x
2009	McLachlin et al.	x		
2009	Oloruntoba and Gray	x		x
2009	Whiting and Ayala-Öström	x		
2009	Maon et al.	x		x
2009	Pettit and Beresford	x		
2010	de Leeuw	x		
2010	Blecken			
2010	Chandes and Pache	x		x
2010	Scholten et al.	x	x	
2010	Salmerón and Apte		x	
2010	Gatignon et al.	x		
2010	Kovács and Tatham	x	x	
2010	Rongier et al.	x		
2010	Egan	x	x	
2010	Abrahmsson et al.			x
2010	Ertem et al.	x		
2010	Oloruntoba			
2011	Wild and Zhou	x	x	
2011	Tatham and Hughes	x		x
2011	Rietjens et al.		x	x
2011	Yang et al.		x	
2011	Nikbakhsh and Zanjirani Farahani	x		x
2011	Vitoriano et al.		x	
2011	Medina-Borja and Triantis	x	x	
2012	Quiang and Nagurney		x	
2012	Liang et al.		x	
2012	Holguin-Veras et al.	x		
2012	Heaslip et al.		x	
2012	Nagurney and Quiang	x		
2012	Lin et al.	x		
2012	Lodree Jr. Et al.		x	
2012	Leow et al.			
2012	Parlak et al.		x	
2012	Huang et al.	x		
2012	Cozzolino et al.		x	

⁵ Details of the 52 articles can be requested from the corresponding author

Definition and measurement of success

The first category focuses at the definition of measurement approaches and frameworks as well as the associated indicators. A first subset of papers discusses methods to ensure target performance levels. Cozzolino et al. (2012) for example considered the agile and lean concept to ensure effectiveness. Yang et al. (2011) suggested the adoption of RFID, sensor and network technologies in humanitarian logistics to optimize humanitarian relief operations. Other authors like Balcik and Beamon (2008) developed a simulation and modeling tool for facility location and stock pre-positioning decisions in a humanitarian relief chain responding to quick-onset disasters. A second sub set defines the frameworks and metrics. Medina-Borja et al. (2007) for example defined input and output criteria and measured the performance by applying Data Envelopment Analysis. A commonly applied method in the commercial sector, the Balance Scorecard (BSC) was modified by Moe et al. (2007) to evaluate natural disaster relief projects. De Leeuw (2010) defined indicators that can be adopted in the BSC to measure humanitarian supply chain performance. Instead of adapting an existing framework Beamon and Balcik (2008) developed a new performance measurement framework. Generally the approaches used to define and measure the performance of humanitarian supply chains are manifold. They are typically derived from operations research and economics research in commercial supply chains, such as Process Reference Models and the BSC, but also Data Envelopment Analysis.

Managing performance in humanitarian supply chains

The second category focuses at the practice of managing performance in humanitarian supply chains. In this category actual humanitarian supply chain performance is evaluated and discussed. Recently, Holguin-Veras et al. (2012) for example evaluated the performance of humanitarian logistics structures after the Port-au-Prince earthquake and define three structure types for comparative purposes. Worm et al. (1998) analyzed the rapid response capabilities of tactical forces and tactical command teams using a so-called mission efficiency analysis (MEA). Chang and Nojima (2001) evaluated the network coverage and highway transportation accessibility after the Hyogoken-Nanbu Earthquake in 1995. Most of the other papers in this category are operations research related. For example Yi and Kumar (2007) used a meta-heuristic of ant colony optimization (ACO) to solve logistics cases in disaster relief activities, i.e. vehicle route construction and multi-commodity dispatch. Kumar et al. (2009) conducted an analysis to assess the performance of non-profit organizations, specifically focusing on how they managed their operation with limited resources and unlimited demand; furthermore they developed a framework that can be used by non-profit organizations to educate their staff in form of how they can use the resources more efficiently. The work of Ertem et al. (2010) focused on resource allocation and on avoiding inefficiencies in procurement of relief items. They proposed an auction-based framework where bidders (suppliers) and auctioneers (HOs) compete amongst each other in multiple rounds of the procurement auction. Rongier et al. (2010) illustrated a method that assist stakeholders in their decisions while carrying out a performance evaluation of the activities run during the crisis response operation.

Challenges in humanitarian performance management

The challenges in managing performance are abundant. Characteristics of humanitarian supply chains are unique; improving organizational performance is typically not straightforward; performance indicators and measurement systems have not been widely developed and systematically implemented in the relief chain and data accuracy is an issue (Beamon and Balcik, 2008). According to Abrahamsson (2010) there are four challenging aspects related to analyzing and evaluating the performance of an emergency response system 1) value judgment 2) complexity of emergency response systems with regard to the context in which they operate 3) validity of information 4) limiting conditions under which the system operates in that specific situation. Determining the best way to evaluate organizational performance is generally a very complex problem due to these challenges. Beamon and Kotleba (2006) argue that various performance indicators exist for traditional commercial supply chains but that the distinct characteristics of the humanitarian relief environment may cause many of these to be inappropriate or irrelevant (e.g. customer indicators are typically irrelevant in a relief setting). Van der Laan et al. (2009) explored that the biggest challenge lie in data accuracy and the fact that the current set of performance indicators is not geared towards future improvement. Furthermore, staff typically does not have a proper qualification for tracking performance.

However, one needs to account for culture too: Maon et al. (2009) identified the cultural differences between relief agencies and the disaster area as a key challenge to measure performance.

3. DISCUSSION

RQ.1 What is the current status of research on performance management and measurement in humanitarian supply chains?

In this research study we found a variety of approaches to performance measurement. One difficulty of performance measurement research efforts in humanitarian supply chains is that few have been empirically tested. For example, the often-cited paper of Beamon and Balcik (2008) does provide a new framework but not an overall empirical validation; a total of three indicators (annual cost, response time and maximum proportion of emergency orders cycle) were used in mathematical modelling of inventory in a relief operation. The frameworks of Schulz and Heigh (2009) and de Leeuw (2010) are based on the idea of the BSC and are based on actual input from practice but have not yet been tested in practice. Others have defined individual performance indicators to evaluate the service level or stock efficacy (Van der Laan, 2009) or to assess the procurement and distribution of relief items, which are matched to appeal coverage (Davidson, 2006) or to measure the network of humanitarian supply chain (Nagurney and Quiang, 2012; Quiang and Nagurney, 2012). Just relatively few HOs have actively contributed to different research projects that have been undertaken in the field performance management and measurement in humanitarian supply chains. For example IFRC participated in the study of Schulz and Heigh (2009) and Gatignon et al. (2010), MSF in the study of Van der Laan et al. (2009) and Red Crescent of Iran in the study of Ghafory-Ashtiany (1999). A second difficulty is that results-based management is often very complicated to achieve; the relationships among inputs, activities, short term outputs, midterm outcomes and long-term outcomes are often missing and difficult to ascertain. In the end humanitarian aid is about alleviating suffering but it is very complicated to identify and quantify the relation between supply chain performance aspects and the alleviation of suffering. Third, the distinction between internal and customer-related indicators raises the question of the suitability of adopting such indicators used by for-profit organizations to measure the success of supply chain activities in a post-disaster response situation. Fourth, HOs must also ensure that appropriate information be readily available to meet the demands of the donor community. In such situations the use of standard indicators is often unsatisfactory as they often do not adequately account for all the cultural nuances impacting activities (Tatham and Hughes, 2011). All in all we can posit that there is still a long way to go in research on measuring performance in humanitarian supply chains, particularly when comparing the status with commercial supply chains.

RQ.2 How useful are the reported indicators and frameworks to measure performance in the humanitarian supply chain?

The indicators we identified do not cover all aspects of a humanitarian supply chain equally. We identified that the most developed key performance indicators can be classified at *organizational* and *process level*. Performance indicators at *network* and *project level* are rare. The *organizational level* (e.g. Davidson, 2006; Blecken et al., 2009; Schulz and Heigh, 2009) measures the achievement of the target of an organization e.g. donations and represents their strategy. The *network level* (e.g. Quiang and Nagurney, 2012) is characterized by knowing and understanding the strategy of the complete supply chain network. It deals with measuring the common targets of the overall supply chain network by applying a common method. At the *project level* (e.g. Moe et al., 2007) each process of the project can be measured. The project in the humanitarian supply chain can be subdivided in three categories based on the phases for the disaster management preparation, immediate response and reconstruction (Kovács and Spens, 2007). At the *process level* (e.g. Van der Laan, 2009; de Leeuw, 2010; Gatignon et al., 2010) the logistics processes are measured, e.g. transportation, warehousing and inventory management.

The *network level* seems to be a challenging issue for the humanitarian supply chain sector due to a lack of collaboration and coordination between organizations in this sector (Nagurney and Quiang, 2012). Common goals of the overall supply chain network are relevant to determine performance indicators and these require that the members of the supply chain network have similar key success factors. Three articles present the

BSC (McLachlin et al., 2009; Schulz and Heigh, 2009; de Leeuw, 2010) as a managerial tool that can be adopted in a humanitarian supply chain setting to fill this gap.

Gunasekaran and Kobu (2007) identified performance indicators common in the commercial sector. We used this overview to compare our 94 humanitarian supply chain performance indicators. The comparison shows that the following commercial supply chain performance indicators can be observed in the humanitarian supply chain: bid management cycle time, capacity utilization, delivery reliability, forecasting accuracy, inventory costs, labor efficiency, lead time for procurement, overhead cost, stock out cost, and transportation cost. Although there are many performance indicators applicable to traditional commercial supply chains, the distinct characteristics of the humanitarian relief environment may cause many of these to be inappropriate or irrelevant to a humanitarian environment. On a more general note, we observed an emphasis on delivery indicators, in particular delivery costs and delivery times.

We then used the performance measurement evaluation aspects of Caplice and Sheffi (1995) to evaluate the indicators in table 5. Caplice and Sheffi (1995) developed six criteria to evaluate performance measurement systems that are used in organizations to assess their logistics performance. First, a performance measurement system should involve all stakeholders, as well as all institutions (comprehensive), secondly it has to capture all activities and indicators that weight the current and future logistics performance (causally oriented). Furthermore a performance measurement system should be connected to a reward system and give an overview of the overall organization strategy (vertically integrated), and it should consider all activities as well as departments along a process (horizontally integrated). Finally a performance measurement system should recognize and allow for trade offs between the different dimensions of performance (internally comparable), it should guide decision makers to take the right action and be understandable (useful) (Caplice and Sheffi, 1995).

Using these as a guideline we concluded that the overview in table 5 does not capture all stakeholders or constituencies; stakeholders such as media, military or the host government (see Oloruntoba and Gray, 2006) are typically not covered. Secondly, it is not causally oriented because the illustrated indicators focus on one-dimensional management and it ignores the beneficiaries' perspective to measure the output. The indicators presented in table 5 do not underline the three phases for disaster management: there is a clear distinction between preparation, immediate response and reconstruction (Lee and Zbinden, 2003; Kovács and Spens, 2007). The overview (table 5) furthermore does not show a connection to the overall supply chain strategy of an organization in a humanitarian setting, therefore it is not vertically integrated. To have a vertically integrated performance measurement system it should cover the vision of HOs such as mission effectiveness or financial sustainability (Van der Laan 2009; Van Wassenhove, 2006; Kovács and Spens, 2007). The overview in table 5 is horizontally integrated because it includes all supply chain activities, functions as well as departments, including inventory management, transport and capacity planning, information management and technology utilization; procurement and human resource management. However, some indicators such as risk indicators or a volatility index are missing. However it does not easily allow for tradeoffs between performance dimensions, such as conflicting interest between donors and beneficiaries or donors and HOs. All the indicators are internally focused on aspects related to procurement and distribution processes. Therefore it is useful at the process level where the decision maker have to take action at the process level.

A performance measurement system should help to guide humanitarian aid actors in their decision making, help improve the effectiveness and efficiency of relief operations and show the performance of the supply chain while increasing transparency and accountability of operations (Beamon and Balcik 2008). In summary, the measurement indicators as presented in table 5 only provide a partial picture and do not support HOs sufficiently in developing appropriate performance indicators for their supply chains. Starting from a process perspective seems to be a logical choice to achieve this, similar to the SCOR model which was used as a basis in the Gunasekaran and Kobu (2007) paper.

Table 5: Performance indicators used in humanitarian supply chains based on Gunasekaran and Kobu (2007)

Phases in supply chain	Performance indicators	
	Financial	Nonfinancial
Plan	<p>Appeal coverage [3] Financial efficiency [3] Management expenses per Household [4] Fundraising expenses per household [4] Management expenses as % of total expenses [4] Operations management [10] Donor management [10]</p> <p>Financial network performance measure [15] Resources [5] Deviation from unit budget [8] Deviation from project budget [8] Service turnover versus plan [8]</p> <p>Inventory turns [9]</p> <p>Income from the community [13]</p>	<p>Total length of highway open [1] Area distance-based accessibility [1] Total distance-based accessibility [1] On time reporting [8] Supply chain adaptability [6] Staff development [8] Actual project time versus planned project time[8] Image [10] Partner management [10] Innovation [10] Network robustness measure [15] Unified network performance measure [15] Supply chain network performance measure [15] Dynamic network efficiency [15] Synergy measure [15] Volunteer hours [9] Capacity creation [13] Human resources efficiency [6]</p>
Source	<p>Donations per household [4] Federated income per household [4]</p> <p>Fund raising expenses per dollar of monetary/public contributions [4] Stocks managed by service agreements [8] Available stock capacity to supply 5,000 families in 48 h (segmented by ownership of stock) [8] Available stock capacity to supply 15,000 families in 14 days [8] Relief stock turnover rate [8] Average procurement cost per transaction [8]</p> <p>Fundraising (income generating) and development resources [13]</p>	<p>Fill rate announcement queue [12] Fill rate allocation share among bidders [12] Demands can be satisfied [14] Demands cannot be satisfied [14] Assessment accuracy [3;6] OS utilisation [6] Accuracy of stock records [7] Procurement transactions using Humanitarian Logistics Software [8]</p>
Deliver	<p>Donation-to-delivery-time [3]</p> <p>Output [5] Flexibility [5] Cost efficiency [6] Stock efficacy [7] Cost recovery [8]</p> <p>Average warehouse cost per m² stored [8] Average % of transport cost of total order cost for airfreight [8] Average % of transport cost of total order cost for other transport mode [8] Value of good sent [9] Donation amounts going directly to the clinics versus the total amount of money donated [9] % of appeal items mobilized & delivered at 2 months [11]</p> <p>Operations total costs at 2 months [11] % logistics costs at 8 months (items+transport+storage value) [11] Cost to deliver relief packages per family at 2 months [11] Cost to deliver relief packages per family at 8 months [11]</p> <p>Efficiency [16] % goods delivered from the region [11]</p>	<p>OSOR (order stock out of risk) [2] Order fulfilment cycle time [6] Order fulfilment rate [6] On time delivery [6] Realised service level [7] Delivery performance [8] Orders with agreed delivery time in days [8] Monthly reports to customers on time [8] Operational vehicles using IT software fleet wave [8] Product/donation velocity [9] Customer satisfaction [9] Number of people served in all facilities [9] Number of people who participate in education programs provided [9] Product and service level [10] Customer relationship (to donors) [10] Customer relationship (to intermediaries) [10] Customer relationship (to beneficiaries) [10] Families receiving at least partial packages by 2 months [11] Average no. of families served by day [11] Days to activate and to end supply chain [11] Order lead time (requisition to delivery) in days [11]</p>

Source: [1] Chang and Nojima (2001); [2] Beamon and Kotleba (2006); [3] Davidson (2006); [4] Medina-Borja et al. (2007); [5] Beamon and Blacik (2008); [6] Blecken et al. (2009); [7] Van der Laan (2009); [8] Schulz and Heigh (2009); [9] Kumar et al. (2009); [10] de Leeuw (2010); [11] Gatignon et al. (2010); [12] Ertem et al. (2010); [13] Medina-Borja and Triantis (2007); [14] Quiang and Nagurney (2012); [15] Nagurney and Quiang (2012); [16] Huang et al. (2012)

RQ.3 What challenges need to be overcome in designing and disseminating performance measurement in the humanitarian supply chain?

Based on the literature review we identified four key challenges in designing and disseminating performance measurement in the humanitarian supply chain. The first is to *align metrics with satisfaction of the donor*. Due to the expansion in the humanitarian sector and the competitive environment, HOs more and more compete for scarce donor resources (Lindenberg, 2001). In the commercial sector, it is commonplace to benchmark performance against other sectors and to develop strategic approaches to align organizational performance (which is typically financially oriented) and supply chain processes (Egan, 1998). In the humanitarian sector, performance indicators towards donors frequently focus on financial indicators in order to link activities in the field back to the donor communities or relevant stakeholder groups whose role is to ensure transparency and correct stewardship of funds (Tatham and Hughes, 2011). Therefore it is necessary to link non-financial performance outcomes to metrics that donors can relate to.

The second challenge, related to the first, is determining *meaningful indicators*. One of the key challenges in the humanitarian sector is in the difficulties related to the connecting measurement of outcomes to impacts in humanitarian relief. The HOs strive to measure performance on inputs rather than outputs like in the non-profit organizations (Beamon and Balcik, 2008). Relating outputs to impacts in the commercial sector is typically easier to achieve than in the humanitarian sector. For example, it is fairly straightforward to identify the impact of stock turns on Returns on Investment but it is difficult to identify what the impact is of stock turnover on alleviating suffering – a key objective of humanitarian aid. The BSC is the most commonly applied performance measurement tool in the commercial sector (Neely 2005). It is therefore not a surprise that the BSC has been suggested as a possible tool for HOs. However, the BSC provides little guidance for a balanced selection of indicators; in fact, many BSCs are not balanced at all. From the commercial sector we know that 70% of BSC operations fail due to poor design and poor execution (Neely and Bourne, 2000) and that may be more problematic in the humanitarian sector.

The third challenge is to apply performance measurement with the objective to *foster learning and training* of employees at every level or organizations. This enables HOs to evaluate and monitor processes as well as educate managers in knowing how to implement effectively their strategies into practice. Unfortunately many are lacking the proper qualifications for tracking performance (Van der Laan, 2009) so fostering learning and training is pivotal to develop humanitarian operations in an efficient and effective way (Maon et al., 2009; Kovács and Tatham, 2009).

The fourth key challenge is the poor *data accuracy and availability*. Non-profit organizations have difficulties to capture robust data in a complex and chaotic environment with a destructed information and communication network (Van der Laan, 2009; Tatham and Hughes, 2011). In many countries consumption data are inaccurate, not reflecting real demand because the supply pipeline has not always been full and drug use has not always been rational (Van der Laan, 2009). Capturing the essential information efficiently and effectively is key to the success of any performance measurement endeavor.

4. TOWARDS A PERFORMANCE MEASUREMENT FRAMEWORK

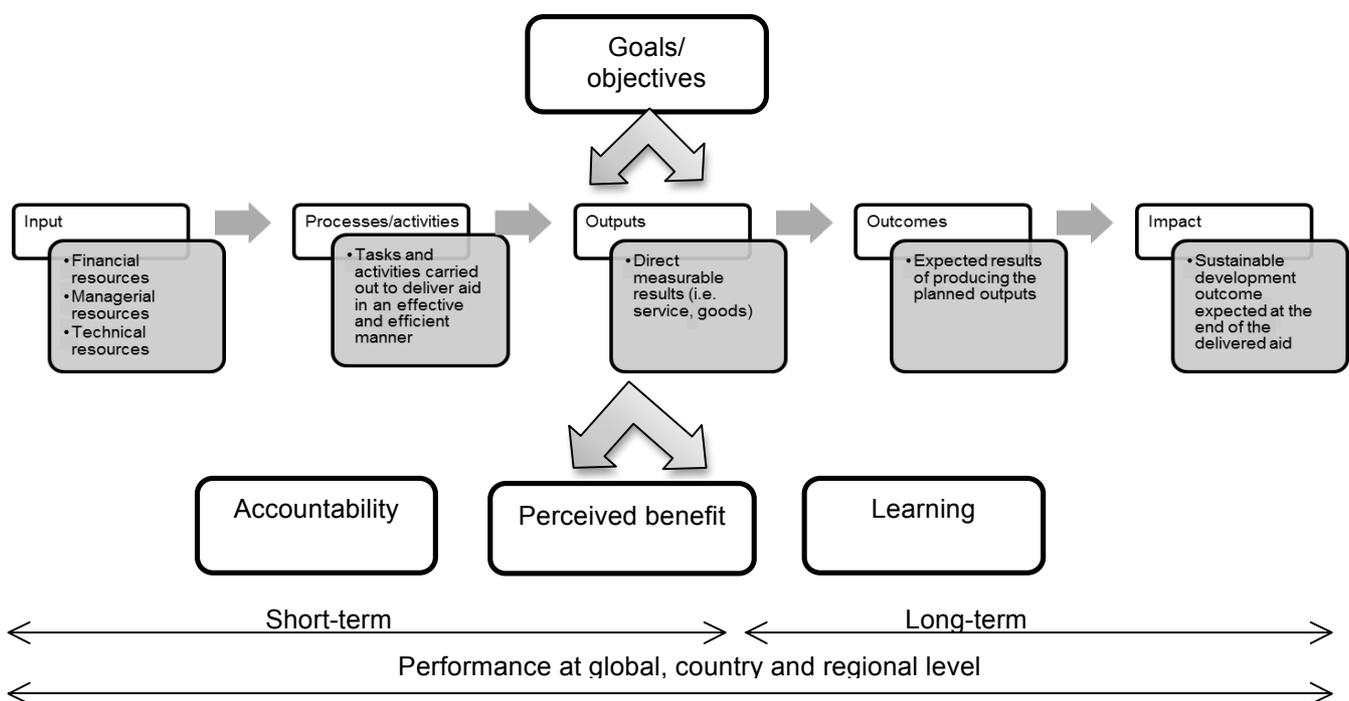
Many papers show that good implementation of performance measurement is key to reaping the organisational benefits from performance measurement and management (de Leeuw and Van den Berg, 2011). Implementation of performance management is defined as putting the performance management system and procedures in place (Bourne et al., 2000) and should be handled as a part of an organization wide project (Bourne, 2005; Bourne et al., 2005). Effective performance measurement and management should be an on-going and continual learning process, which is characterized by ingrained practices and a resistance to radical change programmes (Cheng et al., 2006). The following implementation success factors can be highlighted here based on our literature review. We subdivided them in internal success factors and external success factors:

- Internal success factors that foster use of performance measurement are top management support (Medina-Borja et al., 2007; Pettit and Beresford, 2009; de Leeuw, 2010; Rietjens et al. 2011), availability of appropriate training and learning in performance measurement (Van Wassenhove, 2006; Kovács and Tatham, 2009; Maon et al. 2009; Holguin-Veras et al., 2012; de Leeuw, 2010), selecting and determining useful indicators (Kumar et al. 2009; Van der Laan et al., 2009; Chandes and Paché, 2010), availability of appropriate information systems (Worm et al., 1998; Davidson, 2006; Balcik and Beamon, 2008; Beamon and Balcik, 2008; Van der Laan et al., 2009; Tatham and Hughes, 2011); fit with ethical and cultural aspects of a country (McLachlin et al., 2009; Wild and Zhou, 2011). The latter has to be considered with caution because of the presence of heterogeneous groups of people working in the field. For that reason implementing guidelines need to be established accounting for cultural as well as education backgrounds of the people in the field.
- External success factors that need to be accounted for when implementing performance measurement are first of all the media. It will have a strong impact on the achievement of goals, for example sudden onset disasters are mostly over-financed (Van Wassenhove, 2006) which may affect the performance negatively in terms of efficiency. A further factor to take into account is that logistics typically is not very powerful in a humanitarian organization; it is therefore necessary to encourage logistics in humanitarian aid (Whiting and Ayala-Öström, 2009). A fundamental success factors is coordination of HOs (Ghasfory-Ashtiany, 1999; Maon et al. 2009; Scholten et al., 2010; Nagurney and Quiang, 2012; Holguin-Veras et al., 2012): the need for coordination with other humanitarian relief organizations may complicate the implementation of performance measurement.

Based on the systematic literature review we have developed the following guideline for developing and implementing appropriate performance measurement. First of all, a performance measurement framework in humanitarian supply chain settings needs to consider the regional, country and global level for each part of the disaster management cycle. Typically, HOs are strongly country-focused yet several have a strong regional and global presence as well. Each level may perform different activities and this needs to be reflected in a performance measurement framework. The framework also needs to reflect a short-term and long-term perspective of performance management and measurement (Blecken, et al., 2009; Tatham and Hughes, 2011). Furthermore it should be possible to relate indicators to the goals/objectives that reflect the supply chain strategy of the HOs as determined and expressed by the strategic management of HOs. As argued before, performance measurement should be process-oriented, which implies that it should include 1) input factors which consist of financial aspects (i.e. monetary or in-kind donations), managerial and technical resources (i.e. warehouse or communication equipment) that are needed to have effective activities as well as processes. 2) Processes/activities in the humanitarian supply chain that encompass a variety of tasks such as inventory management, distribution of relief items, warehouse management, procurement of relief items construction activities, fleet management or transportation. 3) The outputs that illustrate the measurable results of the activities delivered in form of relief items or services. 4) The outcomes, which are the expected results of producing the planned output and which show the realization of the ultimate goals and objectives. 5) The impact, which is in fact the core of humanitarian aid. Unfortunately the impact of humanitarian intervention, advocacy, coordination capacity building is difficult to measure. However, impact indicators (such as mortality rate, or severity and intensity of a disaster situation) are crucial for donors; based on knowing the impact donors can choose what to fund and can develop their policies. Impact indicators in fact play a dominant role in guiding disaster preparedness and planning response by national government (Hofmann et al., 2004).

The results of all these factors lead to transparency and accountability. Accountability towards stakeholders can be demonstrated because of learning from experiences and documentation. Despite the challenges inherent in implementing change programmes, modern organizations need to respond more effectively to changing external and internal environments and organizational learning has become an important strategic focus (Cheng et al., 2006). Learning means learning from past experiences and appropriate performance indicators are an essential part of this. This depends on the capabilities and training of the involved staff, collaboration, operations and process management (e.g. recognizing supply chain management as a central topic in preparedness) effective coordination, cross learning possibilities (learning from commercial and humanitarian organizations) and corporate social responsibilities (Van Wassenhove, 2006). Perceived benefit does not mean profit in the humanitarian supply chain sector like it does in the commercial sector. For that reason it is necessary to focus our attention more on spending donations in an effective way, thus helping and providing aid to affected people in an efficient and effective manner. Furthermore appropriate indicators will result in improved control and management of decision-making (Beamon and Balcik, 2008).

Figure 4: Guideline for developing an appropriate performance measurement framework (summarized based on the findings of the systematic literature review (table 4) as well as Hofmann et al., 2004, Buckmaster, 1999 and Crawford and Bryce, 2003)



5. A FUTURE RESEARCH AGENDA FOR PERFORMANCE MANAGEMENT AND MEASUREMENT IN HUMANITARIAN SUPPLY CHAINS

From the discussion above we conclude that the field of performance measurement and management in humanitarian supply chains is still in its early stages: for example, though we found many different performance indicators and frameworks literature is inconclusive about which ones are best applicable in which situation. A framework and the resulting indicators should be comprehensive, sufficiently complex to contain all the main features of the organization - but at the same time flexible, enabling modifications by those who will work with them (Michelli and Kennerly, 2005).

Our systematic literature review gives insights into the conceptual idea of performance measurement and management and provides leads to new research directions. Below we summarize a future research agenda around four aspects.

- *Development of a common performance measurement framework*
 Currently different performance measurement frameworks in the humanitarian supply chain exist (e.g. Beamon and Balcik, 2008; Schulz and Heigh, 2009; de Leeuw, 2010) that are not tested nor used in practice. So far the humanitarian supply chain sector has not seen the emergence of one or a few common performance measurement frameworks similar to what the commercial sector has seen (see for example Neely, 2005). Therefore, a common performance measurement framework has to be established that is easily understandable and manageable. This framework should include standardized, comparable indicators based on common input, and needs to be focused on impact. The framework should support the goals of performance measurement and identify directions for organizational change. This leads to the following research question:
RQ1: What is an appropriate performance measurement framework for humanitarian supply chains and what are associated performance indicators?
- *Initiating the performance improvement cycle*
 One of the key goals of measuring performance is to induce improvement. Performance indicators are required to establish a culture of improvement and accountability for improvement in humanitarian supply chains. Performance measurement needs to be part of an integrated improvement cycle within the focal organization as well as focused on its key stakeholders. This will also allow for measuring, monitoring and improving performance across the network. The focus of the employees should be on supporting the improvement rather than spending a large amount of time on monitoring (Johnston et al., 2002). Attention for implementation aspects is key, for example for the influence of performance measurement on the understanding and motivation of individuals in the HOs (Hall, 2008; de Leeuw and Van den Berg, 2011). We therefore need a better understanding how performance measurement and management can support an improvement cycle in HOs. This obviously requires the availability of sufficient data as an enabler. This leads to the following research question:
RQ2: How to set up and implement a continuous performance improvement cycle in humanitarian supply chains?
- *Developing appropriate information technology (IT) to support performance management*
 Improved information flow in humanitarian organizations is necessary to facilitate performance management. One interesting question here is for example how much staff should spend how much time on collecting and analyzing data, particularly since in the heat of an emergency data collection may not be at the top of the priority list of people. Access to data for the employees should be ensured frequently and in time (Kennerly and Neely, 2002). Simple data access as well as providing standardized data analysis instruments are key drivers in performance management (Bourne, 2005; Bourne et al., 2005), which requires proper training of employees at all levels. Preferably performance data should be collected electronically to save time and to establish stability (Gunasekaran and Kobu, 2007). This is an area where there is an abundance of research in the commercial sector but not in the humanitarian sector. We derived the following research question:
RQ3: What should an appropriate IT platform for performance measurement and management in humanitarian supply chains look like?
- *Involving stakeholders in performance management*
 There are various actors in the humanitarian supply chain e.g. governments and their donor agencies, international humanitarian NGOs, suppliers, 3PL service providers, governmental agencies of aid-receiving countries, media and corporate donors (i.e. Oloruntoba and Gray, 2009). Generally the actors, and in particular donors, are essential in performance management of HOs. Donors want to monitor the extent to which their money is well spent but that does not mean that donors should dictate all performance indicators. This may hamper HOs in developing a common performance measurement framework that presents results about outcomes and impact. We should furthermore take into account that many HOs replicate activities, e.g. they apply for the same funds, they use the same media as well as 3PL service providers and they have similar marketing strategies to increase funds and to stay competitive (Oloruntoba and Gray, 2009). An improved supply chain in terms of performance management may provide the bridge between donors and

recipients as well as a strategic instrument for survival (Oloruntoba and Gray, 2009). This leads to the fourth research question:

RQ4: How to involve stakeholders in managing performance to ensure an efficient and effective humanitarian supply chain and to achieve an integrated supply chain?

6. CONCLUSION

In this study we aimed to describe the state of the art of performance measurement and management in humanitarian supply chains using a systematic literature review. We aimed to define the gaps as well as the challenges in this field and give insights for future research in this domain. For this we categorized the performance measurement indicators into the five supply chain phases based on the classification of indicators developed by Gunasekaran and Kobu (2007). We assessed them based on evaluation criteria that have been empirically tested in commercial supply chains by Caplice and Sheffi (1995): comprehensiveness, usefulness, internally comparable, causally oriented and horizontally as well as vertically integrated. In doing so, we found that performance measurement frameworks and indicators are far from complete and that a process perspective seems to be a logical choice as a starting point for developing a performance measurement framework and indicators, similar to the SCOR model which was used as a basis in the Gunasekaran and Kobu (2007) paper.

The following insights were derived from the systematic literature review: the main body of publications regarding performance management and measurement in humanitarian supply chains has emerged after the 2004 Indian Ocean tsunami disaster. The total number of research articles in this specific field of performance measurement and management in humanitarian supply chains is still low compared to the commercial sector. We furthermore observed that the topic has gained more attention among European researchers than among US, Australian or Asian researchers. There are many valuable contributions based on theory and models, but the number of contributions that deal with actual application in humanitarian supply chains are limited. Further work is needed on the application of theory and models, particularly in the area of mathematical and stochastic programming as well as decision theory.

We have summarized the necessary success factors for implementing a performance measurement and management system in humanitarian supply chains from various investigations of researchers from this field and have designed a first guideline for developing an appropriate performance measurement framework. This guideline has not yet been empirically tested. As a first step towards future research in this area, this framework has been presented to two different international HOs who act as global players in disaster relief in more than 29 countries at the strategic, tactical and operational level. They are now in the process of developing a performance measurement framework based on this concept. They have decided to integrate the topic performance measurement and management in their supply chain strategy and have determined that as a supply chain goal for 2014 in order to align it with their supply chain management concept. An important lesson in this context relies on the identification of the need to focus more on implementation issues of performance measurement and management in humanitarian supply chains and on how to ensure proper data availability. This requires involvement of relevant stakeholders in the supply chain, most notably the donors, but this has consequences for staff training as well.

Another finding based on the systematic literature review is that the topic performance measurement and management is not yet common practice in humanitarian supply chains. This study discussed strengths as well as weaknesses in designing and disseminating a performance measurement and management framework. Such a framework should be implemented as a strategic tool for humanitarian supply chain management that enhances effectiveness, improves the supply chain processes, increases efficiency, enhances donor interaction and satisfaction and makes HOs accountable as well as transparent towards their stakeholders. A process-oriented performance measurement reference model based on SCOR principles could be an appropriate and common framework in humanitarian supply chains where different stakeholders and processes are incorporated. Such a framework should provide information about key indicators such as the service levels and costs for different supply chain activities at the global, country and regional level.

We developed a guideline and categorization since a systematic approach to categorize research output regarding performance measurement and management in humanitarian supply chains does not yet exist. A limitation of this study therefore relates to the general validity and reliability of qualitative literature research. Further research in the area of performance measurement and management is pivotal to not only advance theory but more importantly help improve the supply chains of HOs. The success of HOs these days relies heavily on excellence in supply chain as a core competence and functionality of their missions and that requires appropriate performance measurement and management .

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