Managing in-country transportation risks in humanitarian supply chains by logistics service providers: insights from the 2015 Nepal earthquake

Hossein Baharmand, Tina Comes, Matthieu Lauras

Managing in-country transportation risks in humanitarian supply chains by logistics service providers: Insights from the 2015 Nepal earthquake

Hossein Baharmand[a,*], Tina Comes[a,c], Matthieu Lauras[b]

[a] Department of ICT, University of Agder, 4879 Grimstad, Norway
[b] Mines Albi, University of Toulouse, 81000 Albi, France
[c] TU Delft, 2628 BX Delft, the Netherlands

A B S T R A C T

Humanitarian supply chains (HSCs) play a central role in effective and efficient disaster relief operations. Transportation has a critical share in HSCs and managing its risks helps to avoid further disruptions in relief operations. However, there is no common approach to or culture of risk management that its applicability has been studied through recent cases. This paper incorporates an empirical research design and makes a threefold contribution: first, it identifies in-country transportation risks during Nepal response. Second, we evaluate afore identified risks through an expert driven risk assessment grid. Third, we use our field data to study how some humanitarian organizations in Nepal response used logistics service providers for managing moderate- and high-level transportation risks.

In this paper, we use both qualitative and quantitative methods. Our qualitative analysis reveals that some of the most important in-country transportation risks were delivery delays; market fluctuations; insufficient capacity; loss of cargo; cargo decay; unreliable information; and ethical concerns. Our quantitative work shows that while participants categorized the first three risks as high-level, the rest were ranked as moderate-level. More investigation in our field data indicates that using logistics service providers (LSPs) helped humanitarians significantly to manage afore in-country transportation risks during Nepal response. It also improved overall HSC performance with respect to flexibility, effectiveness, efficiency, and responsiveness. While this finding empirically confirms the "tools" role of LSPs for managing in-country transportation risks in response, it implies another role for LSPs; "contributors" to performance improvements.

Keywords:
Humanitarian supply chain
Transportation risks
Logistics service providers
Field research
2015 Nepal earthquake

1. Introduction

Supply chain risks are, fundamentally, the outcome of uncertain events that prevent the supply chain from achieving its performance aims [1]. In the context of disaster response, these risks emerge due to wrong assessments and misjudgments based on uncertainties (supply, demand, fleets, locations, etc.), complex operating conditions in the field, the effect of the disaster on local labor and infrastructure, and structural differences between responders, especially humanitarian organizations (HOs) [2]. While there is a growing awareness among HOs about the nature of risks in response contexts, current approaches to risk management in such contexts are often ad hoc, inconsistent and fragmented [3]: there is no common approach to or culture of risk management among HOs. Differences are particularly stark between HOs, including in relation to which risks they prioritize, how they balance them, and how they link them with disaster relief objectives [4].

Disaster relief operations crucially rely on the functionality of humanitarian supply chains (HSCs) where transportation is a key operational element [5]. Specifically, in-country transportation, that covers means for shipping relief items and aid to beneficiaries, moving personnel and/or affected people, and conducting needs assessments, plays a significant role in disaster response. There is, however, a lack of research about how and to what extent managing in-country transportation risks within the HSC fosters effectiveness, efficiency, and responsiveness and in turn, better response performance. Especially the need for corresponding empirical work has been pointed out [6–8].

Our empirical work is based on a field research after the 2015 Nepal earthquake, including systematic observations and interviews. Our field study objectives include identifying relief distribution bottlenecks in Nepal response along with investigating those approaches that helped HOs to deal with logistics challenges (e.g., capacity). We use findings of our qualitative field study to develop a survey regarding the impacts of in-country transportation risks on HSC performance. Given the risk

* Corresponding author.
E-mail addresses: hossein.baharmand@uia.no (H. Baharmand), t.comes@tudelft.nl (T. Comes), matthieu.lauras@mines-albi.fr (M. Lauras).

analysis results, we study the impact of risk management techniques that we observed during our field research.

Our multi-method approach in this study is therefore aimed at (a) identifying particular in-country transportation risks that threatened relief operations in Nepal; (b) assess identified risks by the help of practitioners; and (c) analyze a common approach that studied HOs used for managing some moderate and high transportation risks, i.e. employing logistics service providers (LSPs).

Related literature regarding the role of LSPs in disaster relief is described in Section 2. The research design is presented in Section 3. In Section 4, outcomes of data analysis are explained with respect to our research aims. Then, we discuss our research findings and implications for theory and practice in Section 5. We conclude with opportunities for future research in Section 6.

2. Literature review

In this section, we present the theoretical framework of our research. First, we compare risk management strategies in commercial and humanitarian contexts and narrow the scope of our research. Then, we review the role of LSPs in disaster relief operations and position our contribution in the literature.

2.1. Risk management and humanitarian contexts

Supply chain risks are classified differently in the literature; internal and external [9]; operational and disruption [10]; and micro and macro [11]. Despite different titles, afore taxonomies often cover risks with similar characteristics. While external, macro, or disruption risks are driven by the event of a natural or man-made disaster, risks in internal, micro, or operational category originate from internal activities of organizations, HOs in our study, and their relationship with partners [9–11]. Our study focuses on the latter category, micro risks, which include demand, supply, manufacturing, and infrastructure risks [12]. According to Pontré, Welter, Malta, Faria and Chernyshova [4], researchers have paid considerable attention to the risks of demand, supply, and manufacturing. However, infrastructure risks - the risks that are related to information technology, transportation, and financial systems - are rarely addressed [2,13] although their disruption can lead to serious problems in HSC [14].

Due to the critical role of transportation in HSCs, managing its risks is of great importance. Supply chain risk management literature suggests four techniques and strategies for managing risks, i.e. control & accept, become flexible & reduce the probability, cooperate & transfer, and mitigate & avoid [15]. However, not all of afore strategies are applicable in humanitarian response contexts due to: the urgent nature of interventions, the short time-frame for achieving ‘success’, the tangible objectives set for disaster relief, and the comparative simplicity of partnerships in commercial SCs [3].

Accept and avoid strategies are not easily applicable humanitarian response. In general, accept strategy is used when the risk cannot be further reduced, transferred or avoided [12]. Accepting risks in the chaotic response implies further disruptions and can result in more social and financial loss, in comparison to other contexts. Also, avoiding strategy yields trade-offs between weights of the risk and the humanitarian imperative – the urgency and scale of the need for life-saving assistance [3]. Due to the higher weight of humanitarian imperative in majority of cases [3], this strategy is seldom taken into account in humanitarian response, in comparison to commercial contexts. In the latter, a risk may simply become unacceptable based on a profitability cost-benefit analysis which may lead to a decision to end the activity or quit the operation [12].

Reducing risk probability through enhancing flexibility [16] is an effective strategy for humanitarian contexts but may not be always efficient. In this regard, Hajdarovic and Jensen [17] provide supporting evidence about the positive influence of some commercial practices toward improving flexibility on the responsiveness of HSCs [17]. However, the cost-effectiveness of such practices has not been yet studied in humanitarian contexts. Accordingly, a recent study shows that more than 90% of HOs could not provide a medium level of flexibility in their SCs during Nepal response [18]. Implementation of some approaches for enhancing flexibility requires comparable access to monetary and non-monetary resources which demands careful consideration and planning [18].

The remaining strategy, transfer, means “allocating risks to the parties best able to manage them” [5]. In this regard, Tang and Musa [12] contend that LSPs, i.e. logistics service providers, can improve the management of underlying risks in SCs. The term LSP refers to a company provides logistics services for other companies [19]. Skjoett-Larsen, Halldorsson, Andersson, Dreyer, Virum and Ojala [20] define three LSP categories with respect to the services they provide: physical logistics activities, organization and responsibility for implementation, and third-party logistics providers (3PLs). Recently, the category of fourth-party logistics providers (4PLs) has emerged which refers to 3PLs with broader involvement in management and decision-making [21,22].

Some HOs (e.g. Canadian Red Cross) benefit from transferring strategy for dealing with transportation risks: they delegate some (or all) logistics services, e.g. transportation, to LSPs [23], or other HOs, as humanitarian LSPs [5]. Some other HOs (e.g. IFRC) invest on reducing strategy through improving flexibility in their SCs [24]. In this paper, we focus on reducing and transferring strategies for managing in-country transportation risks. We limit our study scope to the first two categories of LSPs due to their common usage in recent humanitarian response operations [25].

2.2. Logistics service providers and their roles in disaster relief

In HSC literature, although very few studies can be found, LSPs has been studied within three roles in relief operations: as “members”, “actors”, or “tools” [25]. As “members”, LSPs share their resources with HOs, transfer their knowledge, and expand their partners` network. Heaslip [7] acknowledges that business can extend much needed technical expertise to the assisted HO and `fill gaps in humanitarian action.' In return, as Binder and Witte [26] note, LSPs achieve positive branding, improved staff motivation, access to business intelligence, and a desire to ‘do good.’

As “actors”, LSPs support HOs through partnerships and coordination. The former refers to offering all kinds of logistics activities [25]. Samii [27] indicates that cooperation between HOs and LSPs can result in cost efficiency, timeliness, accuracy, and flexibility. Furthermore, Abidi, de Leeuw and Klumpp [28] present the positive influence of LSPs on relief operations in complex disasters environments and provide key drivers for increasing and simplifying collaboration between them and other HSC actors. In the scope of coordination, LSPs are referred to as enablers of supply chain integration [29], vertical coordination [30], and horizontal coordination [31,32].

As “tools” LSPs provide professional logistics services to HOs [25]. Bealt, Fernández Barrera and Mansouri [33] study the use of LSPs among some HOs and find that practitioners prefer to use LSPs in preparedness (44%) more than immediate response (41%), mitigation (6%), and recovery (9%). However, Binder and Witte [26] contend that whether in preparedness or response LSPs can bring several advantages in mobilization, transport and distribution of relief items. In other studies, the use of LSPs has also shown improvements in effectiveness [34] and responsiveness [35] of relief operations.

Some studies contend that the role of LSPs, regardless of type, in humanitarian operations is still marginal [26,36] and very few LSPs have been involved in recent disaster relief operations [25,31,37]. Three directions can be observed. First, there is some concern about incorporating LSPs in the humanitarian context with respect to their impacts on the humanitarian principles of impartiality, neutrality, and

independence [25]. Second, humanitarian contexts entail continuity issue which relates to HO's short-term service and high staff turnover [31,33]. Third, the cost of LSP services is not still justified among HOs. In their research, Binder and Witte [26] refer to the lack of understanding about what LSPs can bring into the humanitarian domain, as another barrier that demands further study [29].

Recent surveys call for further empirical research to shed lights on currently identified and other roles that LSPs can play in HSC and their consequences [7,25,38]. To the best of our knowledge, very few paper study LSPs in humanitarian contexts empirically [32,33,39]. Among them, Bealt, Fernández Barrera and Mansouri [33,39] conduct interviews with humanitarians to find some solutions for barriers that hinder LSPs involvement in HSC as actors. In the most relevant study to our research, Cozzolino, Rossi and Conforti [32] investigate the impact of using LSPs on agility and leanness of relief operations within a real case; UNWFP response to Sudan crisis. Through their exploratory research, Cozzolino, Rossi and Conforti [32] briefly explain that using LSPs supports addressing disruptions to traditional supply chain flows and other forces that disrupt logistics, production, and information handling. However, further analysis of how and to what extent this support affect HSC performance has been left for future research.

2.3. Research contribution

Our literature review revealed a few gaps in the literature. First, to facilitate collaboration between LSPs and HOs, empirical research is still required to understand the elements that drive, facilitate, constraint, and affect the relationship between them. Second, the impact of using LSPs on HSC within different roles demands empirical verification, as a solution that justifies their costs and fosters their involvement in future relief operations.

Our work is based on a field study after the 2015 Nepal earthquake. It empirically studies the impact of using LSPs in managing transportation risks after a sudden onset natural disaster. Beyond less exposure of HSCs to disruptions due to transferred risks, as we will show, using LSPs also entails improving HSC flexibility because it reduces the risk probability significantly.

3. Research design

In this paper, we follow the well-known risk management cycle: identify, assess, plan, implement, and review [12]. However, since we intend to investigate the impact of LSPs on managing HSC risks, planning and implementing steps are not in the scope of our paper. In other words, our research design is composed of three main steps. First, we identify in-country transportation risks empirically. Risk identification helps in recognizing the potential hazards and is the first step toward managing risks effectively [11]. Also, identifying risks empirically brings insights on this topic from a practitioner's point of view for further effective risk analysis [40]. Second, we develop a practitioner's oriented measurement scale and investigate transportation risks` impacts. Based on risks impacts, we categorize them. Categorization helps to prioritize risk management techniques and/or action plans [12]. Eventually, we review risk management strategies that HOs used to manage identified and categorized transportation risks. Our focus is on those strategies that included LSPs.

We use both qualitative and quantitative methods in our research design. For the identification step, our research follows the empirical case-study research design for theory testing [18]. Given the aim of our study, we collect empirical evidence regarding the role of LSPs in Nepal response, where our methods are inspired by similar field studies in disaster settings. In the second step, evaluation, and prioritization of risks, we use a questionnaire in combination with an expert risk assessment grid. Finally, we analyze our field data to find out how HOs managed identified transportation risks during Nepal response. In this step, we specifically focus on the role that LSPs played.

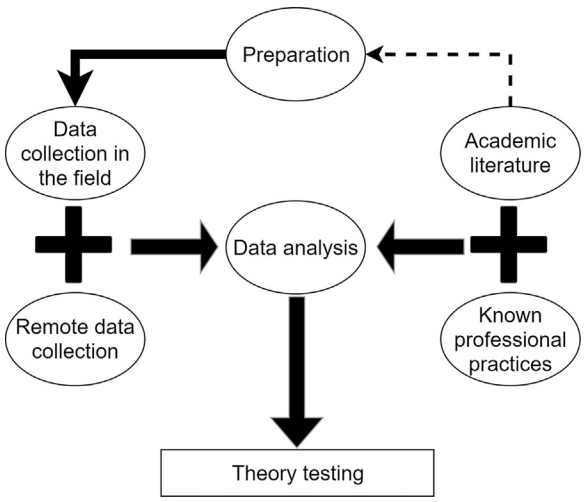

Fig. 1. Schematic overview of our field research design.

3.1. Field research design

Our field research aimed to identify logistics challenge and study underlying problems from the ground and in close collaboration with practitioners. To ensure considering details and sensitivities between several variables in the field, we incorporated a research design which is illustrated in Fig. 1. The workflow of research design is composed of four main steps and they are designed to effectively capture complexities in the field. Our field research design starts with preparation step by gathering results of literature review and other relevant sources to define research questions and to develop research protocols. On-site and remote data collection, the second step, follow the prepared protocols in step 1 toward the combination, or “triangulation” [41], of quantitative (survey) and qualitative (interview, observation, document review) methods for collecting as much data as possible regarding the targeted objectives. Hence, the weaknesses of one method would be compensated by the counterbalancing strengths of another method in order to capture a more complete, i.e. holistic and contextual portrayal of study objectives [41]. The third step includes combining data from all sources (field, literature, best practices), categorizing them with their relevance to our predefined themes, and including them in data analysis. In the final step, fourth, results of the analysis are categorized into theory testing outcomes.

3.1.1. Nepal field research and its preparations

Our Nepal field research was carried out approximately six weeks after the second major earthquake during June 21–29, 2015. The focus of our field research was on the bottleneck and challenges of HSCs' downstream networks as well as problems in coordination, and information management.

The preparations step started in early days of May 2015, after the first earthquake, and was composed of:

- preparing a timeline of concurring events after the earthquake;
- collecting and archiving relevant documents from online sources: Humanitarian Data Exchange,[1] ReliefWeb,[2] MapAction,[3] and Logistics Cluster[4];
- preparing interview and observation protocols based on field

[1] https://data.humdata.org
[2] http://reliefweb.int
[3] http://mapaction.org
[4] http://logcluster.org

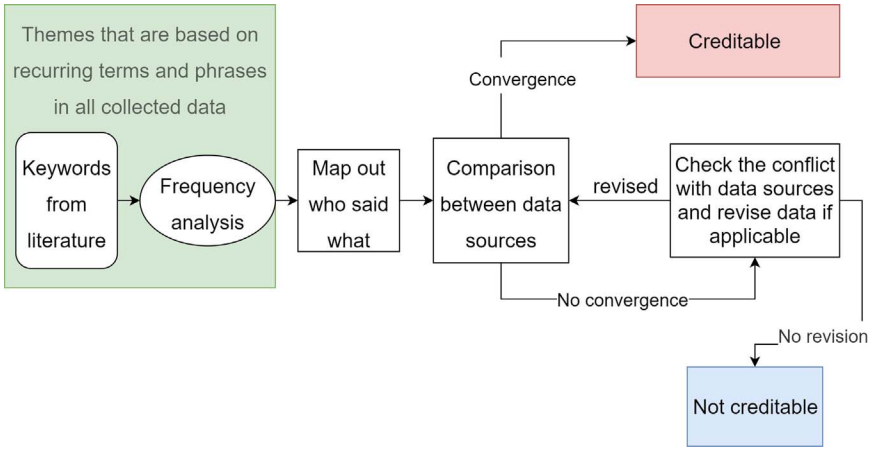

Fig. 2. Validity check of our qualitative data.

research objectives;

- and preparing the first list of interviewees through our pre-existing contacts at HOs along with those that we could confirm their participation by using online community platforms, especially, ReliefWeb, Humanitarian Data Exchange, and LinkedIn after searching for potential interviewees. These interviewees were selected based on their expertise (logistics), experience (having participated in more than four response operations), and availability (presence in Nepal during our field research).

3.1.2. On-site and remote data collection

Our methods for on-site data collection were inspired by similarly conducted field research in disaster settings [42–44]: semi-structured interviews, observations, and document review. We conducted 16 in-depth interviews with representatives from 10 HOs active in relief operations. Our interview protocol is presented in Appendix. Most of our interviews were carried out in Kathmandu. Once we had commenced field work in Kathmandu, we used snowballing technique [45] to identify new research participants. To avoid the limitations inherent in relying on information that interviewees provided only from one perspective, we used cross-validation during interviews to validate the findings whenever possible.

During our field research, we interviewed logisticians from a range of different official organizations that were involved in the Nepal response, international HOs, international non-governmental organizations (iNGOs), and UN agencies. They were Canadian Red Cross, UN OCHA, UN WFP; Oxfam; Islamic Relief Worldwide (IRW), World Vision International (WVI), Cordaid, United Mission to Nepal (UMN), Humedica, and Handicap International. All of our interviews lasted less than one and a half hour and they were all recorded with the consent of interviewees.

In addition to interviews, we spent four days observing interactions between humanitarians and local communities in Rasuwa and Nuwakot. These trips were arranged through our contacts at Kathmandu-based INGOs. On each location, we accompanied iNGO field workers and other humanitarian actors for two days in order to observe how they worked in the community, with community leaders, and with local partner NGOs. During our field research, we also focused on information sharing platforms and collected relevant documents for further analysis. These documents include maps, photos, newspaper articles, meeting minutes (logistics cluster and shelter cluster), data sheets, request forms, and white papers.

Our remote data collection consisted of follow up emails and Skype interviews. These conversations included follow up questions from interviewees for filling the gaps in our on-site collected data or for validating our analysis findings.

3.1.3. Qualitative data analysis

We used content analysis [46] for analyzing the collected data. First, in order to prepare all collected data for further indexation of keywords, we converted interviews to transcripts. Also, we added observation notes and other relevant data that was gathered before and during the field study. Then, we ordered all collected data by data source: interview transcripts, literature reviews, meeting minutes, field notes, white papers, newspaper articles, published initial reports, maps, and photos. Eventually, we categorized the data based on their relevance to logistics, coordination, and information management (initial themes of our field research). These groups of data shaped the basis for keyword indexation and further analysis.

Keywords for indexation were extracted from our research questions and results of a thorough review of the literature regarding risks in humanitarian contexts, i.e. our constructs. To extract data regarding in-country transportation risks in HSC downstream network, we focused on these keywords: distribution risks, delivery risks, last mile, network risks, transportation risks, shipping, truck, driver, pilot, human resource, outsource, logistics service provider, third party, partnership, access, road blockage, landslides, accidents, vehicles, fleet, delegate, navigation, map, loading, unloading, and labor.

We combined the open codes into themes distinguished by the most repetitive keywords. Relevant perspectives of the interviewees regarding the themes were extracted from transcripts, combined with other references and summarized to form a coherent narrative for each theme. By using frequency analysis [46], we were able to map out our collected data and to compare our data sources. Accordingly, we could check the consensus between them (literature and practitioners). Indeed, we decided regarding whether to include or exclude findings in our research based on the availability of sufficient field data for verification. Eventually, key findings regarding how LSPs helped HOs to handle their challenges were categorized according to each category of identified transportation risks.

3.1.4. Validity and reliability

To check the creditability of our qualitative data, we basically followed Guba and Lincoln [47]`s approach and only checked for validity: “since there can be no validity without reliability, a demonstration of the former [validity] is sufficient to check validity and reliability.” In this regard, as Fig. 2 shows, two researchers looked for the convergence between our combined data in each theme. For solving conflicts, we checked data sources again: we reached the relevant interviewee(s) and/or we checked our data through online sources. Eventually, no conflict remained unsolved.

3.2. Risk grid and online questionnaire

We used the structure of the well-known five-scale risk evaluation

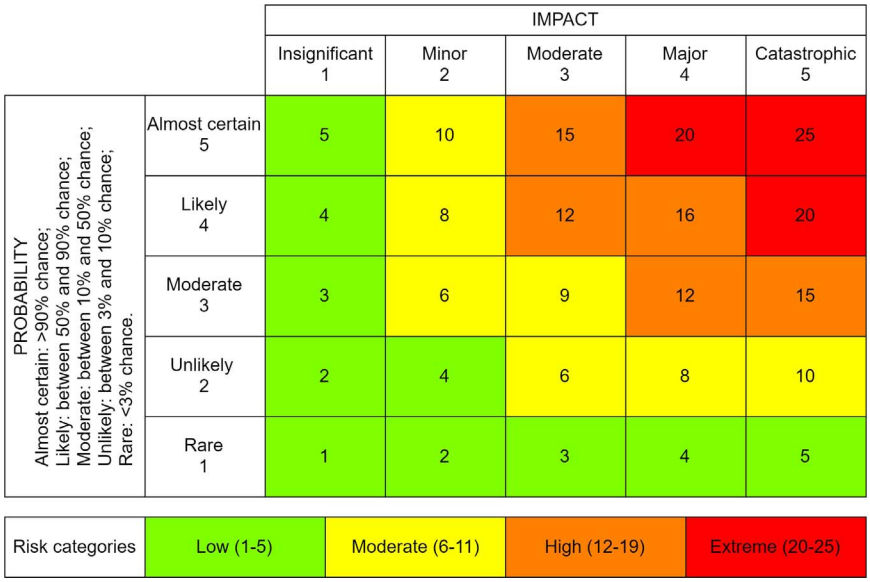

Fig. 3. Risk assessment matrix.

grid [11], as shown in Fig. 3, to assess risks with respect to impact and probability. We derived our probability evaluation grid from similar studies in the literature [48]. However, we developed impact measurement grid in close collaboration with humanitarian logistics experts. Two rounds of group discussion were organized (through Skype) with 4 experienced logisticians from different HOs (UNWFP, Medair, IFRC, CARE) to distinguish thresholds for impact levels (insignificant, minor, moderate, major, catastrophic). In this regard, three criteria were considered:

- responsiveness, as measured by response time: the time with which necessary relief goods or services (including medical services) are delivered to the beneficiaries;
- efficiency, as measured by cost: the financial expenditure of delivery operations;
- and effectiveness, as measured by coverage: the percentage to which necessary relief goods or services (including medical services) are delivered to the beneficiaries.

Eventually, the impact evaluation grid was defined as presented in Table 1. For the risks that may get two different scores for impact (based on their impact on different criteria), practitioners recommended using the higher impact score.

Using the risk grids and equivalent values, the overall risk score is calculated by multiplying risk impact and probability. In order to get values for risk impact and probability, we prepared an online questionnaire and sent it to eight humanitarian logisticians with experience in four or more response operations to fill in our questionnaire. At the time of this research, they were working at WFP, Oxfam, IRW, WVI, Cordaid, UMN, Humedica, and Handicap International. The response rate was 100%. The questionnaire consisted of an explanation of the assessment process, definitions of risks, definitions of our risk grid elements, and questions. Within the questions, we asked respondents to select the most corresponding score for each risk. Since different respondent could have distinct preferences regarding the scores, we calculated the mean value for each risk to reach overall values.

Having the overall risk scores, we could establish four risk categories [48], as depicted by different colors in Fig. 4: low (1–5); moderate (6–11); high (12–19); extreme (20–25). For instance, if a risk has the time impact between two and five days, and its probability can be estimated by moderate, its score becomes twelve and it belongs to the high-level risks category.

4. Results

4.1. Transportation risks in Nepal response

Table 2 shows the transportation risks that are identified from analyzing the interviews and meeting minutes for the Nepal response. Geographical characteristics of Nepal, as well as the weather after the 2015 earthquake, provided many challenges in transportation for HOs. Interviewees stated that the situation after the second major earthquake became worse. They highlighted that raining season (monsoon) could trigger some issues that were uneasy to handle, like access and capacity

Table 1
Risk impact scales, their definitions, and thresholds.

Impact scale	Threshold
Not significant: minor problem easily handled by normal day-to-day processes;	no considerable impact on responsiveness, efficiency, or effectiveness
Minor: some disruptions possible;	responsiveness: time impact less than one day; or efficiency: financial impact up to US$100 K; or effectiveness: coverage impact less than 10%
Moderate: significant time and/or resources are required;	responsiveness: time impact between one and two days; or efficiency: financial impact up to US$500 K or effectiveness: coverage impact between 10% and 40%
Major: relief operations severely disrupted;	responsiveness: time impact between two and five days; or efficiency: financial impact up to US$1 m or effectiveness: coverage impact between 40% and 70%
Catastrophic: continuation of relief operations is at risk;	responsiveness: time impact more than five days; or efficiency: financial impact more than US$1 m or effectiveness: coverage impact more than 70%

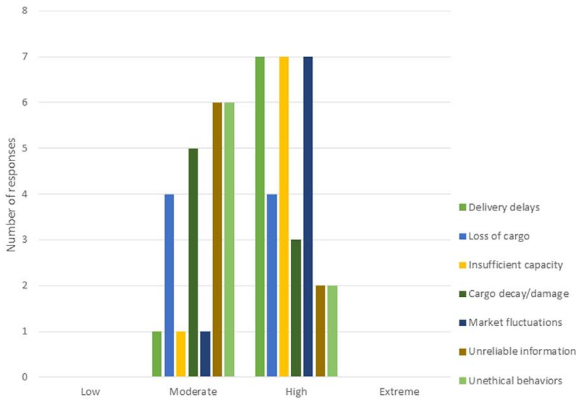

Fig. 4. Distribution of responses to risk scores.

Table 2
Identified transportation risks and their drivers.

Transportation risks in HSC downstream network	Main driver (s)
Delivery delays	Due to inappropriate weather conditions, traffic density, and infrastructure breakdown
Loss of cargo	Due to accidents, landslides
Insufficient capacity	Due to lack of transportation availability, capacity, and labor
Cargo decay/damage	Due to inappropriate transportation
Market fluctuations	Due to price increase in disaster settings
Unreliable information	Due to infrastructure breakdown, lack of sources, lack of technology use
Unethical behaviors	Due to lack of training in the context of humanitarian

issues. Also, they noted the mountainous location of the affected areas as the source of several risks that could bring many challenges to the process of delivering the relief items.

Furthermore, we found some evidence of problems with last mile delivery. We categorized these incidents into the loss of cargo and the cargo damage. In the first category, our observations show a rise in the rate of major accidents (ground and air) due to the increase in the traffic density, and the low level of experience or familiarity with Nepal geographical context [49]. In the other category, cargo damage, we found newspaper articles regarding the decay of some relief items (e.g. rice) due to inappropriate transportation, like exposure to rain and/or high humidity. In addition to economic (HO perspective) and social (beneficiary perspective) impacts, incidents in these categories caused problems for HOs` reputation, according to our interviewees.

Moreover, due to the increasing demand for truck transportation in the aftermath of Nepal earthquake, HOs faced some challenges related to transportation capacity. Our interviewees referred to problems (including delays and backlogs) related to transportation availability or capacity. We observed that some HOs spent at least one and a half day to procure transportation fleets for each delivery. Also, high demand for transportation resulted in 40% price increase according to interviewees. However, HOs that had pre-established partnerships in Nepal (UMN and UNWFP) expressed fewer problems with respect to capacity and price change.

We also found evidence that HOs faced information related problems such as limited access to reliable/up-to-date information, information systems, and technologies.

> *"So, to a large extent or to some extent it is possible for anybody to get information about what was possible. It was…once or twice that people said, "Well this path is open now and that path is not open," but to verify this [information] it's quite difficult. You need to verify when you're trying to use it. You can waste several days taking goods on a path that doesn't exist [anymore]! So, I mean it's a pretty big risk unless you had confidence that the source of the information was a good source. (23.06.2015, WVI, Kathmandu)"*

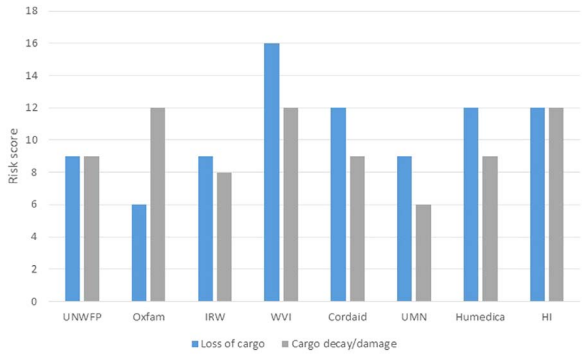

Fig. 5. Detailed overview of responses to risk scores for loss of cargo and cargo decay/damage.

We observed that people in the field needed more training for the effective use of information systems and technologies in constrained contexts. We also observed a lack of using tracking and monitoring systems for transportation due to constrained access to required equipment and lack of trained drivers.

4.2. Risks prioritization and used techniques

Fig. 4 shows the distribution of responses after assessing identified risks. As this figure depicts, the majority of respondents often had similar opinions regarding risk categories, except for "loss of cargo". Also belonging of "cargo decay/damage" to either moderate- or high-level category was marginal. Fig. 5 shows the divergence between final choices of our respondents for these two risks. We calculated the mean of responses for these two risks. Eventually, both "loss of cargo" and "cargo decay/damage" are categorized as moderate-level risks.

Table 3 shows prioritization results after calculating scores` means. Not surprisingly, all risks could be categorized as either moderate or high. This confirms that transportation risks threaten relief operations significantly. Also, having identified no risk in extreme and low levels, we refer to the limitations of our field study (the number of key informants, focus on the distribution network, problems with scales, etc.).

According to our interviews, we found three strategies that practitioners were using to deal with afore identified risks, as shown in Fig. 6. As this figure shows, we could not confirm the use of avoiding strategy for transportation risks in Nepal. This may refer to our focus on interviewees with operational positions. Also, we distinguished considerable concentration on co-operating & transfer technique that covered four identified risks. Given categories and number of related risks (two moderate and two high), this shows the significance of cooperation in humanitarian response contexts. In the next section, we explore the role of LSPs accordingly.

4.3. Logistics service providers and transportation risks in Nepal response

During the Nepal response, international HOs depended on the local

Table 3
Categorized risks.

Risk category	Identified risks
Extreme	–
High	Delivery delays; insufficient capacity; market fluctuation
Moderate	Loss of cargo; cargo decay/damage; unreliable information; unethical behaviors
Low	–

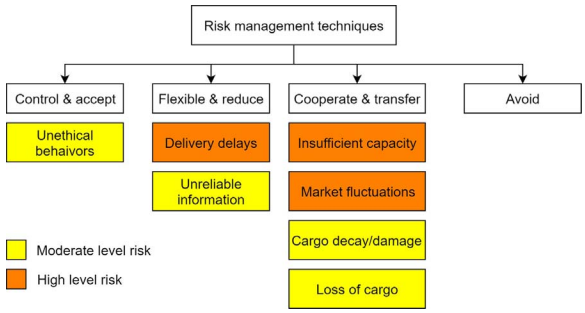

Fig. 6. Identified risks management techniques and relevant risks.

NGO community, commonly referred to as implementing partners, for distribution of relief items to the beneficiaries. According to interviewees, NGOs with a proven track record and an extensive local network and knowledge were preferred as they can ensure timely and widespread territorial coverage in the distribution phase. The government of Nepal obliged HOs to identify and outsource the relief items distribution to an implementing partner. However, the transportation of relief items remained as a significant challenge for HOs.

The majority of the severely affected people were difficult to reach [50]. Transporting relief items to these locations demanded access to different transportation modes, air/ground, and reliable real-time information depending on these modes, e.g. road condition for trucks or weather condition for helicopters. Many participants stressed the difficulty of procuring and managing a fleet in the immediate response. Others stated that the management of heterogeneous fleets is a common challenge. Participants noted that within a few days after the earthquake, they found hiring a commercial carrier to manage the details of most of the transportation might be the simplest solution. Within this approach, HOs could take over at final destinations to distribute to beneficiaries. Given the above explanation, we illustrate the main outcomes of using LSPs in Nepal through with respect to identified risks.

Those HOs who did not have fleets in Nepal had to either transport their fleets to the region, hire individual drivers with trucks, or use LSPs to take over their transportation. Transporting fleets to Nepal was declared "inefficient" with respect to "required fleet volume and variety" (WVI and IRW representatives), "local transportation opportunities" (UMN and Oxfam representative), and "required time for shipping" (Cordaid representative). Only some UN agencies, UNOCHA, UNICEF, and IFRC imported a number of light field vehicles from neighbor countries, like India, for transporting staff, need assessment trips, and medical kits delivery.

Hiring drivers with trucks brought challenges for some HOs. According to IFRC and UNWFP representatives, some drivers/truck-owners refused to drive to remote areas and hence, a further market search was required to find new drivers or trucks. This postponed some relief deliveries significantly (IFRC and Canadian Red Cross representatives). Some of the interviewees highlighted that safety of drivers was paramount and having an accident during relief item transportation was a real concern. Some potential strategies for safety produce additional challenges. For instance, UMN representative mentioned that they were not able to provide the relief items to an affected area because the region was at risk of landslides. This participant noted that since this threat could endanger driver's life, the operation was postponed. The same experience happened several times to the UNWFP when transporting relief items to mountains with helicopters, as a few accidents were also reported [51].

However, those HOs who let LSPs to take over in-country transportations not only escaped the challenges of previous groups but also could deal with transportation risks effectively. Our interviewees mentioned that being mainly settled in Kathmandu helped them to have access to several LSPs. These LSPs were mainly active in tourist industry before the event of Nepal earthquake. Some HOs benefited from a number of LSPs instead of one. For instance, during the Nepal response different UN organizations lead distinct clusters like the UNWFP in the logistics cluster. Therefore, and in theory, the WFP acts as the main LSP for other UN organizations, like UNICEF, or even other HOs, like WVI.

Those HOs who had signed contracts with commercial LSPs for in-country transportations were not influenced by fluctuations in the transportation market. Due to several reasons (demand increase, lack of available trucks/drivers, fuel problems, etc.), transportations prices raised dramatically after the earthquake. However, most of our interviewees paid their corresponding LSPs based on terms and conditions in their contracts. In this regard, we observed the importance of having ready-to-use transparent contracts.

Our interviews show that LSPs played a complementary role to HOs within their logistics capabilities. Most of the interviewees noted they are not specialized in logistics and do not own any kind of fleet, trucks or warehouses. Therefore, the ability of an LSP goes beyond the ones HOs possesses regarding logistics. Additionally, participants pointed that when LSPs were in charge of logistics, decision-making process became rather decentralized, providing a significant advantage in daily operations management in HOs.

Another benefit of incorporating LSPs, according to interviews, was to use their knowledge of the region. When drivers know the area but the HO does not, there may not be enough information to make detailed routing plans for vehicles. Some interviewees described difficulties in making deliveries across rough terrains and preferred using a combination of small capacity all-terrain vehicles and less flexible larger trucks to adapt to damaged infrastructure. Another participant cited limitations in its routing because of both infrastructure damage and danger traveling in areas with risk of landslides. Therefore, interviewees explained that LSPs were able to provide them with their required fleets when they were needed. In addition, since LSPs maintained several connections in different regions (for instance with police stations), HOs benefited from these existing relationships in their transportation operations.

> *"Our LSP have a good connection with every part of the country. In Pokhara they have their own office; in Chapang they have their own office; In Dhunche they have regular transportations … So they can call the locals and know about the road conditions and every other thing that we want. We can call them in advance and ask like road is ok or not? Sometime there are landslides in Dhunche and first we have to know the road conditions and other related things, so I do that before the departure…on the highway they also know all the police stations… we cannot work if we don`t have any connection. (22.06.2015, Canadian IFRC, Kathmandu)"*

Commodities in disaster relief can be many different types of goods, such as food, medications, or tents. Participants noted that they easily solved the problem of specific transportation requirements for some items with LSPs. For instance, the vehicles for transporting shelter items were different with the ones for specialized medicine or medical equipment. In addition, we found that the safety of the vehicle was included in the contracts, and it was based on the type of relief items being carried. In these contracts, the LSP had the responsibility for the safety of the cargo, such as its safety against accidents.

The risks of accidents and unexpected events while on routes, e.g. landslides, were considerable in Nepal response, according to interviewees. Especially in the beginning of raining season, the accessibility of roads was changing constantly and unpredictably. Lack of technology-equipped trucks in Nepal and lack of mapping systems with updated information were a big challenge for transportation and required discovering the best routes by driving and exploring. According to interviewees, LSPs had access to several contacts in the region and could ask them about updated information on the roads. Therefore, they could minimize risks for delivery delays and accidents as far as possible.

Table 4
Summary of key findings regarding the impact of LSPs on each transportation risk.

Identified risk	Risk category	Impact of using LSP
Delivery delays	High	Improved fleet allocation, scheduling, and routing due to their expertise in logistics;
Loss of cargo	Moderate	Improved safety and security of cargo due to tracking and monitoring technologies;
Insufficient capacity	High	Providing access to variety of fleets and experienced drivers;
Cargo decay/damage	Moderate	Providing appropriate cargo transportation with respect to the cargo and/or HOs` requirements;
Market fluctuations	High	Enabling constant prices according to contract terms and conditions regardless of improved prices in the market;
Unreliable information	Moderate	Enabling wide access to contacts and reliable sources in the region and/or country;
Unethical behaviors	Moderate	Providing access to professional and trained human resource;

Table 4, summarizes key points of this section.

5. Suggestions of propositions

Although this research is of Nepal earthquake responders, our observations and findings of in-country transportation risks in HSC also provide general indications for other sudden onset natural disasters. Our rationale refers to, first, the existence of several common characteristics in relief operations contexts after sudden onset natural disasters. Second, our interviews encompassed organizations of many different sizes, capabilities, and infrastructures that work in various regions worldwide. And third, the context of Nepal entailed several challenges (aftershocks, landslides, landfalls, floods, monsoon season) for HOs and their supply chains. Hence, any robust solution that could deal with these challenges can be one of the best practices for future relief operations. In this section, we will discuss the implications of our findings in three propositions for the use of HOs and their decision makers.

The first proposition concerns transportation risks that threaten relief operations in the response. Our interviews show that not all of logisticians (practitioners) were aware of and experienced in dealing with such risks. Although risk management and related approaches have been widely discussed in both commercial [12] and humanitarian literature [2], we observed the lack of related knowledge regarding risk management strategies in the field.

The existence of this gap can be discussed and proved within two points. First, we combined several coded transcripts from various interviews to reach our list of transportation risks that is shown in Table 2. Most of the participants refer to the risk of delivery delay due to the threats to the reliability of the transportation network and did not mention the others, though they were highly exposed to them. However, one might expect HOs pay attention to all these risks because most of them are already noted in the literature under different risk management frameworks (for instance in [2,4]). Second, our interviews show that practitioners were struggling a lot with ambiguity in the availability of vehicles, their capacities and changing road conditions. They put much efforts and finance to respond to disruptions, as the results of those risks. For instance, we found that, except the risks of losing cargo and unethical behaviors of drivers, all respondents experienced delivery delays, lack of sufficient capacity for transportation, food-items decay, and missing reliable information during planning.

We found that an excess of relief goods that have to be distributed within the constrained shipping capacity, bottlenecked transportation pipelines and infrastructure as well as delays and breakdowns in the supply delivery process, are only a few critical issues of HSCs [52–54]. HOs are highly threatened by delivery delays and market fluctuations in downstream. Also, they are exposed to moderate-level risks related to missing information, cargo decay, and loss of cargo. In return, HOs are cautious in planning their routes because of the physical safety of drivers, variations in routing and distribution times and difficulty reaching remote and rural beneficiaries.

From our observations and interviews that we made in our field research, and the survey regarding the risks` impacts, it is concluded:

P1. In-country transportation risks threaten the performance of response through moderate and high categories.

The second proposition relates to impacts of using LSPs in HSCs. Either by reinforcing the response capacity [21], improving disaster preparedness skills [55], or by supporting the humanitarian sector with their best practices from commercial settings [56] LSPs can bring solutions for several challenges and issues of HOs. However, very few HOs delegate their logistics activities to LSPs [33].

Our observations and interviews revealed other benefits as well; finding qualified employees, managing funds, deploying assets, and locating facilities in disaster settings. Our findings support similar research studies in the literature: learning opportunities for humanitarian and commercial sides [34], improvement of the efficiency and capabilities of humanitarian logistics [5,31], and enhancement of coordination and decision-making in HSCs [25]. Although some of these benefits can be reached by hiring local commercial drivers, however, the concept of LSPs are much broader.

Beside the above positive impacts, in the few experiences of participants, they pointed to the positive influence of using LSPs in the scope of risk management. This became more apparent when our participants categorized in-country transportation risks as moderate- and high-level risks. Given the possible disruptions as a result of such risks, HOs either transferred them to LSPs or reduced their probability by improving HSC flexibility with the use of LSPs. Our analyses show that by using LSPs, transportation risks can be transferred or reduced effectively.

In this regard, LSPs improved HOs access to a wider logistics capacity, the variety of fleets, the up-to-date tracking technology, and enhanced cargo safety (due to better transportation). They changed the often centralized operational decision-making in the field [57] to a rather decentralized one providing more flexibility in the daily management of relief distribution. Furthermore, LSPs are more familiar with the affected area from several perspectives. Exploring the tradeoffs of different routing behaviors helped HOs to improve delivery quantity while maintaining a high level of safety. In addition, since natural disasters are also information disasters [58], LSPs access to extensive network brought reliable information to HO. Although we observed the lack of technology-equipped fleets, we found that LSPs used their knowledge about environment effectively and also shared them with each other. Moreover, due to the familiarity of local LSPs with geographical characteristics of Nepal, their partner HOs experienced fewer disruptions due to accidents and inappropriate cargo transportation.

With respect to our risk assessments results and the analysis of risks management strategies, we suggest that:

P2. Using LSPs is an effective approach for HOs to transfer and to reduce some high- and moderate- level in-country transportation risks.

The third proposition reflects our findings regarding the whole performance of HSC. in addition to afore advantages that HOs achieved regarding managing in-country risks, our interviewees admitted that LSPs helped them to “bypass some challenges with local government policies, like customs control”. Moreover, our analyses confirm that using local LSPs not only helped local communities (e.g. supported local economy) to become more resilient [33,59], it improved the relief

operations in terms of the coverage, delivery time, and operations costs [38].

Our analyses also show that HOs often kept a minimum level of coverage (80–85% of estimated households) in their relief distributions during Nepal response. However, their main concern was to maintain optimized performance regarding responsiveness and efficiency. In this regard, we observed that those HOs who used LSPs showed better performance in these criteria. We confirmed this observation by first, assessing possible impacts that in-country transportation risks could have on effectiveness, efficiency, and responsiveness. Second, we showed how HOs managed those risks by using LSPs.

Indeed, using the capacities and capabilities of LSPs bring two main advantages to HOs. First, HOs will have the opportunity to transfer some operational risks to LSPs because they have more experience and expertise in managing logistics. LSPs assisted HOs to reach more beneficiaries (coverage), to decrease delivery time and delays (response time), and to drop the chance of being affected by price change in transportation market (costs). Second, LSPs improved HSC flexibility with providing more reliable and updated information, enhanced decision-making, better tracking and monitoring, and access to a variety of fleets. Therefore, LSPs play a significant role in improving the HSC performance.

P3. Using LSPs implies performance improvement of HSC in response with respect to flexibility, efficiency, effectiveness, and responsiveness.

Considering above three research propositions, we highlight our contribution within two points. First, we empirically confirmed positive impacts of using LSPs, as “tools” [25] for managing in-country transportation risks. Second, given previously studied roles for LSPs in HSCs (members, tools, actors) [25], our research shows that LSPs can also be “contributors” to performance improvements. This role shows the positive influence of LSPs on HSC performance which helps to justify the cost of their services.

5.1. Implications for theory

We shed light on the significance of using LSPs for in-country transportation in humanitarian response. Having studied the role of LSPs in managing transportation risks within a real case, we empirically confirmed their role as “tool” in HSC. We think moderate- and high-level transportation risks can be reduced by or transferred to LSPs due to their expertise in logistics, experience in shipping, and access to technology with a reasonable cost.

Our study also shows another role for LSPs in HSC; “contributors”. According to Bealt, Fernández Barrera and Mansouri [33], LSPs are considered less appropriate for response rather than preparedness. While the criteria for appropriateness are not clearly discussed in the afore paper, our empirical study shows that LSPs play a significant role in improving the HSC performance in response. Our criteria include flexibility, effectiveness, efficiency, and responsiveness. Using LSPs not only results in improvements in HSC flexibility with respect to much broader logistics expertise and better access to information, but also enhances relief coverage, costs, and delivery time.

Our research has other implications for theory as well. First, while our findings support the positive impacts of LSPs on HSC performance, research toward what criteria must be considered for selecting and cooperating with LSPs in humanitarian contexts is missing. Practitioners also require some practical key performance indicators in order to be able to evaluate such cooperation before starting the next mission. Second, with respect to transportation risks that threaten disaster relief operations, humanitarian context needs more empirical research in both upstream and downstream part. In downstream, the scope of our research, since we could not find any risk in low- or extreme-level, we think this shows that our scale needs more verification.

5.2. Implications for practice

As the main implication for practice, our research suggests a systematic use of LSPs in disaster relief operations. However, before commencing such cooperation (in terms of partnerships or other concepts) some challenges have to be considered: differences in mandates and/or goals, differences in working rhythms, culture, and individual perspective [31], limited resources for developing partnerships [60], field problems for commercial partners [61], different perspectives of affected communities, and lack of key performance indicators for LSPs in humanitarian contexts.

Accordingly, the inclusion of commercial LSPs in cluster systems may bring some coordination challenges as well. Our field research shows the effective role of UNWFP as the main humanitarian LSP in the logistics cluster during Nepal response. It improved the coordination and the flow of relief distribution efforts through the cluster system [59]. However, since commercial LSPs do not have to follow the humanitarian principles, practitioners needed other mechanisms to ensure that they are adhered to. As a solution, we observed that the role of commercial LSPs in Nepal response was mainly limited to the first category (very few in the second category); asset-owning logistics companies that perform physical logistics tasks.

Furthermore, our research suggests improving the HSC flexibility to reduce being disrupted by risks. In this regard, different supply chain strategies can be adapted to improve flexibility. While one approach toward this improvement can be the systematic use of LSPs, other approaches also need consideration; as Baharmand, Comes and Lauras [18] suggest incorporating decision support systems (DSS) and information and communication technology (ICT). The former can assist the critical decision-making in chaotic and complex environments, like the aftermath of disasters, regarding optimum use of capacities [16]. The latter provides several opportunities for tracking and monitoring systems that can avoid risks regarding cargo delays, losses, and damages [16].

6. Conclusions

Despite positive impacts of using logistics service providers (LSPs) in commercial supply chains, LSPs` role in humanitarian contexts is still marginal [6]. In this regard, recent surveys reveal the lack of field grounded research regarding the outcomes of using LSPs in humanitarian supply chains (HSCs) [25,38,62]. Our empirical research aims to address this gap and studies the role of LSPs in managing in-country transportation risks in disaster relief operations.

Having conducted a field research after the 2015 Nepal earthquake, we found seven transportations risks during Nepal response. They are delivery delays; insufficient capacity; market fluctuation; loss of cargo; cargo decay/damage; unreliable information; and unethical behaviors. We then categorized these risks by developing a risks assessment grid in close collaboration with practitioners. Our results show that delivery delays, insufficient capacity, and market fluctuation were high risks in Nepal response while the others belonged to moderate risks. Further analysis of our qualitative data shows that Nepal responders mainly used reducing and transferring techniques for dealing with identified risks. In this regard, we could study the role of LSPs in each technique according to our Nepal field research.

According to our interviewees and the experiences that they shared with us, we found that using LSPs implies several improvements in HSCs. As as result, LSPs can be “contributors” to performance improvements as well as “member”, “tools”, and “actors” in HSCs. Our findings highlighted the role of LSPs in providing a wide range of transportation means, especially trucks for Nepal case. Also, they played a complementary role to HOs within their expertise and experiences with logistics, specifically for transportation. Furthermore, LSPs` wide access to contacts among authorities could provide updated and reliable information for HOs. Involving LSPs for operational

decisions, enhanced scheduling, decreased delivery delays, and fosters HSC responsiveness. Moreover, LSPs could offer experienced drivers that decreased the risks of road accidents, cargo damage, and unethical behaviors. In return, using LSPs helped the local economy since the tourism business, one of the main sources of outcome for locals, was severely disrupted after the Nepal earthquake.

Our research indicates implications for both theory and practice. In the former, we highlight two dimensions: criteria for selecting LSPs and key performance indicators for evaluating them; and lack of empirical research regarding risk management in HSCs. In the latter, while our research suggests a systematic use of LSPs in disaster relief operations, we also highlight other supply chain capabilities that can help humanitarians to avoid risks in disaster contexts, such as flexibility.

Our research is limited from various aspects. First, our list of in-country transportation risks is not exhaustive in the context of humanitarian response to a natural sudden onset disaster and more research is required to study risks in similar contexts. Second, transportation risks may be studied in other contexts as well, like in conflicts that are far more complicated than natural disasters. Third, lack of finding low- and extreme-level risks in this research indicates that our scales for risks assessment require further verification. Fourth, managing transportation risks in humanitarian contexts should not be limited to using LSPs and future study can study other solutions as well given that all HOs are not able to use LSPs. Fifth, our research shed limited light on the improvements that can be achieved though enhancing HSC flexibility and hence, this requires further investigation. Sixth, transportation risks cover only one category of risks that threaten HOs in humanitarian response and studying other risks in this context helps to better plan and implement in risk management strategies.

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Appendix A. – Semi-structure interview protocol for Nepal field research

Interview Introduction

Introduce the research team and briefly outline the research mission's background, rationale, objectives and intended deliverables: We want to study the challenges in disaster response from different perspectives; logistics, information management, and coordination.

Go through the main elements of the interview (only logistics perspective).

▲ To be addressed when there is little time
▼ Address if time is available

Part 1: Information about the interviewee

- ▲ Role (in the response to the earthquake)
- ▲ Responsibility, task/job description, rotation
- ▲ Experience, training, background and daily job

Part 2 Information about the organization

- ▲ Objective, mandate
- ▲ Type and size of organization, size of operation, duration
- ▼ Network: formal and informal links to other organizations (local community groups,
  diaspora, other (I)NGOs, government bodies (regional, national, international)
- ▼ Relief team composition in Nepal

Part 3: Logistics processes and flows

- ▲ How is the structure of your supply chain (describe)? What logistics sources do you have?
- ▲ What is the state of logistics (transport capacity, hubs and warehouses, distribution centers)?
- ▲ What risks do threaten your logistics? How do you deal with them?
- ▲ What is the flow cartography? Where are the bottlenecks?
- ▼ How do you usually deploy your required logistics (place or transportation)?
- ▼ What characteristics do you usually consider when you are deploying them?

Part 4: Accessibility and priority

- ▲ Who decides where to go and what to deliver?
- ▲ How your targeted affected populations are reached?
- ▲ How do priority items are procured, and then delivered (how can these be improved)?
- ▲ What, if anything, limits access to the affected populations?
- ▼ How do you access very remote areas (How do you deal with constraints)?
- ▼ In your point of view, which areas are the most critical and what are the priority sectors (health, food, shelter, etc.)? How does this assessment affect your operations?

Part 5: Information and coordination

- ▲ What information is available for making decisions and what is missing (what do you know and what do you need to know)?
- ▲ What is the source of information and how accurate do you assess the available information from 1 (not accurate) to 5 (highly accurate)?1–5)?
- ▲ How do you verify information?
- ▲ What risks do threaten your information access? How do you deal with them?
- ▼ How is information shared? What products were useful / what problems were less useful?
- ▼ What type of ICT systems and products do you use in your organization?
- ▼ What gaps do you see in the information?

Part 6: Best practices

- ▲ How do you compare this disaster response with other deployments?
- ▲ What are the main differences or challenges posed in this specific disaster response?
- ▼ What did work specifically very well in Nepal deployment?

Interview round up

Explain that the combined insights and recommendations from the research mission will be shared with the respondent in the form of a short paper. Ask if the respondent can recommend other contacts relevant to the research project. Ask if it's okay to get back to the respondent in the near future with additional questions (if required).

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