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TOWARDS DESIGNING AND IMPLEMENTING AN EMPIRICALLY GROUNDED RESEARCH FOR HUMANITARIAN LOGISTICS AFTER NEPAL EARTHQUAKE

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ABSTRACT

Purpose

This paper proposes a research design for effective use of qualitative data from field research in a quantitative analysis of humanitarian logistics.

Design/methodology/approach

Our research design is composed of qualitative and quantitative components. The qualitative part has four steps: preparation, data collection, data combination and analysis, and interpretation. We triangulate qualitative data through semi-structured interviews, observations, document review, and online surveys. We use frequency analysis to map out qualitative data to themes that were identified through literature review and best practices. After combining data from various sources, we apply content analysis and then interpret the findings.

Findings

The results of implementing our research design for Nepal case show its effectiveness for capturing the complexities of and the relation between variables in disasters. Its workflow and research methods exclusively enable using field insights to test theories, inform models, and find field driven research directions. We demonstrate these findings through examples from our field research after 2015 Nepal earthquake.

Research limitations/implications (if applicable)

Limitations: our disaster field research was constrained by the typical short time to prepare/conduct the research, lack of access to key informant and, limited sample size. Furthermore, the results of our research are based on one case.
Implications: our research design resulted in an effective and a traceable use of field data for addressing challenges that practitioners were experiencing. Therefore, proposed research design can be adopted in future for conducting and empirically grounded research on HL.

Practical implications (if applicable)

Proposed research design enables developing field informed models that can be used as a decision support system in the immediate response.

Original/value

In this paper, we explicitly explain how we translated Nepal field work into a model and what the problems were in such settings.

Keywords: Humanitarian logistics, Field research design, 2015 Nepal earthquake.

1. INTRODUCTION

Natural sudden onsets disasters, like earthquakes, hurricanes, and floods, have hit the world frequently during the last decade. In 2015, two major earthquakes hit Nepal and affected roughly 5.5 million people, leaving nearly 9,000 casualties, and approximately 7.1 billion dollars in economic damages (Government of Nepal, 2015). In response to such devastating disasters, humanitarian organizations (HOs) play a significant role with their resources, expertise, and knowledge in alleviating the suffering of affected communities. Humanitarian logistics (HL) refers to processes, technologies, operations, and policies that are required to deliver aid and relief items to beneficiaries (Jahre et al., 2007). The effectiveness and efficiency of response depend on the performance of HL given disrupted infrastructures and volatile demand (Van Wassenhove, 2006). Discussions regarding critical challenges of HL, namely delivery delays, backlogs, losses, and duplications, have been among the hot research topics during the last decade (Baharmand et al., 2015).

Conducting research in the contexts of humanitarian logistics can be carried out by a variety of methodologies (Crum et al., 2011). Aiming at improving relief operations and assisting HOs, several scholars have studied HL problems from different perspectives providing solutions, tools, and systems based on models and simulations (Galindo and Batta, 2013).

However, as we observed in our field research after the 2015 Nepal earthquake, practitioners often express reluctance to use the corresponding outcomes. Indeed, their concerns and working conditions are often neglected by researchers and developers (Van de Walle and Comes, 2015). On the other hand, research that is groundbreaking from a theoretical point of view may also not be deemed valuable by HOs (Howden, 2009). Ultimately, delivering valuable research demands scholars continuously reflect upon, and in some cases, revise, the research approach to staying relevant to humanitarians without compromising methodological rigor.

Recent surveys in HL literature frequently recommend empirically grounded research to bridge the gap between HL research and practice (Galindo and Batta, 2013, Habib et al., 2016, Gutjahr and Nolz, 2015). One of the main challenges is to effectively incorporate the findings of qualitative studies in quantitative models.

HL literature lacks supporting theories regarding using empirical research for developing evidence-based models and satisfying their data requirements. Field studies in HL are often used for theory testing rather than model or theory building (for instance Van de Walle and Comes (2014)). Furthermore, our review (Section 2) shows that methods of currently conducted field studies in HL literature are not documented in a reproducible way. Thus, we see a gap between data collection and conclusions.

This paper aims at addressing this gap by illustrating how the authors use qualitative results from their Nepal field research to inform and adapt a location-allocation model. This article explains the barriers that we experienced before/during/after conducting such research, the methodologies that we incorporated into our study, and eventually in how far the data that we collected in the field informed our HL modeling.

The rest of paper is organized as follows. In the next section, we provide an overview of relevant literature. Our research proposal and its application to the Nepal case is presented in Section 3. In Section 4, we present the results of our analysis. In Section 5, we discuss the limitations and opportunities of conducting a research like our Nepal field research. Then, we conclude in Section 6 with implications for future research.

2. LITERATURE REVIEW

In this section, two literature streams are investigated: challenges in HL during response and empirical research in HL. For the first, we focus on HL survey papers that have been published within the last decade. For the latter, we complement our findings from the HL literature with papers from other contexts that discuss field research for theory building.

2.1. HL challenges in response and research requirements

Disaster response is characterized by high urgency and uncertainty (Pedraza-Martinez and Van Wassenhove, 2016). During relief operations, humanitarians often do not have the sophisticated information and communications systems, and they lack data analytics competencies of commercial companies. Operations may be under-resourced and staff poorly trained owing to high turnover levels (Comes and Van de Walle, 2016). Indeed, HOs often operate under strict resource and budget constraints (Van de Walle and Comes, 2015). As a result, humanitarians tend to focus on immediate action more than analysis.

Moreover, there are also typically a large number of humanitarian actors as well as many stakeholders including governments, the military, private business, donors, and obviously, the beneficiaries. Relief resources are frequently largely insufficient and time pressure is very high on decision makers in the field. All of these conditions are known to introduce a series of cognitive biases, make effective planning difficult (Comes, 2016).

Above characteristics indicate some guidelines for conducting relevant research on HL. First, the context of study needs to be clearly defined since the characteristics of disaster types (slow vs. sudden onset; natural vs. manmade) as well as phases in disaster life cycle are different (Baharmand et al., 2015). Second, in order to tackle complex humanitarian problems, they have to be studied from different domains and research perspectives. Third, due to limited access to reliable data and key informants, a researcher needs to combine different methods to triangulate results. Fourth, this discipline demands to work closely with humanitarians to stay focused on relevant problems that may yield impactful results. Fifth, impact requires empirical validation. And sixth, research in humanitarian context requires close collaboration between the different stakeholders, integrating them in cross-sector and cross-disciplinary teams. This appears to be the only way to bring all required competencies together and to increase the probability of acceptance of the solutions (Comes and Van de Walle, 2016).

Despite the afore requirements, literature has prioritized optimization models based on abstract problems that are not sufficiently grounded in empirical observations (Altay and Green, 2006, Galindo and Batta, 2013, Gutjahr and Nolz, 2015). Models are methodologically rigorous and deal with interesting technical challenges but often offer limited insights into practice (Pedraza-Martinez and Van Wassenhove, 2016). Failure to understand practice results in difficulties to establish a relevant theory for humanitarian contexts. Furthermore, most of these contributions do not respond to the constraints of time pressure, limited resources, high staff turnover, or limited funding (Laguna Salvadó et al., 2015b, Baharmand et al., 2015). Due to the gap between research and practice, not much progress can be seen in the field. Therefore, as analyses of Nepal case have revealed, humanitarian response is still suffering from inefficiency and ineffectiveness (Paul et al., 2016, Sheppard and Landry, 2016).

2.2. Empirical case study and its application in humanitarian logistics

According to Wacker (1998), empirical research methodologies use data from the external organizations to test the hypothesized relationships, primarily through an inductive approach. The empirical research is typically classified into three major sub-groups: empirical experimental research, empirical statistical research, and empirical case-study research (ECR)

(Wacker, 1998). ECR, the focus of our paper, often refers to case studies, field studies, or action research, and generally, is used to develop relationships within a limited set of data points. Its sample size is often kept small but with a large number of variables to identify new empirical relationships (Meredith et al., 1989). This type of study can be used to provide a description, to test a theory, and/or to generate a theory (Eisenhardt, 1989). A recent survey shows that ECR is the most common type of model informing and theory building exercise in HL research where it accounts for nearly 80% of the total empirical research output (Kovács et al., In Press).

Several papers in HL literature acknowledge the need for field research in disasters (e.g., Altay and Green (2006), Holguín-Veras et al. (2012a), and Kovács and Spens (2012)). The overall idea is to gain a deep understanding of the formal and informal structures in post-disaster HL and thereby, improve systems and tools. Gralla et al. (2014), for instance, examine the relevancy of decision criteria for fleet management in HL. Unlike the focus of most academic optimization models on costs, they find effectiveness as the primary concern of practitioners (Gralla et al., 2014). Or, Holguín-Veras et al. (2012a) reveal the need for keeping socio-technical perspective while proposing HL-related models for field-based decision makers.

A variety of research methods have been used in HL related field studies. Holguín-Veras et al. (2007) present their findings after 22 in-depth face-to-face and telephone interviews with "key organizational actors." Since their research commenced four months after Hurricane Katrina 2005, presented findings were only based on interviews (Holguín-Veras et al., 2007). In-depth interviews with key informants have also been conducted by Van de Walle and Comes (2014) in their field study after 2013 typhoon Haiyan. They also included field observations which were collected just 3-4 weeks after the disaster (Van de Walle and Comes, 2014). In addition to interviews, Zissman et al. (2014), used surveys to elicit data from responders. Powell (2011) shape discussion groups with responder community members during his field study and launch virtual survey and questionnaire afterward. In Holguín-Veras et al. (2012b) (2010 Haiti earthquake), Laguna Salvadó et al. (2015a) (Ebola crisis), Comes (2016) (2013 typhoon Haiyan), and Baharmand et al. (2016) (2015 Nepal earthquake), researchers incorporate the following in their field research: a timeline of concurring events, collecting and archiving relevant document for further review; interviews with responders at different positions within distinct organizations; and observations. Thus, the authors could validate information with external sources to ensure the validate the picture of post-disaster HL "practically".

Moreover, some papers propose multidisciplinary or interdisciplinary research designs to get a thorough understanding of problem characteristics (Van de Walle and Comes, 2014, Chan and Comes, 2014, Laguna Salvadó et al., 2015b) stemming from research on managing organizational crises. These authors propose that method and approach chosen in such research should be fit for multiple purposes, reflecting the complexity and diversity of the group as well as the strategic goals (Van de Walle and Comes, 2014, Chan and Comes, 2014). It is suggested that if data collection processes are aligned effectively, high synchronicity can be achieved by feedback mechanisms between the team (Comes et al., 2015). Chan and Comes (2014) discuss that trust and a shared understanding of the most relevant questions and issues are required along with the ability to flexibly adapt the research design if the realities of the field require so. Moreover, the individual level of experience – both in terms of research and field experience – need to be respected and integrated into the design (Laguna Salvadó et al., 2015b).

With respect to practical guidelines that researchers may require during their field research in disaster settings, we found some instructive papers. Chan and Comes (2014) highlight the significance of presence and engagement in the field during the study. Pedraza Martinez et al. (2010) provide a generic list of recommendations for empirical studies in humanitarian contexts. They suggest that researchers may first need to build trust by building understanding between their research aims and practitioners. Their other recommendations include: learning

the language of field workers; respecting the current expertise of them; being concise about the required information; attaining some knowledge about and from the field; contributing something in exchange; and sharing relevant results with field research participants (Pedraza Martinez et al., 2010). Also, Comes et al. (2015) depict the advantages of combining on-site field research with remote expert support during their multidisciplinary field study on 2014 Ebola outbreak, where this approach improved the performance of researchers on the ground.

2.3. Literature gaps and research statement

Presented review in Section 2.1 depicts existing challenges in HL and highlights the need for conducting empirical research in disaster settings, specifically on relief distribution networks. Accordingly, we review the use of ECR research in HL literature in Section 2.2, and extract informative guidelines for carrying out such study in disaster settings. However, our review reveals a missing part in HL literature related to this research design. Our reviewed papers usually describe research sites and data collection methods comprehensively. But, they give little space to discussion of analysis and how they combine their field findings, so a gap often separates data from conclusions. Hence, HL literature lacks theories that support using field research findings for model informing/theory building.

In this paper, we aim to address the gap between data collection and data analysis of ECR studies in HL literature. This paper explains how we use our field research after 2015 Nepal earthquake to inform our quantitative model for optimizing relief distribution networks.

3. RESEARCH DESIGN AND ITS APPLICATION ON NEPAL CASE

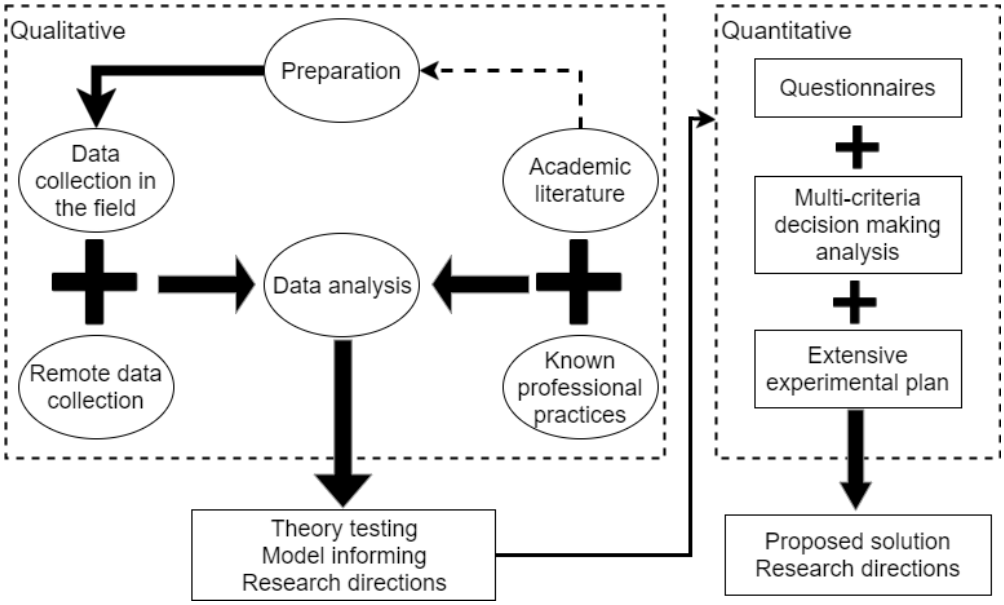

Figure 3.1 Research design (inspired by Laguna Salvadó et al. (2015b))

3.1. Research design

Following Laguna Salvadó et al. (2015b), our research aims to capture the details, sensitivities, and complexities of the field, see Figure 3.1. To this end, it is composed of two components, qualitative and quantitative, which correspond to research methods. Each component has a workflow. This paper demonstrates only the qualitative component.

Our research design in qualitative part starts with preparation step, which refers to defining research objectives and related research questions. In this regard, we gather results of literature

review and other relevant sources to define objectives (research questions) and to develop research protocols. Onsite and remote data collection, the second step, follow the prepared protocols in step 1 toward triangulating as much data as possible regarding the targeted objectives. The third step includes combining data from all sources (field, literature, best practices) and including them in data analysis. In the final step, fourth, the results of analyzing the data qualitatively and quantitively can be categorized as research directions, practices for theory building and model informing, and outcomes of theory testing. In this section, we explain these approaches through their application in our field research after the 2015 Nepal earthquake.

3.2. Nepal case study

On 25th of April 2015 and a mere 17 days later, Nepal was hit by two major class earthquakes, measuring 7.8 and 7.3 on the Richter scale, respectively. During 21-29 June 2015, just before the beginning of recovery phase, a multidisciplinary research group conducted a field study in Nepal. The primary objective of our field research was to study challenges and bottlenecks in HL, information management, decision-making in the field, and coordination during response.

3.3. Preparation

Preparations for the field research started in early May 2015, and consisted of six main parts.

i. Collecting of data (news, reports, maps, etc.) related to the situation to get an overview of the context and what to expect in the field;
ii. Developing individual protocols and guidelines for interview/observation based on individual research objectives. From the logistics perspective, the protocols aimed at identifying challenges and bottlenecks in relief distribution networks. The HL protocol included qualitative and quantitative questions regarding processes, technologies, operations, and policies. Table 3.1 shows some questions with respect to each aspect;
iii. Developing the multidisciplinary perspective, several remote meetings were organized through Skype. In these meetings, the overall mission was defined;

Table 3.1 Included questions in HL related interview protocol

HL aspect	Related question
Processes	How corresponding HO organizes its distribution network; How often they modify the network;
Technologies	What technologies corresponding HO uses for different logistics components; How far they are engaged with using technologies in warehousing, shipping items, etc.;
Operations	How corresponding HO manages the warehouses; How they manage transportations;
Policies	What criteria corresponding HO considers for establishing relief distribution networks; What collaboration policies (with other HOs) do they follow;

iv. An early stage conceptual model of HL, illustrated in Figure 3.2, was developed before the trip. This conceptual model was prepared based on a literature review and available information that we found on online resources like ReliefWeb, LogCluster, and StandByTaskForce. It was the basis for investigating the relief distribution network during the immediate response in Nepal. The objective was to validate this model by field findings and then, populate the analytical version of it with data that we collect;

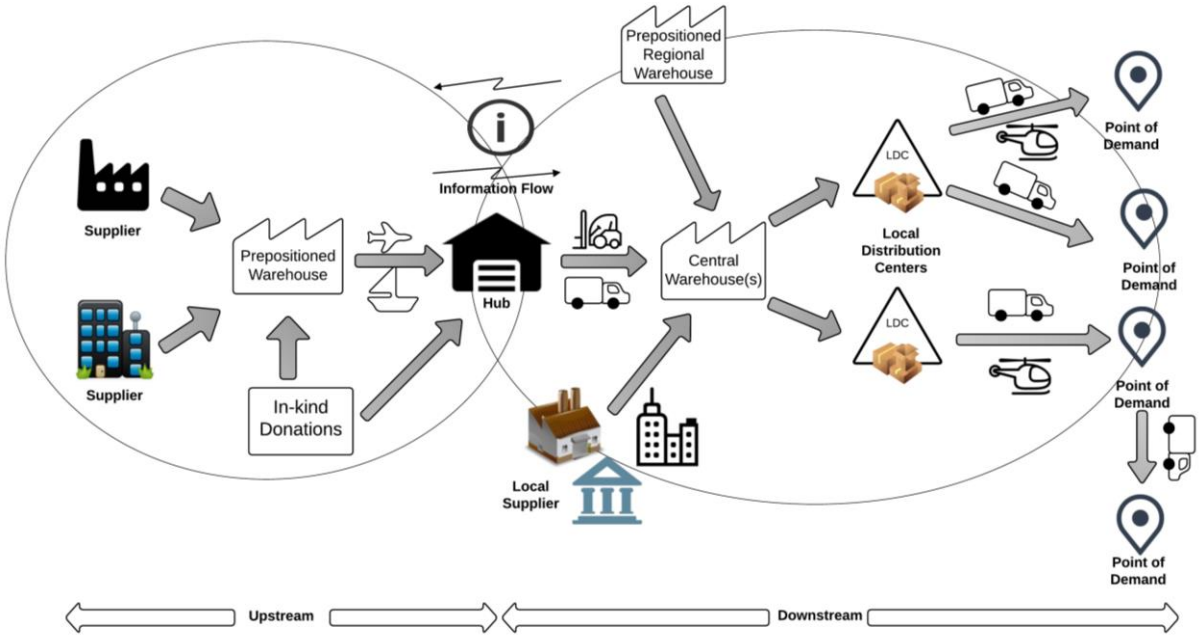

Figure 3.2 The early stage conceptual model for relief distribution networks in Nepal

v. Logistics: developing contact lists through our pre-established connections in local and international non-governmental organizations (NGOs) as well as UN-related organizations in Nepal. With respect to HL, the interviewee selection was done according to (1) expertise, experience, and background of the contact (logistics, information management, coordination) (2) responsibility in targeted organization and being involved directly in Nepal response (3) presence in Nepal during the field study. Our initial list was filled with names of logisticians or country managers collected from online resources, mainly ReliefWeb, Humanitarian HDX, and LogCluster.

vi. We also established a remote expert team that was composed of senior researchers who supported field researchers. The expert team provided their inputs regarding improving data elicitation progress, finding relevant contacts in the field, and organizing field trips.

3.4. Data collection

We carried out our on-site data collections in Kathmandu, Nuwakot, and Rasuwa districts in close collaboration with local agencies. As shown in Figure 3.3, we focused on severely hit districts. Our study involved informal and semi-structured in-depth interviews, observations, and accompanying practitioners in different relief operations during response. We primarily conducted 31 interviews with key informants based at multilateral agencies and iNGOs. Among them, 16 interviewees were logisticians. Furthermore, we complemented our field interviews and observations with data collected through online sources (such as minutes from cluster meetings, maps, and white papers) and articles of local newspapers.

Experts based at the following organizations contributed to our research during our field visit:

- Multilateral agencies: UNOCHA; IOM; WFP.
- Nepali branches of INGOs: Oxfam; Cordaid; IFRC; ICRC; World Vision; Handicap International; Islamic Relief; IsraAID; Transparency International; Finnish Evangelical Lutheran Mission; SOS Children's Villages; Humedica.

- Nepal based NGOs: Kathmandu Living Labs (KLL); United Mission to Nepal; Nepal Red Cross Society.
- Local government: Nuwakot and Rasuwa District Administration Offices.

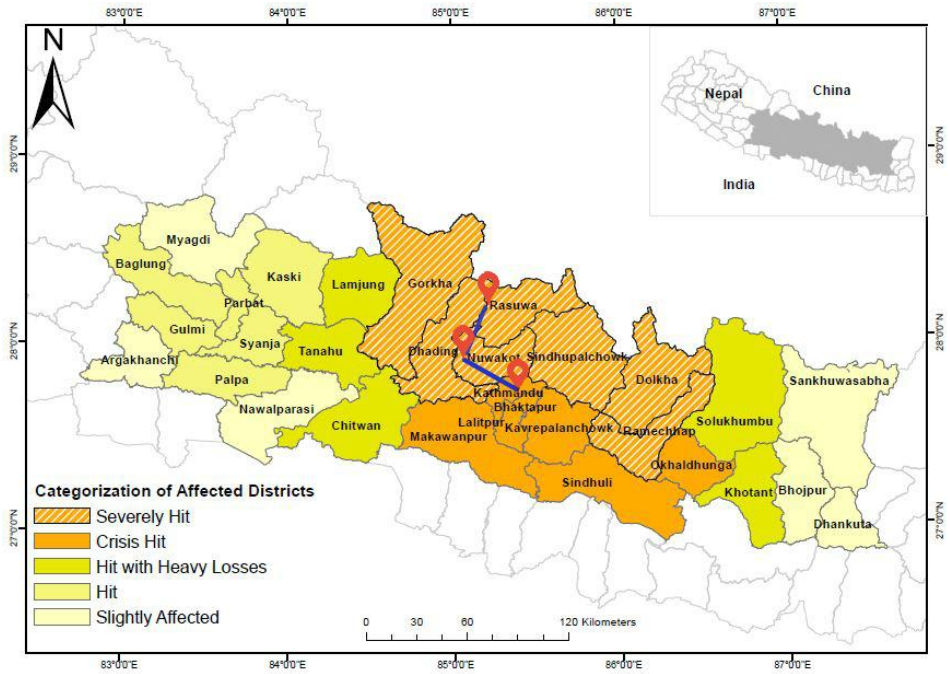

Figure 3.3 Affected areas by 2015 Nepal earthquake and our visits during field study (map from Government of Nepal (2015))

3.5. Combining qualitative data with other sources

One of the main objectives of conducting Nepal field research was to validate characteristics of our conceptual model for Nepal case and to populate the field driven model with evidence-based data. In our study, we incorporate the cross-case comparison which is common for theory building from qualitative studies (Eisenhardt, 1989). This approach ensures effective inclusion of field findings in any theory building and/or model development study while proposing demanding future research directions (Meredith et al., 1989).

Literature proposes some tactics for effective application of cross-case comparison. One tactic is to select categories or dimensions (derived from research questions or literature), and then to look for within-group similarities coupled with intergroup differences. Another tactic refers to selecting pairs of cases and then to list the similarities and differences between each pair. A third tactic is to divide the data by data source. Eisenhardt (1989) mentions the ability of the third tactic to exploit unique insights from different types of data.

Our research design applies the third tactic for cross-case comparison as illustrated in Figure 3.4. First, we converted interviews to transcripts. We also added observations notes and other relevant data, such as meeting minutes, field notes, white papers, newspaper articles, published initial reports, maps, and photos. Then, we divided the data by data source, observation data, interview transcripts, document reviews, literature reviews, etc. Lastly, we categorized the data based on their relevance to logistics, coordination, and information management. To avoid biases four researchers did the categorization manually and conflicts were solved under the supervision of a senior researcher. Overall, the resulted groups of data shaped the basis for keyword indexation and further analysis.

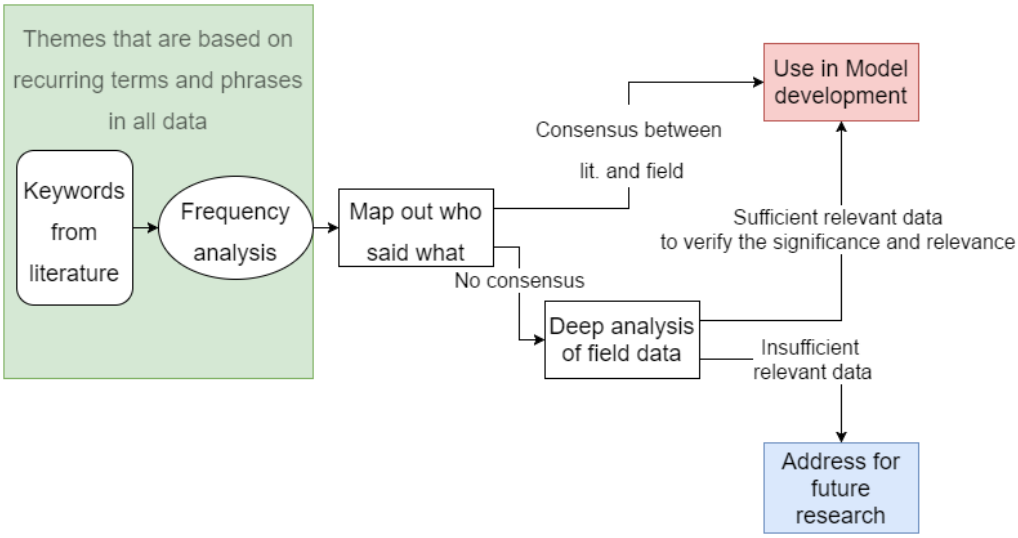

Figure 3.4 Schematic presentation of how we combined field findings with model development

Within the proposed tactic, when a pattern from one data source is corroborated by the evidence from another, the finding is stronger and better grounded. When evidence conflicts, we reconcile the evidence through deeper probing of the meaning of the differences. At other times, this conflict exposes a spurious or random pattern or biased thinking in the analysis. If after some iterations, we could not interpret the finding, we finally marked it for future research.

3.6. Data Analysis

From the detailed field notes that we wrote during our field study plus our cross-site tactics and overall impressions, tentative themes, concepts, and relationships between variables began to emerge. In this section, we explain the iterative process we applied to compare systematically the emergent frame with the evidence from each data source in order to assess how well or poorly it fits with Nepal case data. The central idea is that we constantly compare theory and data-iterating toward a theory which "closely fits" the data. As Eisenhardt (1989) highlights, "*close fit is important to building good theory because it takes advantage of the new insights possible from the data and yields an empirically valid theory*."

Following Figure 3.4, we used content analysis for analyzing our qualitative data. Keywords for indexation were extracted from our research questions and the results of extensive literature review depending on the topic of demanding research, i.e. constructs. These keywords were extracted after a thorough review of analytical models in post-disaster HL (Baharmand et al., 2015). 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. Eventually, the list and relevant topics shaped the categories of findings.

By using frequency analysis, we were able to map out our collected data and to compare our data sources. Accordingly, we could check the consensus between them. Indeed, we decided whether to include or exclude findings in model development based on the availability of sufficient data. If after some iterations, as explained in Section 3.5, we could not find convincing material (repetition among conversations/interviews, the significance among field-based decision makers, instances from observations, etc.) to support theory building from field driven proposal, we categorized the corresponding finding as a direction for future research. In the next section, we will explore the results of using this approach in three categories.

4. RESULTS

In this section, we categorize our findings based on proposed research design (cf. Figure 3.1): theory testing, model informing, and research directions.

4.1. Theory testing

Figure 4.1 shows a typical relief distribution network that we observed in Nepal response which is also validated by our data analysis. Comparing Figure 4.1 with downstream part of Figure 3.2, which was developed based on a literature review, one notices some structural differences between. These differences confirm that the structures of relief distribution networks are basically context-based and a general solution doesn`t exist, which is often neglected by HL scholars (Pedraza-Martinez and Van Wassenhove, 2016).

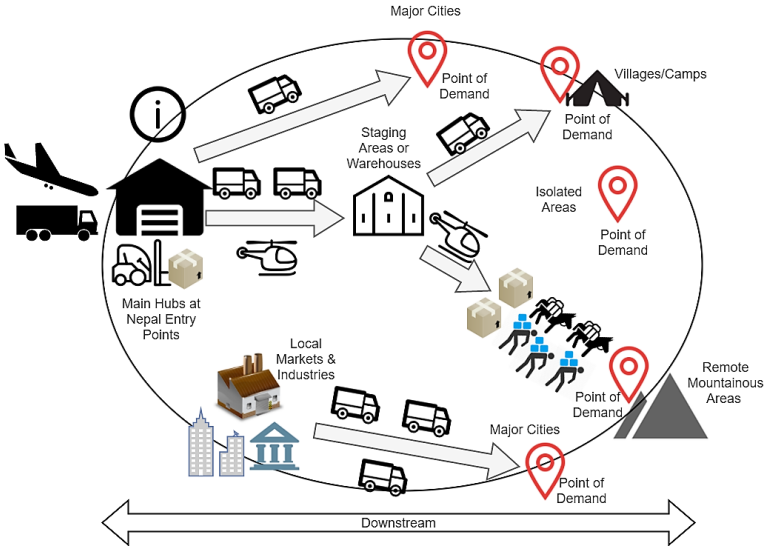

Figure 4.1 Revised conceptual model showing common downstream part of relief distribution networks in Nepal

Another major finding from data analysis refers to the flexibility of downstream networks. In this regard, HL scholars often assume that relief distribution networks are flexible enough for implementing suggested designs effectively. While we are still analyzing our related field findings, our primary results suggest a divergence between reality and this assumption. Having applied a field driven flexibility measurement framework on downstream networks of seven interviewed HOs in Nepal, we measured low degrees of flexibility in 90% of studied organizations. Therefore, our analyses indicate that it is necessary to consider measuring network flexibility in humanitarian supply chains before suggesting agile or resilient network designs given that these designs basically depend on flexibility (Charles et al., 2010, Maria Jesus Saenz et al., 2015).

The next finding in this category refers to the impact of collaboration and outsourcing on the performance of humanitarian logistics during response. In this regard, HL literature suggests the relevance of incorporating logistics service providers (LSPs) in humanitarian contexts as they are referred as best practices in commercial logistics (Jafari, 2015). However, empirical studies that support this suggestion are rare (Heaslip, 2015). During our field study, we observed the constructive role that LSPs can play to mitigate the transportation risks during relief distribution operations. Therefore, our analyses propose the systematic use of LSPs to improve the disaster response performance.

We found pieces of evidence in our collected data that downstream networks in the field were mainly configured by experience and use of simple calculations with papers and printed maps. Besides, we observed several duplications, delivery delays, and unmet demands during our field trips which revealed inefficiency and ineffectiveness of distribution networks. In this regard, as HL literature suggests, equipping field-based decision-makers with effective decision support systems (DSS) that benefit from realistic models is of great advantage (Anaya-Arenas et al., 2014; Galindo and Batta 2013).

4.2. Model informing

In line with our theory testing results, we aim to develop an analytical model to assist the afore decision-makers in critical location-allocation decisions in immediate response. In this regard, our analyses show that any developed DSS and included model must be able to work effectively in critical situations, as after a sudden onset disaster, and should not require deep knowledge for carrying out basic modifications. It also needs to be compatible with those applications that practitioners are used to using in disaster settings, like Excel sheets.

Our findings also informed our model`s data input, assumptions, objectives, and constraints. Regarding the use of deterministic or stochastic data modeling, we found that field-based decision makers in Nepal basically relied on deterministic data, such as the latest census report for estimating the demands in affected regions. Also, we were informed that our model has to consider more than one criterion because our respondents often mentioned more than two criteria for HL related decisions. However, their main challenge was to transparently deal with tradeoffs between these criteria given limited resources, expertise, and access to all stakeholder. Furthermore, observed some decision support tools that were useless in the field mainly because their models were not developed appropriately. Hence, we were informed that models for relief distribution networks must be flexible (in terms of underlying parameters and elements) to be able to cope effectively and efficiently with the context of affected region.

Since presenting our field-driven location-allocation model is not the notion of this paper, Table 4.1 summarizes how far this model differs from the existing models in HL literature.

Table 4.1 Characteristics of our location-allocation model with respect to HL literature

Model elements	Existing location-allocation models in HL literature for immediate response	Our location-allocation model for immediate response in Nepal
Data type	Both deterministic and stochastic	Deterministic
Assumptions	Often not justified and basically just assumed	Justified and evidence-based
Problem type	Mostly single criteria + static	Multi-criteria multi-modal + dynamic
Decision criteria	Often effectiveness, efficiency, responsiveness, or a bi-objective combination without justification	Four decision criteria per field findings: effectiveness, efficiency, responsiveness, and fairness
Multi-objective modeling approach	Often converting multi-objective to single objective through weighted approach without	Combining multi-attribute value theory with extensive Monte Carlo simulation for different combination of weights

	justifying a transparent approach to deal with tradeoffs	
Solution approach	Often exact approaches with the use of commercial applications	Exact with heuristics that can be compiled with open-source applications
Constraints	Capacity constraints without justifications	Storing capacities (volume, surface), transportation capacities, human resource capacities,

4.3. Research directions

We found that field based decision-makers, were still struggling with tactical and operational decisions. They had to adapt to the complexity of the situation, time pressure, several uncertainties, and different resource requirements of operational tasks. At the same time, these decision-makers were reluctant to use currently available tools. They had concerns regarding the applicability of these tools in terms of their computational, knowledge, and/or expertise requirements. Our field research also confirmed that transparent analysis of decision alternatives is largely lacking in practice. Therefore, more research toward developing an effective and applicable DSS for field-based decision makers is required.

Our analysis also revealed some bottlenecks in the downstream network of humanitarian supply chains in Nepal response. Due to these bottlenecks and lack of flexibility, HOs and their supply chains were disrupted quite often. Hence, another identified research directions are to study:

- risk management in HOs;
- distribution networks flexibility and resilience during disaster response;
- coordination and collaboration structures;
- adaptation of ICT tools for tracking and monitoring in the field;
- impacts of HOs` mandates and policies on the performance of relief operations.

5. DISCUSSION: limitations and opportunities

In this section, by focusing on our field research in Nepal, first, we illustrate what we have used, what we could/could not use, and why we conducted our field study as the way it is described in Section 3. This illustration leads us to discuss, on one hand, the limitations in terms of theory building and/or modeling in disaster settings, and on the other hand, the opportunities that we experienced in our research.

First, since HL still suffers from several challenges in the field, conducting timely field research can revise the ongoing research effectively. However, there are some main considerations:

i. Targeting interviewees for a multi-disciplinary research must be done carefully since some of our respondents, as also noted by Van de Walle and Comes (2014), only had specific knowledge about their responsibility. While they did not have a holistic perspective of other roles in their corresponding HO, we had to see many people within one HO to obtain the information.
ii. Elicitation of qualitative data through interviews in the field may need cross-validation within other resources to avoid biases.

iii. Combining qualitative data with quantitative approaches demands careful analysis with several iterations for verification and often require follow-up communications with participants.

Second, as discussed in Section 2, HL literature suggests several methods when it comes to conducting an empirical study. However, it lacks introducing relevant research designs and all referred research methods cannot be effectively applied in all disaster contexts. For instance, filling in surveys and questionnaire requires dedicating enough time, commitment, and focus while practitioners have other priorities. On the other hand, the semi-structured and conversational interview has one main advantage. It provides more flexibility for both sides to share information without formalities and at the same time, it converts the interview meeting into a story telling session that helps participants feel more relieved. Hence, guidelines and protocols for conducting field research at, for instance, a slow onset disasters need to be different from the ones that are developed for natural sudden onset. Conducting field research at the latter has relatively fewer challenges than the former. Indeed, we considered the type of disaster carefully before selecting incorporated research methods.

Third, disaster settings have specific characteristics that impose limitations on conducting field research and simultaneously, provide some opportunities. Table 5.1 summarizes our experiences regarding each category. For instance, the main challenge in our field research was to conduct interviews with key informants and decision makers since they had more priorities than participating in a research. Hence, getting access to a large sample of relevant logisticians was not possible in our field research. On the other hand, we had the opportunity to access to first hand data including verified information, maps, meeting minutes, and local newspaper articles. From this collection, we extracted informative findings that informed our location-allocation model, helped us to propose future research directions, and provided opportunities for conducting joint research on these directions.

Table 5.1 Limitations and opportunities of conducting Nepal field research

Limitations	Opportunities
Short time for preparation	To collect relevant data to better understand the challenges and eventually improve systems and tools.
Abnormal field conditions	Access to first-hand data and on-site observations
Lack of access to several key informants	Getting a realistic perspective about what is going on and what is needed
Constrained access to severely affected areas	Exploring best practices for being adopted in similar cases at future
Finite research resources (monetary and non-monetary)	Developing guidelines and frameworks for future research
Lack of dominance on qualitative research approaches and ethical dilemmas	Possible joint works, partnerships, and business cooperation

6. Conclusions

Developing models and simulations that are not grounded in empirical research may not result in progress in the field (Pedraza-Martinez and Van Wassenhove, 2016). However, a significant

drawback in the HL literature refers to limited research designs that support theory building and/or modeling from field studies in disaster settings. This paper formulates the field research design that we used in our Nepal field study in four steps, namely preparation, data collection, data combination and analysis, and results interpretation. Our proposed workflow enables other researchers to reproduce a similar study in the same or another context. Through this paper, we also explained what methods can be used through our proposed research design during a field research after a sudden onset disaster.

Based on proposed research design, we categorized our field findings in theory testing, model informing, and research directions. Within our observations, we revised an early stage conceptual model for Nepal relief distribution networks which was developed in preparation step. We also find some evidence regarding a lack of flexibility in the downstream network of some HOs. Our field study mainly informed our pre-developed location-allocation model where we reworked its characteristics with respect to our field findings. Our study also revealed that HL literature demands more research on decision support systems with field-driven characteristics for crisis managers.

We also admit the limitations of our research. Our findings are based on only one case, and this can be one of the main limits of our research, as discussed earlier. However, our research design can be incorporated into future research given the clarifications that we presented regarding the methodologies, constraints, and possible opportunities. The mathematical implementation of our field-driven model is under development and will be populated with the quantitative data that we also collected during field research. While further analysis is still required, the results of an early implementation of our model on the downstream network of one HO that was present during Nepal response can be presented at the conference.

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