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Research methods in humanitarian logistics
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1. Research methods in humanitarian logistics

1.1 Background and introduction

Research in humanitarian logistics is maturing, and numerous calls have been made for not only empirical research, but also mixed methods in humanitarian logistics and operations research. Currently, mixed methods are not used and empirical evidence in publications is scant, thereby undermining both the rigor and the relevance of humanitarian logistics research. There is no shortage of ideas, however – 43 review articles alone could be found in the last decade (see Kovács and Moshtari, 2019 for a meta-analysis of these). Conceptual papers and studies on models, which are based on assumptions and tested by hypothetical data, are abundant. To increase the quality of research (i.e. relevance and method rigor), scholars have suggested a number of strategies. These include reaching out to humanitarian organisations and formulating research questions (Kunz et al., 2017), using real and field data (e.g. Gupta et al., 2017), understanding the pros and cons of research methods in humanitarian logistics, matching the methods and research questions in humanitarian logistics (Kovács et al., 2018), taking a complementarity view on the different types of methods (i.e. explorative, theory building, theory testing and analytical modelling), collaborating with researchers with expertise in different methods, and using a mixed-methods approach. However, not only are there no mixed methods, but empirical evidence in publications is scant, and this has undermined the rigor and relevance of humanitarian logistics research. Aside from the capability trap, which can serve as a barrier to using multiple methods, another issue may be related to the fact that researchers are not fully acquainted with the limitations of their set of methods and the positive value and potential of other methods.

Humanitarian logistics, humanitarian operations and supply chain management need evidence-based decision-making, and therefore, empirical research. Researchers, however, struggle to gain access to the field and to apply the various methods. Notwithstanding, there is no shortage of data (Starr and van Wassenhove, 2014). Apart from the vast number of humanitarian organisations and their programmes, there are also increasing volumes of data online and even endeavours to share data in this field via, for example, the Humanitarian Data Exchange and the Humanitarian OpenStreetMap. All the same, questions have arisen regarding the quality of the data, data gaps and missing data vs Big Data (Gupta et al., 2017; JHLSCM’s special issue 2016, Vol. 6 No. 3) – and the availability of relevant data for a particular decision.

Relevant data can also originate from other angles, such as forecasting the path of a hurricane for evacuation models, meteorological data for mobilisation, natural hazard patterns for facility location, migration data for planning integrated development plans and refugee programmes, agricultural production data for potential famines, pandemic data for various health crises, and political risk monitoring for general crisis outbreaks. Humanitarian logistics therefore can – and does – borrow insights and theories from related disciplines (Tabaklar et al., 2015), not just logistics, operations, and supply chain management. Disaster management, cartography, geology, meteorology, peace research, epidemiology, public health, among others, are also considered. Nonetheless, humanitarian logistics can do more in this regard when it comes to research methods.

2. Problematisation of data access and how to overcome it

Apart from an abundance of modelling approaches in humanitarian operations (for a recent review, see Kovács and Moshtari, 2019), there have been repeated calls for more
evidence-based studies in humanitarian logistics and supply chain management (Kunz et al., 2017), not least as a basis for modelling (Starr and van Wassenhove, 2014). There are, however, some hurdles to overcome to be able to collect empirical data, including:

- a lack of access to disaster areas and conflict zones;
- the impact of disaster on, for example, transport, energy, and telecoms infrastructure, which can make data collection more difficult and time-consuming, or data collected beforehand obsolete;
- not wanting to stand in the way of aid delivery during a disaster when collecting data;
- a lack of willingness of humanitarian organisations to grant access to their data;
- ethical questions about collecting data from vulnerable people;
- security considerations when handling data from conflict zones; and
- an excruciatingly low survey response rate in humanitarian contexts combined with a low finite number of potential respondents with the relevant expertise.

Not surprisingly, many researchers in humanitarian logistics turn to secondary data or, nowadays, to open data and/or social media data to overcome some of these restrictions. Big Data are also available in a disaster (Gupta et al., 2017), although handling it requires a solid understanding of its quality, as well as how to identify and address the gaps in such data. The latter point is the most important as the most vulnerable people may not have access to the technologies required to communicate their needs (e.g. social media), and a lack of data from a particular region may be the best indication for that region having been hit the most severely by a disaster. The absence of data may actually be the data to look for. Gupta et al. (2017) revisited many types of secondary data and suggested specific measures to increase the quality of Big Data analysis in humanitarian operations.

At the same time, there are solid approaches to accessing primary data, including field research (Sohn, 2018), case research (Vega, 2018) and partial least square method to evaluate survey results from smaller resultant samples (Moshtari, 2016). Many of the issues with these types of methods are delineated in the Palgrave Handbook of Humanitarian Logistics and Supply Chain Management (Kovács et al., 2018).

Field and case research can be used to overcome the problem of accessing disaster areas and/or humanitarian organisations. Designing a research project and co-defining research questions with humanitarian organisations can also be used to overcome this issue (Kunz et al., 2017). Collaborative research brings researchers together with practitioners and means that researchers can include both traditional researchers as well as practitioners (Campbell, 1969). Khoury’s (2019) article offers a prime example of how a humanitarian practitioner conducted research on his and his organisation’s activities. It is one of the articles in the Practice Forum of JHLSCM that so aptly combines research and practice. Similarly, humanitarian logistics research can be conducted by means of participant observations, action research, and constructive research, with the researcher being part of the practice in all cases. This is perhaps most common for both practitioners themselves (like Khoury) and researchers who are on the rosters of humanitarian organisations.

From both researcher and practitioner perspectives, collaborative research (e.g. Sabri et al., 2019) highlights the importance of unearthing new methods of enquiry and analysis as humanitarian supply networks, humanitarian work, humanitarians themselves and the overall humanitarian context evolve. Collaborative research can be brought about by having researchers in the field and acts to introduce different perspectives and to explain the reasons things are done in certain ways. This approach has added advantages as the research must evolve with the rest of the (humanitarian) context. Researchers understand that
knowledge is constantly changing, and their responsibility is to capture this knowledge. Collaborative research is also a way for researchers to be responsive to the needs of the humanitarian community and, importantly, to affected communities and people of concern.

Furthermore, for researchers, collaborative research allows the rigor and efficacy of the methods used in both academia and practice to be tested. Another advantage of collaborative research is that it helps overcome the limitations of prior research by facilitating the exchange of information (i.e. in transferring findings) from one context to another. Importantly, however, for collaborative research to be truly beneficial, it should be relevant to users, academics, and practitioners (Stokols, 2006). Another positive aspect of collaborative research is that it enhances relationships and trust (Fry, 2006). This is valuable for longitudinal research and allows researchers to regularly test their methods and findings using many snapshots in time to give them a more coherent picture. In bringing together differing points of view, collaborative research may offer new solutions to difficult problems.

When talking about collaborative research and fieldwork, it is important to think about how to collect data within the specificity of the humanitarian context. This brings to light another important area touched on in this special issue: the use of innovative approaches to data collection itself, such as games (see Lukosch and Comes, 2019) and the Delphi method (Gossler et al., 2019). Authors such as Gordon (1970) and Shubik (1989) pointed out that methods available to researchers include those of simulations and games. In such cases, researchers and practitioners can learn from participating in games, as well as in the analysis from subsequent discussions (Thatcher, 1990). Overall, the variety of approaches humanitarian logistics researchers can use to overcome problems with access to data is astounding and attests to their innovativeness.

3. Innovative research methods in humanitarian logistics

This is a special issue on research methods in the field of humanitarian logistics and supply chain management. The articles in this issue do not provide an overview of all possible approaches, but they offer very good insights into their variety and demonstrate how to use them. This special issue consists of seven empirical research papers, and each of them utilises a different method: one of the papers uses mixed methods, two can be classified as qualitative, and the rest are quantitative. This variety of methods provides a reliable mix of ways to address the topic of humanitarian logistics beyond the most common approaches (i.e. modelling, simulations and case studies) (Kunz and Reiner, 2012).

The issue starts with an article from the journal’s Practice Forum that truly embodies research by practitioners. Khouy’s (2019) article is on the highly current topic of cash-based interventions, with a perspective from an otherwise highly inaccessible conflict zone in Syria. Lukosch and Comes’s (2019) article also deals with the problem of conflict zones. They present an innovative solution to help overcome problems with data access and to elicit deep insights, namely, a simulation game for the purposes of data collection. As they state, “gaming is a suitable research method to explore and analyse behaviour and decisions in emergent settings that require team work and collaborative problem solving” (Lukosch and Comes, 2019). They further discuss the suitability of gaming for humanitarian logistics, with details given from simulation gaming and an actual demonstration of their approach showing how they used a physical board game called Plaitra to collect in-depth data, which was later validated through the use of a computer-assisted simulation game.

The paper by Sabri et al. (2019) applies the collaborative methodology proposed by Sabri (2018) to a case study, thus making an empirical contribution to validate the methodology. The focus is on the process of collaborative research and the phases of forming a collaboration team, understanding the problem and context, data collection, practitioner orientation, collaborative data analysis, joint planning for action, implementation and
evaluation, and monitoring within a case setting. In so doing, the paper contributes to the literature by testing the use and contextualisation of collaborative research in a humanitarian logistics setting. While the process itself ends with implementation and monitoring, future research could also add possible academic outcomes, such as the high-level publication of the collaborative process.

Novel research methods aside, the knowledge base of humanitarian logistics is changing, and specific methods are needed to study such changes. Two articles stand out here in this respect. First, Obaze (2019) sought to understand how humanitarian services are changing over time. To do so, she applied mixed methods to study the supply, distribution, and transportation of charitable resources to underserved communities. She used systems dynamics (SD) (Forrester, 1961) as a concept mapping methodology, which employs both qualitative and quantitative modelling, to analyse complex systems. Obaze also applied a qualitative SD model, which included the use of causal loop diagrams (CLDs) and archetypal structures, to analyse the descriptive, judgmental and numerical data. The paper thus provides a relevant overview with references regarding the pros and cons of SDs and explains how CLD is conceptualised qualitatively and which kinds of software are available for CLD. While providing interesting insights into CLD, the method could be compared with the traditional integration and dimensionalisation of concepts (Spiggle, 1994; Gioia, Corley, and Hamilton, 2012) to provide the possible development of both methods.

Second, Gossler et al. (2019) also aimed to understand future developments by using the Delphi method to understand outsourcing in humanitarian logistics. Their article further demonstrates the use of Calibrum Surveylet software (Aengenheyster et al., 2017), which electronically administers two-way Delphi (i.e. e-Delphi) (Hasson and Keeney, 2011). The Delphi data were analysed with an NVivo type of content analysis and were complemented with two-day focus group data. The research process is explained in detail, and the article provides an overview of the rigors of several iterations of different data. It therefore serves as a model of one kind of research design.

Another type of content analysis and its automation is presented by Kunz (2019). While content analysis is commonplace in qualitative research, Kunz introduces the automated content analysis of documents to extract the quantifiable aspects of their content. In so doing, the paper also provides insights on the use of alternative (i.e. secondary) data, which is particularly important in humanitarian settings where primary data is often of an inferior quality. However, the drawback of the content analysis of existing text is that it is time-consuming and, thus, this paper introduces automated quantitative content analysis to make the coding process less irksome. The process starts with automatic word counting. Thereafter, the most frequently occurring words are further coded, and computer-aided (NVivo, Atlas) categorisation is explained. The novelty of the paper is that it offers a way to detect over-represented concepts.

Last but not least, Tacheva and Simpson (2019) present a different method to analyse the content of extant research. They propose the use of social network analysis (SNA) for humanitarian settings and provide guidelines on how to use SNA in this context by focusing on two case studies in which they applied SNA as a method.

4. Conclusions
Humanitarian logistics researchers often encounter limitations when attempting to access the object of their study (Oloruntoba and Banomyong, 2018). Despite the many challenges there are in accessing data, there are also good solutions and innovative research methods to help overcome them.

Collaborative research has been discussed at length as a way to overcome the lack of access to humanitarian data. The innovative approaches here were not simply used to
co-define research questions and to implement the research alone; rather, they systematically followed the approach by defining teams, jointly analysing data and even monitoring the study. Both researchers and practitioners can derive considerable benefit from the collaborative approach, which supports research with empirical evidence and increases the relevance of research while simultaneously supporting practice with evidence-based decision making and rigor. There is a range of ways to incorporate the researcher in such an approach, from collaborative teams, to researchers working as practitioners, to practitioners conducting research on their practice.

However, when access remains difficult or the verbalisation of insights proves inaccessible, the gamification of research may help elicit deep insights while simulating the decision under scrutiny. Traditionally, simulation approaches have been used to overcome both feasibility and security constraints, yet gamification adds another layer to this in research by focussing on issues that may otherwise not even have surfaced.

Technology adds a further layer to innovative research approaches. Technology such as online simulations can be used for data collection and validation (Lukosch and Comes, 2019), the coding and analysis of data (whether with ACQA, NVivo, Atlas, Calibrum or others), or the automatisation of data analysis. More and more, empirical researchers are turning to the use of analysis software, some even to the actual coding of such analysis software, and the use of various apps for visualisation. While it can make researchers’ lives easier, it is nevertheless important that researchers also understand the limitations of the software they use, and that research – and research on methods – is less about the tool and more about the knowledge a study contributes.

Gyongyi Kovacs
HUMLOG Institute/Supply Chain Management and Social Responsibility, Hanken School of Economics, Helsinki, Finland

Mohammad Moshtari
Laboratory of Industrial and Information Management, Tampereen Teknillinen yliopisto, Tampere, Finland

Hlekiwe Kachali
HUMLOG Institute/Supply Chain Management and Social Responsibility, Hanken School of Economics, Helsinki, Finland, and

Pia Polsa
Department of Marketing, Hanken School of Economics, Helsinki, Finland

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Logistics data analytics alongside voucher programme phases

Bashar Joseph Khoury
Independent Researcher in Humanitarian Logistics

Abstract

Purpose – The purpose of this paper is to steer the logistics efforts during different phases of cash and voucher and lead aid assistance operation to right destination by analyzing logistics data and converting it to feasibility information.

Design/methodology/approach – This research paper depends basically on a quantitative approach by depending on previous references relevant to this topic. Furthermore, interviews with experts in the field consider the dependable references for this research paper.

Findings – There are many findings in this research paper such as a simply logistics algorithm that could help logistics experts to determine the key components in market supply chains and draw different scenarios to clarify the full picture.

Originality/value – This research paper can be considered as reference for advance research papers in future. Furthermore, it stimulates academic researchers to open a serious discussion about logistics data analysis in all phases because it considers as a good source for decision-making information.

Keywords Humanitarian logistics, Supply chain management in disaster relief, Supply chain integration, Humanitarian supply chain, Development aid logistics, Emergency logistics

Paper type Research paper

1. Introduction

Cash and voucher (C&V) modalities have many definitions that have the same common specifications, herein some of definitions due to different humanitarian organizations as following. Cash-transfer programming (CTP) in emergencies is one form of humanitarian responses that can be used to address basic needs and/or protect establish or re-establish livelihoods (IFRC and ICRC Guidelines for CTP). Transfer of resources using market mechanisms is a response to problem of “access” not “availability”, e.g. people cannot afford food, where there is no shortage (WFP). Cash transfers are assistance to beneficiaries in the form of cash payments, bank transfers or mobile money. Beneficiaries can meet their own needs in the marketplace (CaLP). In result, there are many kinds of humanitarian financial assistances mentioned under many modalities such as commodity voucher, cash-based transfer (CBT), CTP, C&V, value voucher and so on. Within this research, we will focus on voucher programmes as the main terminology that presents roughly all above-mentioned modalities. There are many reasons to choose voucher programmes as the core of this research. First, distinct kinds of vouchers allow variations in the level of commodities to be distributed and can provide goods and services as long as shops and service providers are functioning, guaranteeing the beneficiaries will receive the established amount of goods/services in the case of price fluctuation (DG ECHO, 2013a, b, c). Thereby, concerning about voucher in this research allows us to simplify our calculations because beneficiaries will get specific goods and services with fixed prices approximately. In addition, voucher programme owns specific aspects in terms of specific value, specific levels of commodities or services, specific distribution’s areas and other. Therefore, all these specific factors allow us to study promptly the impacts of voucher intervention on market supply chains and, then, extract the ultimate results in a clear manner. Thus, this research is going to focus on voucher programmes because we can determine exactly the targeted market and its relevance supply chains, for example studying e-voucher winter clothes project by UNICEF, that have been implemented in Syria since many years, which is feasible because we know targets, prices,
sales points, beneficiaries needs and distinct kinds of given commodities (winter clothes for children), whereas any unconditional cash programmes by humanitarian organizations would complicate the research because of several needs of beneficiaries; therefore, we cannot determine where cash will be spend exactly, thereby discouraging the study on the impacts on relevance market supply chains. In result, research is going to concern voucher programmes to limit the scope of research and avoid any unnecessary deviations from research’s goals.

Ultimately, all these modalities have approved their effective and efficiency, thereby encouraging humanitarian community to recommend them as appropriate solutions in all stages (mitigation, preparedness, disaster and recovery). The following citation expresses their importance “Where markets and operational contexts permit, cash-based programming should be the preferred and default way of support” Report of the Secretary-General (Pan Kei Moon) for the World Humanitarian Summit 2016. Nowadays, we witness the expansion of these modalities among countries such as Haiti, Somalia, Pakistan, the Philippines, DRC and lately in Syria. In spite of that, a major role is being played by a logistics team nowadays than before; now they are responsible for monitoring local markets and assuring the proper functioning of market supply chains because every different processes in all different stages (mitigation, preparedness, disaster and recovery) have an impact on local markets; therefore, C&V-based assistance only work when we monitor markets’ supply chains and maintain our own segregated supplementary supply chains when needed (The Cash Learning Partnership, 2018). Nowadays, logistics team supports voucher programme functions in many stages, and this support is translated into many activities such as monitoring market and its supply chains, monitoring availability of commodity, observing voucher behaviour in respect to market supply chains, submitting advices in terms of logistics support services, confirming disbursements against entitlements, distrusting C&V to beneficiaries according to procedures and so on. Thereby, there is an essential need to establish modern algorithms that could give quick analysis of market supply chains’ behaviour at glance when inserting the necessary logistics inputs. Of course, this paper does not come under mathematics research studies; on the contrary, it attempts to build the simply algorithms that could be used even by non-logistics experts. Eventually, herein below, the research plan has been sequenced. First, this paper is going to discuss different mechanisms to monitor and evaluate market supply chains’ performance and voucher impacts; thereafter, the paper is going to discuss key affected logistics factors relevant to market supply chains. In addition, the research is going to analyze when and how logistics team must help and uphold market’s supply chains by direct interventions. Then, research discusses deeply how could the algorithm be combined logically with the previous logistics factors that would be used to monitor supply chains’ functions within local market subject to voucher programme. Consequently, there are many relevance recommendations given about benefits. Herein, mentioned below is the plan of this research:

1. mechanisms to monitor markets supply C&V performance;
2. relevance factors that affect market supply chains;
3. suitable time and types for logistics interventions besides voucher programme;
4. chained algorithm to analyze market supply chains and voucher performance; and
5. final recommendations.

2. Mechanisms to monitor markets supply chains and voucher performance
Implementing C&V projects requires different skills to manage in-kind transfers. If logistics are often simpler, there is a need for additional administrative and finance capacity.
Furthermore, assessments and monitoring need to include analysis of markets and distribution networks (DG ECHO, 2013a, b, c). The extract from previous citation that is finding out mechanisms is so essential, especially in the case of analysis of market supply chains affected by voucher programs because mechanisms are tools to measure whether all functions within entirely market supply chains perform well. By default, any kind of resource transfer may impact markets and local economies. For CBT, the market assessment must demonstrate whether there is sufficient supply or traders can increase the supply of the necessary commodities and evaluate the risk of causing or contributing in inflated prices of key goods. For in-kind transfers, the risk is likely causing deflation in the prices of key goods, which, for example, can disrupt local production cycles (DG ECHO, 2013a, b, c). This paper will focus on three categories as below, but not limited to, apart from any economic growth trends, exchange rate fluctuations, imports and exports, employment, inflation rates, geospatial information, insecurity, distances and sudden changes in the economy or government policies that could have serious and lasting effects.

2.1 Measuring ability and accessibility of local markets
The feasibility of C&V rests on the expected future ability of markets to respond to increased demand, if cash or vouchers were provided, and not simply on the state of the market before any intervention. Decision making should include the consideration of possible measures that could be taken to address any market constraints (e.g. addressing constraints facing traders such as capital, credit, storage and transport). Seasonal, regional and global trends can all influence prices. Likewise, the ability of traders to ensure timely supply at an appropriate price and quality may be critical. Therefore, potential impacts on markets by distinct types of transfers should also be considered (Levine and Bailey, 2015).

Prices are an overarching indicator that provides key information such as the outcome of supply and demand forces; they can give a timely insight into many different drivers that influence the functioning of a market and that are relevant for assistance programming. Of course, analyzing markets’ prices looking at three aspects:

1. the structure, as actors and institutions for supply and demand, barriers to entry as a market player, trends in production and market catchments;
2. the conduct, as competition levels, rules and standards as well as contract enforcements; and
3. the performance, as different methods of price analysis such as seasonality and volatility, market integration, profit margins and income generation, and purchasing power patterns (Caccavale and Flämig, 2017).

Furthermore, there are other indicators such as a flexibility indicator that is needed to meet the most pressing needs especially the heterogeneous needs of individual disaster – affecting households and individuals. Cash provides the flexibility to move beyond a standard kit/ration that meets the average needs of a household. Conversely, a restricted type of markets or poor ones may have a larger impact on a specific objective that presents to help beneficiaries and small traders indirectly (DG ECHO, 2013a, b, c).

In result, the analysis mostly focuses on price changes over time, besides other indicators, because of the issue of price volatility, which is likely to transmit uncertainty when price fluctuations are not predictable, could usually reflect the market supply chains’ ability and beneficiaries’ accessibility in the field.

2.2 Measuring agility of market supply chains
The agile supply chain refers to the use of responsiveness, competency, flexibility and quickness to manage how well a supply chain entity operates daily. The agile supply chain
uses real-time data and updated information to leverage current operations and real-time data against demand forecast, which helps to improve the overall efficiency and productivity of the given entity. Another key benefit of agility in the supply chain is focusing on avoiding potential shortages and eliminating excessively stocked inventory (Robinson, 2016).

Mostly, local market supply chains in the developing world that comply to voucher programmes are often fragmented and inefficient that is resulting in higher prices, greater losses and less access to commodities for the poorest. Millions of small- and medium-sized businesses and smallholder farmers are made poorer by the inability to access markets and support themselves. For example, most smallholder farmers worldwide produce barely enough to feed their families. Difficult access to agility logistics functions impedes investment and that means the loss of a harvest can push entire communities into hunger. For example, poor transport links hinder trade and drive prices up.

In fact, many concerns are raised by logistics experts when assessing the agility of supply chains for one or more markets that subject to voucher modality; herein below, some basic questions are given that are always faced by experts:

- Are the people we support getting the best value for money with their cash assistance?
- Are they able to cover their basic daily requirements or are shop prices too high due to inefficient or disrupted supply chains?
- Is the quality of the commodities they buy safeguarded?
- Can the retail sector supply the additional demand generated by our CBT, month after month?

In areas where voucher modality operates, the experts study local retail conditions, supply chain networks, prices and potential bottlenecks or inefficiencies that they can help to remove. Logistics experts may help selected wholesalers and retailers to plan to avoid potential supply breaks and negotiate better prices from suppliers and transporters. They work across the entire supply chain with a broader goal to improve retail management in local markets and ensure that the beneficiaries have access to excellent quality commodities that are consistently in stock and available at fair prices. Logistics experts also support retailers to better manage their inventories, purchase their stocks, and arrange transport and storage so that they can provide the best possible service to all beneficiaries appropriately. Finally, logistics team could propose ideal logistics solutions to humanitarian problems. Although the focus also lies on how best we support the people we serve, working on strengthening retail supply chains that help entire communities who shop at the same stores. Furthermore, after the end of operations, logistics experts can say “we leave behind a more robust, sustainable and competitive sector at affordable prices and poor families reap the benefits of supply chain efficiencies” (World Food Programme, 2018a, b, c, d, e). In result, assessing the agility of market supply chains is a critical mechanism for understanding the ongoing voucher performance because increasing agility inside local market supply chains means serving beneficiaries effectively at fair prices.

2.3 Procurement logistics

There is another tool to monitor macroeconomics and market’s logistics behaviour, some of research works use terminology called “Procurement logistics” that consists of activities such as market research, requirements planning, make-or-buy decisions, supplier management, ordering and order controlling. The targets in procurement logistics might be contradictory, for examples, maximizing efficiency by concentrating on core competencies, outsourcing while maintaining the autonomy of the organization, or minimizing procurement costs while maximizing security within the supply process. Thereby, procurement logistics principles could be feasible to leverage local traders’ capacity and evaluate the solidity of market supply chains.
A good example on procurement logistics is what happens instantly after a disaster strikes, relief organizations conduct an initial assessment (usually within one day after occurrence). The expected quantity of supplies required to meet the relief needs of the affected population is estimated (Thomas, 2003) as well as pre-positioned supplies, already available at the organizations warehouses, are evaluated. Relief items, which need to be procured from suppliers, are determined (Balcik and Beamon, 2008). As a next step, this assessment is translated into supply requirements. Demand for relief supplies varies in terms of magnitude, criticality and type of required materials that are mostly too highly unpredictable (Kovács and Spens, 2007). In result, using procurement logistics mechanism to assess the local market is a key tool to know precisely the realistic results in terms of voucher performance, market supply chains and local suppliers.

3. Relevance factors that affect on market supply chains

Indeed, many factors could influence the functioning of market supply chains, consequently, that leads to positive or negative effects on voucher behaviour. Furthermore, in some cases, voucher behaviour itself could be a positive or negative factor that affects market supply chains. For examples, a voucher programme encourages local smallholder traders to improve themselves, stand up again and stimulate their local economic activities among market supply chains. On the contrary, the voucher programme sometimes has negative impacts on market supply chains such as prices inflation, huge demand on specific commodities, competition on transportation services and so on. Therefore, this research intends to study precisely the accountable factors that could be measured mathematically. After that, we could consolidate these factors and make them components of the simply algorithm that could be used in monitoring impacts of both voucher behaviour and market supply chains, thereby using the extracted results to correct whole operations relevant to voucher programme and market supply chains. The key logistics factors vary, but not limit to, and herein below the important ones. Of course, we could add or remove some of them depending upon the nature of specific operation.

3.1 Availability and accessibility of commodities in market

This is the first basic stone to build successful market supply chains and successful voucher programs. Without availability and accessibility of stock, upstream market supply chains and local purchase, appropriate local markets do not exist that could address the local needs adequately. There are a lot of examples; therefore, let us take WFP case as first instance. WFP works with local retailers through its cash-based assistance transfers and helps make local commercial markets more professional and efficient. Lower costs translate into lower prices, giving vulnerable people the possibility of having more money to meet their basic needs. In Jordan, WFP’s retail engagement strategy changed the existing contractual arrangement and has boosted so far by 8 per cent the purchasing power of 80,000 Syrian refugees living in the sprawling Zaatari refugee camp. Working with the camp’s shopkeepers to use their store’s itemized sales data, WFP is in the process of helping them to make their supply chains more efficient (sourcing and delivery) with a potential to further reduce selling prices (thus, further increase purchasing power) by another 7–9 per cent (World Food Programme, 2018a, b, c, d, e). Available stock in market and strength pipeline are fundamental issues that affect voucher programme and market supply chains; therefore, it considers as a startup point for any planning regarding the voucher programme and market supply chains.

The second example that highlights the importance of upstream market supply chains and limitations in terms of availability and accessibility of market is related to the joint venture report by many humanitarian organizations that analyzes the market supply chains in Yemen and how it addresses the needs of people, the mentioned report says “they found that in the
west of Yemen, two market systems are operating semi-independently of one another. Divided by the line of conflict, the north-west and central-west of the country is supplied primarily by the port Al Hudaydah, while the south-west of the country is supplied by the port of Aden. The two supply networks have varying availability of goods, and different distribution mechanisms, with Al Hudaydah supplying vendors through a wholesale distribution network for most products, whereas distributors in Aden tend to directly supply vendors in neighbouring governorates. The port of Al Mukalla and the cooking gas producers of Marib are the exceptions to this trend, supplying vendors across the west of Yemen” (CMWG, 2017). Therefore, it can be said that market supply chains in Yemen are provided with commodities in line with limitations that hinder availability and accessibility of market.

Third example demonstrates the importance of local productions in addressing the needs of market in low prices. Even a plentiful harvest can have its downsides. Inadequate capacity to store market and transport food surpluses causes food prices and quality to drop. Farmers are unable to put their produce for sale at a premium when demand is highest, food is wasted and spoiled, and market volatility is sharpened. There are many other examples in terms of supporting local production that can have a positive influence such as supporting smallholder farmers through the facilitation of credit, capacity development and access to markets (World Food Programme, 2018a, b, c, d, e). Consequently, local production would get strengthened in all times and support voucher modality and market supply chains; furthermore, local production would be considered as a main resource for market supply chains and facilitate the implementation of voucher modality.

3.2 Capital and cash flow
According to experts in fields, the capital is considered as an extreme key factor because without enough capital, there is no commodity procurement, transportation, stockpile, voucher programme processing and so on. Therefore, all experts agree together that capital streamlines all processes of market supply chains; therefore, voucher programme experts and logistics team always study the assets and financial capacity for whole traders, small traders, transporters, distributors and so on.

For example, in the case of traditional aid assistances, the relevance organizations might have worked with a maximum of 10–20 suppliers for their needs in a country, on large framework agreements, but now in a voucher modality, they might have up to 300 vendors serving the beneficiary needs (each on a much smaller scale). Many agencies are now recognizing the value of engaging in market strengthening and market support activities to aid recovery and stimulate trade in the immediate geographical and economic vicinity of affected populations. Activities vary from rebuilding infrastructure, supporting micro-traders in seeking credit/scaling up, or giving grants to supporting micro-traders to recover (to buy fuel, to repair their shops, etc.). These are the small and simple traders who are oftentimes affected by the emergency themselves and can be beneficiaries. Therefore, they need to support them with logistics and financial services. In result, any new voucher project needs to study the subject market critically, relevant to its logistics, and financial capacities before issuing any project (Logistics Cluster, 2014).

Furthermore, the humanitarian organizations should pay attention to new term known as supply chain finance likewise supplier finance or reverse factoring is a set of solutions that optimize cash flow by allowing businesses to lengthen their payment terms to their suppliers. This results in a win-win situation for the buyer and supplier. The buyer optimizes working capital, and the supplier generates additional operating cash flow, thus minimizing risk across the supply chain (Prime Revenue, 2018).

In result, cash flow, funding and payment terms are essential issues in voucher modality and market supply chains; therefore, voucher programme’s contracts with traders must stipulate about payment terms critically and, likewise, periodical payments and advance
funds that could submit to traders for starting up; voucher logistics experts must teach small traders and household traders about optimal methods of payments to their suppliers that leverages their position in market and enable them to get best prices and discounts. In addition, voucher and logistics experts must establish the critical invoicing system that grantees the fund of organization spends in its place and grantees the traders’ entitlements pay orderly and immediately. Thus, organization ensures that cash flow is under control; otherwise, any chaos in payments against invoices and logistics services could lead to huge claims and interruptions in market supply chains.

3.3 Contracting and ordering lead time
The contracting and ordering functions are considered as complex issues in the procurement cycle and sometimes the most effective functions in reducing costs and expenditures. There is a fundamental difference between traditional humanitarian aids and voucher modality in terms of procurement process and scales. For instance, traditional humanitarian response usually uses the large competitive procurement processes, awarding sole business to the best bidder. This method is still useful and can achieve consolidation-related cost efficiencies, but that differentiates in the case of voucher modality because we also need to broaden our methods and design processes that allow us to contract with many local suppliers. The good example that demonstrates the mainly idea is WASH project in Pakistan, where an assessment shows that markets around affected beneficiaries are fully functioning with many small stores in communities and camps replete with hygiene items. Indeed, there are many benefits of working with many as opposed to a single award contract in this scenario and, on the other hand, this imposes a lot of complex processes, large scale of transactions, and huge administration and logistics documents (Logistics Cluster, 2014).

To sum up, when voucher modality is implemented within a specific market, experts must assure that contracting, ordering, and other procurement processes could meet the final needs of beneficiaries; otherwise, it would create seriously interruptions in market supply chains dramatically. Generally, the definition of the lead time is the latency between the initiation and execution of a process. In industry, lead-time reduction is an important part of lean logistics (Antunes et al., 2016). A more conventional definition of lead time in the supply chain management’s point of view is the time from the moment the customer places an order (the moment the supplier learns of the requirement) to the moment it is ready for delivery. In the absence of finished goods or intermediate (work in progress) inventory. It is the time, which an order is taken to a manufacture without any inventory other than raw materials. The Chartered Institute of Procurement & Supply identifies “total lead time” as a combination of “internal lead time” (the time required for the buying organization’s internal processes to progress from identification of a need to the issue of a purchase order) and “external lead time” (the time required for the supplying organization’s processes, including any development required, manufacture, dispatch and delivery) (CIPS, 2012).

Of course, all above definitions appear obviously the important of lead-time term in supply chain generally and within market supply chains especially, by default, implementation voucher programme in specific market would require agile logistics functions from traders to replacement any stock out with recovery ones. Of course, minimized lead-time leads to minimized costs of huge stockpiling and minimizes likeliness of stock run out.

Therefore, focus on lead-time issue in market supply chains and voucher programme is vital because minimized lead-time reflects agility in market supply chains, thereby resulting in agility in voucher programme implementation.

3.4 Transport capacity and fuel
Generally, the definition of transportation refers to the movement of product from one location to another as it makes its way from the beginning of a supply chain to the hands of final customer.
This requires a new broad look at the business of transportation supply chain, including supply chain management, logistics and procurement. Therefore, the logistics experts harness the transportation functions as much valuable tool to enhance and execute the whole market supply chains. On the contrary, the non-understanding of transportation role in supply chains could cause many adverse effects. For example, when freight costs are high, even seemingly small oversights can result in unneeded expenses, hence causing cut into overall profit margins. In addition, probably more detrimental to budgeting because of the hidden cost of transportation in a poor supply chain. When getting goods from one point to another is a crucial aspect of business, ensuring that this process is the most efficient becomes a huge economic concern. This is especially true in large enterprises and the obvious connection between visibility of freight and the transportation economics becomes easy to see. Even in smaller businesses where the margins are rather low, transportation costs are still a crucial element of creating profitability (Robinson, 2015). Thus, we can result from above explanation that transportation is a crucial issue in all kinds of aid relief operations either voucher or direct aid assistance; therefore, logistics experts must study local transportation capacity before commencing with drawing for any humanitarian operation or, otherwise, all their efforts will be wasted easily because of transportation fail to meet the fundamental needs of humanitarian operation. In result, transportation considers within market supply chains as a key element because low transportation means added value for both local markets and voucher beneficiaries. Of course, transportation is functioning well where there is enough fuel in appropriate prices which considers else the key element in market supply chains. Because fuel is a critical issue that is affected dramatically with general supply chain functions especially on market supply chains.

Both voucher modality and direct aid assistance will need trucks to deliver the assistance items in question, thereby that means the transportation needs to enough fuel always with constantly level. For example, fuel is always in demand, particularly when it is scarce – a common situation during an emergency. To keep the relief operation vehicles well supplied with fuel and lubricants, a meticulous gas mileage record must be established based on the routes taken. Sometimes it is possible to get credit at a gas or petrol station, and vehicles are refuelled upon the presentation of authorized coupons. This very convenient solution eliminates having to store and supply fuel (Pan American Health Organization, 2001). Another realistic example extracts from report about Yemen, where the shortage of fuel was reported across Aden and the south west of the country, which subsequently resulted in transportation issues, longer restocking times and dysfunctional market price mechanisms for essential products. Then, this would have severe repercussions across the centre west and north-west of the country. Rapidly increasing fuel costs have impacted upon all sectors of the market, with many communities now financially and physically unable to access their local markets (CMWG, 2017).

To recap, each of market supply chains, direct aid assistances and voucher modality will need transportation in all stages that is possible only when fuel is available with constant amounts and prices. Therefore, logistics experts should grantee this matter and know the expected level of fuel that will be needed during the period of planning before they commence with serious operation.

Furthermore, some of humanitarian organizations start new initiatives that aim to provide transporters or party that responsible for transportation with enough share of fuel that will be used in the transportation of assistance items.

3.5 Storage capacity
Storage capacity that is possessed by small traders and wholesalers is an essential issue in the design of market supply chains because this issue affects directly the inventory level and the total available stocks that could meet the needs of the beneficiaries as and when required.
In addition, stockpiling represents a large cost to small traders and wholesalers who participate in voucher programme. This is made up of the cost of the inventory itself, plus the cost of transporting the goods, cost of managing the goods (labour, fumigation, repackaging, etc.) and keeping the goods in warehouses. Thereby, the role of logistics experts is learning small traders and wholesalers to make inventory available at the lowest possible cost. To achieve this, the small traders and wholesalers must ensure to keep balance between supply and demand by establishing minimum holding stocks to cover lead times. To achieve this, they must liaise constantly with the voucher programme planners to keep abreast of changing needs and priorities. Besides that, the warehouse must always have sufficient stocks to cover the lead-time for replacement stocks to avoid stock-outs (White, 2015).

Furthermore, storage facilities is considered as much important node in market supply chains because warehouse processes should be examined to find areas of eliminating waste of resources and non-value-added steps. For example, one area that small traders and wholesalers should always be working on is the reduction of unnecessary inventory. The accumulation of inventory requires money and resources to store and maintain it. By reducing unnecessary inventory, thereby small traders and wholesalers can minimize warehousing space and handling, in turn reducing overall costs (Murray, 2018).

Consequently, the adequate storage capacity of traders could enhance the ability of market supply chain; furthermore, the planning for appropriate inventory levels will contribute to conducting voucher modality smoothly without interruptions and streamline the functions of market supply chain.

3.6 Traders capacity
The local traders’ capacity is considered as a sensitive issue in market supply chains because traders are main actors in market. Furthermore, increase in traders’ capacity could translate as increase in addressing of beneficiaries’ needs.

Of course, traders must build their own supply chains, either short or long ones, in an appropriate manner; therefore, they commence with establishing lean market supply chains that are free from any kind of waste and losses. In addition, organizations that enhance voucher modality commence to teach traders the terms of lean supply chains, and how to build it effectively.

The traders are encouraged to use lean supply chain management if they want to streamline their processes by eliminating waste and non-value-added activities. Traders may have several areas in their market supply chain where waste can be identified as time, costs or inventory. To create a leaner supply chain, traders must examine each area of the market supply chain because lean supply chain management requires businesses to examine every process in their supply chain and identify areas that are using unnecessary resources, which can be measured in dollars, time or raw materials. This will improve the traders’ competitiveness as well as improve the traders’ overall profitability (Murray, 2018).

In other words, we can say that traders must enhance themselves by building cutting edge and lean supply chains that address the beneficiaries’ needs with an appropriate manner.

3.7 Beneficiaries’ needs
Now, we proceed to the fundamental issue in voucher modality and market supply chains that is beneficiaries’ needs because all functions in market supply chain is drawing to address these needs effectively and efficiently. Unfortunately, some of humanitarian organizations forget this fact and commence to draw their humanitarian supply chain due to their goals only apart from beneficiaries’ interests.

In the realistic instance, one of field researchers observed that the humanitarian organizations are running operations in a survival mode, as they are dependent on funding from donor organizations. At the end of programme, they exit without achieving realistic
physical results, whereas there is still a need to provide small-scale aid and basic nutrition services. As we talk about supply chain integration here, future work should consider beneficiaries as commercial supply chains integrate consumers into their chain, and humanitarian organizations need to communicate properly to beneficiaries and hear their voices to create sustainable communities. Moreover, local actors are important for communicating to the local communities, as they are well aware of the needs of the affected population. The local actors can also enable humanitarian organizations to quickly scale up their capacities while continuing to provide humanitarian services to the beneficiaries. For instance, the International Federation of Red Cross and Red Crescent Societies (IFRC) has been building scalability into their supply chains to be more sustainable and to allow them to scale up quickly by cooperating with local bodies (Tabaklar, 2018).

In other words, beneficiaries’ needs are the aims of all functions of market supply chains; otherwise, all humanitarian supply chains are fund wasting. In addition, it may affect adversely on entire humanitarian operations.

4. **Suitable time and types for logistics interventions beside to voucher programme**

When is the best time of logistics intervention? Where is the best place for logistics intervention? What is the best approach for intervention? All these questions are raised by logistics team after they have studied precisely the above relevance logistics factors especially when studies indicate interruptions in market supply chains. Thereby, logistics team extracts that there is an urgent need to intervene directly besides voucher programmes. Let us clarify these points through below explanation.

Depending upon distinct kinds of disasters, there is likely one or more over-effective logistics factors as described above that could impact adversely market or functioning of market, not complying with appropriate status, thereby highlighting the role of directly logistics interventions. Of course, there are distinct kinds of logistics interventions that could manipulate deficits of market or stimulate local markets by many mechanisms.

Indeed, this research paper is going to highlight on distinct kinds of logistics interventions that relate to humanitarian organizations, which are acting in various areas worldwide. Furthermore, this paper is going to study the best time and terms for logistics interventions besides voucher programme. Some empirical examples are given as below.

First instance, when local production fails to meet the basic needs of beneficiaries, logistics employees must study this case and, then, find out the empowering mechanics to enhance market supply chains’ functions, likewise providing formers with livestock so that they could produce in large volumes for local markets.

There is obvious example related to this matter. Globally, WFP spends $40m in commodities every year from smallholders with plans to triple that in the coming years. Furthermore, WFP has signed long-term agreements with six selected local mills to produce fortified wheat flour for its programmes. Therefore, the wheat flour production has grown from nothing to 70,000 metric tons, and the source of which is 20 per cent of local farmers. They also support the millers to grow their businesses into sustainable ventures and commercialize their production so that they can access markets beyond WFP (World Food Programme, 2016).

Second instance, when local formers, traders and wholesalers have weaknesses in their capacities that are not enough to cover local needs of beneficiaries. Herein, logistics employees must study distinct aspects of their capacities and determine the bottlenecks, and then, they could propose the appropriate solutions that fit to handle the bottlenecks wisely and, likewise, providing with advance cash credits, necessary tools, especially electronic tools, training them on modern approaches, supporting importers to import the specific commodities and so on. The realistic instance appears in terms of Somalian voucher...
programme case, the traders in Somalia who cited the lack of demand as one of the top business constraints, so by creating more effective demand, the cash programme caused directly benefit traders operating in the areas where cash was distributed. Competition between traders is also very strong, and this additional demand put pressure on traders to meet supply requirements. To help ensuring that traders could supply the required goods, some NGOs informed traders about the project ahead of time; therefore, traders interviewed all reported that they were able to meet demand, albeit after dealing with difficulties such as poor road conditions (Longley et al., 2012/2018).

Third instance, fuel availability may affect adversely on market supply chains; therefore, logistics intervention becomes vital and, herein, logistics team could arrange contracting, ordering and distributing enough amounts of fuel on relevance-contracted transportation vendors in such way market supply chains function without interruptions.

Forth instance, when threats and risks are extremely high in a specific area and there is a huge possibility that all roads and supply chain networks are hindered. Then, the right preparedness action is to keep additional stockpile in temporary and permanent warehouses within a specific area in such way that logisticians could submit urgent aids to beneficiaries continually when supply chain networks would cut down. Herein below a map is given that is the good example of stockpile concerns; the map presents in details the figures within Syrian NFI Stockpile Report (March 2017) issued by HOs that indicates the levels of different relief items in different areas of Syria and how humanitarian organizations attempt to keep reserved stockpile even in severe conflict areas for any quick responses (Figure 1).

In other words, keeping serious plans related to logistics interventions in market besides voucher programme is always essential strategy to overcome the sudden logistics hurdles and prevent any interruption in supply to beneficiaries. Of course, above examples demonstrate the terms and times of appropriate logistics interventions and, for these reasons, this research will commence in next paragraph to build a simply chained algorithm that help logisticians to understand the behaviour of market supply chains and then take decisions about times and terms of appropriate logistics interventions besides voucher programme.
5. Chained algorithm to analyze market supply chains and voucher performance

The previous sections discussed in detail the different elements that could impact market supply chains, thereby resulting sometimes in the adverse impacts such as interruptions, delays, failures and non-settlement that are caused by voucher programmes or other reasons. Initially, this research aims to manipulate logistics data to know exactly the performance of market supply chain under potential impacts of voucher implementation.

Therefore, this research compiled the information from diverse sources such as informal interview with logistics experts, references and official reports about monitoring the performance of voucher programme, market supply chains, and settlement of markets in cooperation with many experts and organizations from humanitarian field. Furthermore, these specific elements could be combined in one chained algorithm that could serve monitoring market supply chains. Of course, the proposed calculations would be smoothly apart from any complex mathematics. In this paper, focus is on non-sophisticated mathematics because algorithm would be used by non-mathematic experts.

Therefore, this research proposed below created an algorithm that predicts the protentional scenarios against inserting logistics inputs and, in addition, its extracted result could be considered extremely in next decisions in terms of market supply chains and supporting voucher programs because the extracted result indicates where are the bottlenecks and hurdles in distinct stages of market supply chains.

In sequence, decision makers could determine the optimal logistics interventions likewise provision relevance parties with necessary supports directly such as transportation, capital, fuel or even aid food stockpile. Herein below the components of potential algorithm are given:

\[
\text{Availability \& Accessibility of Commodities in Market} \leq \text{Capital\& Cash Flow} \leq \text{Contracting \& Ordering Lead-Time} \leq \text{Transport Capacity\& Fuel} \leq \text{Storage Capacity} \leq \text{Traders’ capacity} \leq \text{Beneficiaries’ Needs.}
\]

In the above-created chained algorithm, components are link together with symbol “LESS or Equal” “\(\leq\)” because all relevance components must own enough capacities to achieve the final goal of market supply chain that addresses final beneficiaries’ needs. In some cases, once or more one components could own high capacity more than others and that considers as positive indicator by some logistics experts because that means market supply chains have self-ability to support voucher processes. In spite of that, most references refer to surplus capacities for some of components with bad indicator because that means unnecessary losses related to funds, for example, huge warehouse that is not almost occupied fully in most times is considered as losses for capacity and money.

Of course, the above algorithm depends on elements that could be measured during specific period even week/s, month, biannual and annual. On the other hand, this algorithm intends to use the above elements; that describe in detail previously; that must measure orderly due to specific standards. Of course, the lowest capacity for one of components will be taken into consideration during the calculation of the result of above algorithm. And it leads to fall apart of all functions of market supply chains because of all functions will suffer from severe interruptions per lowest capacity related to once of functions. Let us explain the principle of algorithm in few examples as below.

First example, there is a shortage related to fuel in local market that use in specific transportation modules; thereby, there is decreasing in relevance transportation capacity definitely. Subsequently, the amounts of available commodities in local market would be reducing to equal available transportation’s capacity. In result, the algorithm’s
result will down to fit the lowest capacity among all components that is representing herein with amount of available fuel that effects on the rest components of chained algorithm and by default it could impact on performance of entire market supply chains. Even if there is a large capacity of available commodity or transportation capacity exceeds the needs, the beneficiaries would receive only the limited amount of commodity that could be transferred by limited transportation capacity due to the limited fuel.

Second example, there is a limitation in commodity that does not address the expected needs and, in this case, there are the huge volumes of transportation capacity, handling forces, fuel, storage capacity and others, that will convert gradually to useless elements because limited proportions components and that will affect adversely other components, in other words, reducing the ability of all market supply chains’ functions and diminishing voucher effectiveness.

For more understanding about working mechanism of this algorithm, let us take empirical example that demonstrates how to calculate results exactly. Let us suppose that an assessment team visits disaster-affected area, called territory A; depending upon the occurrence of disaster and their observations that affected people will urgently need wheat flour that is usually used in their daily basic meals and, also, they estimate the following preliminary figures:

- number of affected people is around 20,000 persons; and
- the white flour amount that is needed for each person is around 2 kg per day.

Indeed, the basic infrastructure is destroyed during disaster, so there is neither warehouse nor mill facility that will help in the provision of necessary wheat flour. Due to preliminary inquiries, quick response logistics team discovers that there is appropriate mill facility in the neighbourhood area, called territory B; they assume it could address the needs of wheat flour.

Therefore, logistics team will use the previous algorithm to estimate what logistics capacities would need exactly to build adequate market supply chains from origin B until final distribution A; herein below the necessary components are calculated:

1. Commodity and pipeline: according to mill owner assumption, he has adequate pipeline to receive wheat (raw material); consequently, the mill owner will need around 45 MT of wheat daily (plus 10 per cent as production losses) to address the needs of 20,000 beneficiaries; thus, mill needs agile pipeline that provides around 49.5 MT of wheat daily (45 MT for production and 4.5 MT for production losses) at least.

2. Capital: of course, this operation will need budget that covers commodity, production, transportation, fuel, handling, storage, employee’s salary, 10 per cent as administrative expenditures and other expenditures. Therefore, logistics team will allocate the necessary resources monthly to perform all above activities and sometime pay in advance.

3. Contracting and ordering lead time: the estimated period of relief response operation will last three months at least; therefore, procurement section must sign contract at least for three months; of course, it is preferably to stipulate that contract could extent for either 6 or 12 months automatically after mutual approvals. By default, the daily ordering amount must equal daily needs (40 MT) + spare margin (5 MT); therefore, the estimated daily ordering equals 45 MT. Procurement unit and logistics team must contract promptly with transportation in addition to appropriate employees that will be needed in the warehouse facility and distribution process.
• Transportation: the specific shipment of wheat flour with weight 45 MT will need trailer with load-capacity equal at least to 45 MT daily. Of course, selection and contract with appropriate vendor who will be responsible of logistics team.

• Handling forces: this specific shipment will need enough number of manpower for offloading, stacking, inspection and recording; therefore, it is supposed to have around 40 employees to do that daily. Of course, select and contract with an appropriate vendor who will be responsible of logistics team.

• Storage facility: the specific shipment (45 MT) will need enough space to store and distribute it; therefore, logistics team supposed to install wikkhall tent (temporary facility) that is enough to store around 60 MT, so there is enough space to store spare amount and conduct distribution process smoothly.

• Traders: herein the trader is mill owner, so logistics team will study the ability of owner to do milling, purchase and pick up around 49.5 MT daily; therefore, a trader must have cash flow and financial capacity that could cover all expenditures for at least a month. Furthermore, the specific mill must produce at least 20,000 x 2 kg = 40,000 kg = 40 MT to meet daily needs from wheat flour, of course, any surpluses exceeding 40 MT will be so much useful, for example 5 MT as spare margin.

• Beneficiaries: the final aim for this cycle is the final beneficiaries, and logistics team is supposed to distribute 2 kg per day for each person out of 20,000 beneficiaries which is a key indicator for successful market supply chain to achieve its mainly goal that is serving affected people in an effective way.

At the end, the logistics team could build their market supply chain that is enough to serve 20,000 persons who need wheat flour as shown in below algorithm:

Raw wheat commodity = 49.5 MT daily ≤ capital that cover all mentioned costs for at least one day & ordering at least 49.5 MT of wheat ≤ ordering one trailer with weight-load 45 MT from contracted transportation vendor on daily basis with enough fuel ≤ warehouse capacity that enough for 60 MT ≤ mill owner with enough capacity to cover his expenses adequately & cash flow cover all services for at least one day ≤ 40 persons employed to distribute and handle 45 MT to 20,000 beneficiaries daily ≤ 2 kg per day for each persons out 20,000 affected people daily.

Table I demonstrates logistics prerequisites daily to achieve the main goal (2 kg per day for each beneficiary), any amendment in one component’s value that means changes in most of components’ values.

<table>
<thead>
<tr>
<th>Items</th>
<th>Availability and accessibility</th>
<th>Capital and cash</th>
<th>Contracting and ordering lead-time</th>
<th>Transport and fuel</th>
<th>Storage capacity</th>
<th>Traders capacity</th>
<th>Beneficiaries’ needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat flour</td>
<td>49.5 MT of wheat daily</td>
<td>Budget that cover commodity, production, transportation, fuel, handling, storage, employees’ salary and 10% as administrative expenditures</td>
<td>Contracting with miller, transporter, and others to cover daily needs</td>
<td>Trailer with capacity 45 MT daily</td>
<td>Warehouse with capacity for 60 MT</td>
<td>Capital to cover purchase enough wheat beside to other entitlements plus production ability equals 45 MT at least daily</td>
<td>20,000</td>
</tr>
</tbody>
</table>

Table I. Logistics prerequisites
The above empirical examples are simple and include one item only and, by default, the issue will be more difficult and complex when affected people will need distinct kinds of relief items, from different origins and from different resources.

In addition, the above algorithm could describe as “If chained functions do well” because shortage in one of the combined components effects adversely other components; therefore, the relevance chained functions will start from first objective; available of specific commodity; and finish with final objective that aims to meet fundamental needs of beneficiaries. In addition, the middle components participate substantially in an algorithm in either positive or negative manner. In spite of availability of local production, the weaknesses or shortages in one or more of components such as funds, transportation, stores, traders’ capacity, cash reimbursements, fuel, contracting, orders management and others could reduce constantly the responses to people in needs. Objectively, the capacity of each component will decrease gradually to comply with the capacity of the most weakness component. Now let us clarify the above explanations by more complex case; let us suppose that previous assigned logistics team will take place the assessment for local market supply chains and if the specific market could meet the diverse needs of beneficiaries after while of disaster occurrence. After quick assessment, logistics team finds out that there are many urgent needs in affected area such as blankets, water, kitchen sets, clothes, canned food and others. The delivery of these commodities will need adequate market supply chains; herein, Table II demonstrates the ideal logistics capacities that will need to deliver these commodities for the first time in emergency response.

Albeit available capacity extremely, logistics team finds out that transportation capacity would reduce 30 per cent according to many reasons such as fuel limitation and bad maintenance of trucks; therefore, the result will be as follows (Table III).

<table>
<thead>
<tr>
<th>Items</th>
<th>Availability and accessibility</th>
<th>Capital and cash</th>
<th>Contracting and ordering lead-time</th>
<th>Transport and fuel</th>
<th>Storage capacity M2</th>
<th>Traders capacity Handling</th>
<th>Beneficiaries’ needs Persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blankets</td>
<td>3,000</td>
<td>30,000</td>
<td>One week</td>
<td>67</td>
<td>3,000 M2</td>
<td>Enough</td>
<td>20,000</td>
</tr>
<tr>
<td>Wash</td>
<td>2,000</td>
<td>2,000</td>
<td>One week</td>
<td>44</td>
<td>2,000 M2</td>
<td>Enough</td>
<td>20,000</td>
</tr>
<tr>
<td>Kitchen sets</td>
<td>5,000</td>
<td>100,000</td>
<td>One week</td>
<td>111</td>
<td>5,000 M2</td>
<td>Enough</td>
<td>20,000</td>
</tr>
<tr>
<td>Clothes</td>
<td>3,500</td>
<td>7,000</td>
<td>One week</td>
<td>78</td>
<td>3,500 M2</td>
<td>Enough</td>
<td>20,000</td>
</tr>
<tr>
<td>Canned food</td>
<td>5,000</td>
<td>10,000</td>
<td>One week</td>
<td>111</td>
<td>5,000 M2</td>
<td>Enough</td>
<td>20,000</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>6,000</td>
<td>18,000</td>
<td>One week</td>
<td>133</td>
<td>6,000 M2</td>
<td>Enough</td>
<td>20,000</td>
</tr>
<tr>
<td>Total</td>
<td>24,500</td>
<td>167,000</td>
<td>One week</td>
<td>544</td>
<td>24,500 M2</td>
<td>Enough</td>
<td>20,000</td>
</tr>
</tbody>
</table>

Table II. The ideal logistics capacities

<table>
<thead>
<tr>
<th>Items</th>
<th>Availability and accessibility</th>
<th>Capital and cash</th>
<th>Contracting and ordering lead-time</th>
<th>Transport and fuel</th>
<th>Storage capacity M2</th>
<th>Traders capacity Handling</th>
<th>Beneficiaries’ needs Persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blankets</td>
<td>3,000</td>
<td>30,000</td>
<td>One week</td>
<td>47</td>
<td>3,000 M2</td>
<td>Enough</td>
<td>14,000</td>
</tr>
<tr>
<td>Wash</td>
<td>2,000</td>
<td>2,000</td>
<td>One week</td>
<td>31</td>
<td>2,000 M2</td>
<td>Enough</td>
<td>14,000</td>
</tr>
<tr>
<td>Kitchen sets</td>
<td>5,000</td>
<td>100,000</td>
<td>One week</td>
<td>78</td>
<td>5,000 M2</td>
<td>Enough</td>
<td>14,000</td>
</tr>
<tr>
<td>Clothes</td>
<td>3,500</td>
<td>7,000</td>
<td>One week</td>
<td>54</td>
<td>3,500 M2</td>
<td>Enough</td>
<td>14,000</td>
</tr>
<tr>
<td>Canned food</td>
<td>5,000</td>
<td>10,000</td>
<td>One week</td>
<td>78</td>
<td>5,000 M2</td>
<td>Enough</td>
<td>14,000</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>6,000</td>
<td>18,000</td>
<td>One week</td>
<td>93</td>
<td>6,000 M2</td>
<td>Enough</td>
<td>14,000</td>
</tr>
<tr>
<td>Total</td>
<td>24,500</td>
<td>167,000</td>
<td>One week</td>
<td>381</td>
<td>24,500 M2</td>
<td>Enough</td>
<td>14,000</td>
</tr>
</tbody>
</table>

Table III. Albeit available capacity
As we can see in the above table that availability of commodities is still the same in spite of the fact that delivery of different commodities is just enough for 14,000 beneficiaries because of reducing transport capacity by 30 per cent; furthermore, all other logistics capacities become surplus and their usage proportions as given as follows:

Availability & Accessibility = 17,150 tons \leq Capital & Cash = 116,900 \$ \leq Contracting = different contracts “outputs enough for 14,000 beneficiaries only \leq Ordering Lead-time = One Week \leq Transport capacity = 381 trucks \leq Fuel = enough for 381 trucks \leq Storage capacity = 17,150 M2 \leq Traders capacity = enough to handle different commodities for 14,000 beneficiaries \leq Beneficiaries” Needs for only 14,000 beneficiaries.

In fact, we still use symbol “\leq” instead of symbol “=” because of a lot of above logistics components would likely fail to avail to the right capacity. Herein, we can see exactly the significant role played by logistics team in terms of supporting market supply chains and voucher implementation because they could take appropriate actions to diminish weaknesses from different logistics functions, regarding to our example, the logistics team could support transportation by availing fuel to local transporters and support local maintenance workshops to expand their activities.

By default, there are pros and cons of this algorithm. First, herein some negative points are given as below:

- The specific algorithm is extreme sensitive and needs correct data; otherwise, the extracted result will not reflect the facts on ground, which objectively will lead to wrong decisions, thereby affecting the people in need.
- This specific algorithm needs to compile various data to reach the intended result and spend a lot of time and efforts.
- This specific algorithm needs to critically analyze and that is not easy in the time of an emergency. Therefore, it preferably prepares it in preparedness phase then updates it in next phases later due to changeable factors.
- Each of component needs to be calculated in a segregated manner due to the proposed crucial standards by experienced employees and then all components needs to integrated due to the lowest value; therefore, it requires the crucial calculations to match the lowest capacity related to components, otherwise, the ultimate results would not represent the ground facts.

On the contrary, herein many positive points related to this specific algorithm as below:

- This algorithm is dynamic, and its figures could change at glance when one of the components has changed due to field circumstances.
- This algorithm is created for non-professional employees and it needs for basic knowledge in mathematics, thereby it can be used smoothly without complexes.
- This algorithm is a key that demonstrates the market supply chain capacity that covers beneficiaries’ needs realistically; therefore, logisticians could determine the portion of deficit in market and how could it be handled.
- This algorithm describes the bottleneck points in market supply chains by highlighting on the lowest values and bottlenecks in distinct stages; thus, logisticians could handle them in future gradually.
- This algorithm owns un-fixed components that could be amended anytime to fit the fluctuation nature relevant to humanitarian operation; by default, we can add new components or remove unneeded components according to an appropriate algorithm due to field circumstances.
This algorithm is the valuable tool to monitor the positive and negative effects on market due to voucher programmes; therefore, it must be calculate on a regular basis and the results should be reported officially to in-line management, thereby, enabling management to address bottlenecks promptly.

6. Final recommendations

This research strongly recommends finding appropriate mechanisms that enable logistics team within any voucher programme to monitor mutual impacts of voucher behaviour and its market supply chains because it is so important to follow up any change in terms of market supply chains even positive or negative. This research discusses the three mechanics that are measuring market ability and accessibility, measuring agility supply chains and measuring capability of logistics procurement. All of them are important tools according to many logistics experts but not limited to these methods. Indeed, each case of voucher programme worldwide deserves to study separately because each market has specific behaviour in response to voucher impacts that appears obviously as changes in markets supply chains’ functions.

Therefore, logistics experts recommend strongly to study each case of voucher modality and determine the appropriate methods to monitor market supply chains’ functions under effects of voucher programme. Of course, this evaluation must conduct continually on timely basis; otherwise, logisticians cannot measure changes in a right manner. Apart from the number of methods, the compiled data must be precisely as possible; otherwise, the monitor and evaluation results can give wrong indicators about impacts of voucher programme on market supply chains performance vice versa.

Definitely, the role of logistics team within voucher programme is vital because they work hard to map the weakness points in specific local markets; of course, they are responsible for choosing appropriate mechanisms to evaluate the nature of market supply chains before, upon and after voucher programme implementation and that gives a clear picture about the impacts of voucher programme on market behaviour and its supply chains. Thereafter, the logistics team could determine smoothly the relevance logistics factors and how could build them in one algorithm that streamlines evaluation of market supply chains capacity any time. This research discusses the relevance factors that could impact market supply chains and voucher implementation; this research paper discusses the key logistics factors such as transportation, storage capacity, final beneficiaries’ needs, cash flow management and others. Of course, each attribute of market supply chains could be affected extremely by one of logistics factors as mentioned above, for example, geopolitical factors could be majority factors that could impact extremely entire humanitarian operation. Of course, there is another example that is a safe factor because safe is an essential factor that could impact whole humanitarian operation especially in last-mile phase; indeed, if safe level is low in destination area, so we would not able to build market supply chains that reach to destination territory smoothly; therefore, it will become difficult to conduct any kind of voucher modality. In other words, determining relevance logistics factors that affect voucher programme performance and its market supply chains’ ability is so important because any failure in determination of relevance factors would hinder whole operation, causing limitation of effectiveness and unneeded interruptions in humanitarian aid efforts.

Any case study must focus on voucher programme, its market supply chains, and relevance logistics factors that lead to know properly the bottlenecks, their places and relevance factors that caused them. Of course, these hurdles must address the proposed solutions that could improve the performance of voucher programme and its market supply chains dynamically. For example, submission advance devices and training to small traders could facilitate voucher programme processes extremely and avoid them any mistakes;
likewise, meeting with involved traders periodically and revising their invoices precisely could avoid lot of obstacles and let the cash flow with more feasibility. In other words, revising performance of voucher programme and its market supply chains periodically is a vital issue; even if all indicators refer to affirmative situation, we still need to determine which are the functions that need improvement. In addition, determining what are the appropriate logistics interventions in need and when is the ideal time for interventions. Thereafter, logisticians could evaluate whether these interventions achieve their goals affirmatively. Ultimately, there is a key point that must clarify precisely, all above mechanisms, assessments, monitoring and analyzing relevance logistics factors that could be implemented on other modalities such as direct cash interventions, cash-transfer programmes, in-kind donation and others. Therefore, these methods could be considered as feasible in other cases.

Eventually, the key result for this research that created chained algorithm/s that are going to use by logisticians to analysis market supply chains that respond to voucher programme to know if the distinct functions are work well. We will need right logistics inputs that are compiled from field and, then, study all assumptions, scenarios and results. In this way, logisticians could follow up behaviour of market supply chains under voucher programme impacts and analysis results step by step. Thereby, logistics team would propose the right logistics interventions related to specific market to avoid any severe interruptions to the beneficiaries in case any of market supply chains’ functions fail to address the needs. These algorithms consider simply and address the needs of voucher programme logisticians and maybe developed in future to become as advanced excel table or advance computerizing system to address increasingly needs by voucher programme logisticians to analysis the behaviour of voucher programme and functioning of market supply chains.

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**Corresponding author**
Bashar Joseph Khoury can be contacted at: bashar915@hotmail.com
Gaming as a research method in humanitarian logistics

Heide Lukosch and Tina Comes

Faculteit Techniek Bestuur en Management, Technische Universiteit Delft, Delft, The Netherlands

Abstract

Purpose – The purpose of this paper is to present a methodology for research through game design and discuss how simulation games can be used to bridge the gap between operational exercises and simulation or analytical modelling and to provide guidelines on how simulation games can be designed for different research purposes in the context of humanitarian logistics.

Design/methodology/approach – This paper combines a literature review on gaming as a research method with an analysis of requirements for humanitarian logistics research methods. Starting from this theoretical framework, the authors develop a design thinking approach that highlights how games can be used for different research purposes. To illustrate the approach, the authors develop two different game set-ups that are of increasing fidelity and complexity. Finally, the authors discuss the results of the evaluation of both approaches, reflect on the design choices and provide recommendations for research and practice.

Findings – Gaming is a suitable research method to explore and analyse behaviour and decisions in emergent settings that require team work and collaborative problem solving. Especially when safety and security concerns may hinder access and experimentation on site, gaming can offer a realistic and engaging quasi-experimental environment. The aspects of engagement and realism also make gaming a suitable tool to combine training and research.

Originality/value – Although the use of games has attracted some attention in commercial supply chain management and crisis response, there is no systematic overview of gaming as a research method in humanitarian logistics. This paper is set to make a headway in addressing this gap by proposing a concrete approach to design games for humanitarian logistics research.

Keywords Humanitarian logistics, Conflict, Information and communication technology, Research method, Research by design, Simulation gaming

Paper type Research paper

1. Introduction

Today 80 per cent of humanitarian funding goes to conflict-driven disasters (GHA, 2017). At the same time, only a small fraction of humanitarian logistics research explicitly addresses man-made disasters and conflicts (Kunz and Reiner, 2012). Maybe not surprisingly, there are only few empirically grounded studies on conflicts since field studies would expose researchers and partnering organizations to risks.

The example of conflicts is only one example calling for research methods that allow us to capture and explore the richness of the context in a controlled and safe research environment. Despite the many calls for empirically grounded research methods in humanitarian logistics (Baharmand et al., 2017; Kovács and Spens, 2009; Kunz and Reiner, 2012; Van Wassenhove et al., 2012), Jabbour et al. (2017) in a recent survey highlight that almost half of the humanitarian logistics publications do not consider context and type of disaster.

As gaming enables participants to experience first-hand the complexity and the pressure to act that are typical for humanitarian operations (Harteveld and Suarez, 2015), and players experience the consequences of their decisions in a protected environment, gaming approaches...
are promising to bridge this gap. Gaming has been used successfully for training in disaster management, security or supply chain management with the ambition to equip decision-makers with the skills to handle the situations they will be confronted with (Barbara et al., 2015; Koray et al., 2015; Kurapati et al., 2015; Meesters and Van De Walle, 2013; Noori et al., 2017). While the possibilities to use games for training are therefore uncontested, little has been written about gaming as a research method in humanitarian logistics.

In this paper, we present gaming as a research method and develop a framework that allows researchers to design and develop games for humanitarian logistics research. We start with a background section that provides insights into the requirements for research methods in humanitarian logistics and discusses simulation gaming generally and as a research method. In Section 3, we explain our methodology: research through game design for humanitarian logistics. Subsequently, we provide two examples of increasing complexity and fidelity that illustrate how gaming can be used for a technology innovation case. In Section 4, we present a board game, primarily targeted at exploratory research and awareness creation. In Section 5, we use a large-scale simulation exercise to combine testing of technology innovation with its impact on performance and usefulness. In a synthesis (Section 6), we compare the main differences and rationales of our design choices, and discussion implications for our findings. Finally, we conclude with an overall reflection on gaming as a research method for humanitarian logistics, and present implications for research and practice in Section 7.

2. Background

2.1 The need for relevant and contextualized research in humanitarian logistics

Although many authors have stressed the need for empirical research (Starr and Van Wassenhove, 2014; Van Wassenhove et al., 2012), the most prominent research method in humanitarian logistics is still analytical modelling and simulation (Kunz and Reiner, 2012; Leiras et al., 2014). At the same time, there is increasing concern about the relevance of humanitarian logistics research for practice (Laguna et al., 2015; Leiras et al., 2014).

Kunz et al. (2017) identify eight barriers to relevant research, falling broadly into barriers for research and barriers for communication and data sharing (including trust and competition). We will use the first set of barriers to develop requirements for gaming as a research method, and to identify problem areas for which gaming is a particularly promising method:

1. Problem definition driven by standard problems: much research is dedicated to improving operations research models and simulations (see above). But humanitarian logistics problems are often ill-structured and messy, requiring the use of multi-disciplinary cross-functional approaches (Näslund, 2002). At the same time, Jahre et al. (2009) stress the need for theory building within the field of humanitarian logistics. Particularly to explore and understand the impact of new, emerging and innovative practices and technologies, such as cash transfers, digital identity, block-chain based smart contracts or new monitoring and tracking systems, research methods are required that support theory building and problem formulation across different research areas and disciplines.

2. Lack of contextualization: as humanitarian responders are working in a complex systems of different organizations, mandates, norms and supported by a range of technologies (Van de Walle and Comes, 2014), it is important to consider interventions in the context. To overcome the lack of context, which is crucial for socio-technical systems, case studies for theory building, field work or participatory action research have been advocated in logistics research (Jahre et al., 2009). Being bound to past or ongoing cases, however, implies that logistics research is not oriented towards the future and the fundamental changes that it may bring (Näslund, 2002). Maybe most prominent in this context is the discussion on trends such as climate adaptation...
or urbanization (Kovács and Spens, 2011), and the interplay between response and
development via social protection systems or local procurement programmes.

(3) Difficult data collection: access to regions that are affected by disasters may put
humanitarians, beneficiaries and researchers at risk and adds a burden to already
stressed system. The lack of research on conflicts has already been mentioned
before. But even if access to selected sites or responders can be achieved, there are
often only few data points are interviewees (Chan and Comes, 2014). Here, methods
are needed that foster the reproducibility and generalizability of results in a safe
environment and allow for comparing different variables and settings.

(4) Lack of validation with practice: model validation is most commonly done by
comparing computational results with benchmark cases (e.g. performance for a past
case) without being reflective on why specific decisions were made and if the
underlying modelling assumptions on the constraints or objectives are correct. Here,
methods are needed to foster the participation of humanitarians in a way that fosters
learning in both academia and practice.

2.2 Simulation gaming

Simulation gaming is an increasingly accepted research method to study complex systems
(Kurapati et al., 2018). Simulation games can be described as experimental, rule-based,
interactive and social organization, constituted by the players themselves, who learn by
taking actions and by experiencing their effects through feedback mechanisms within the
game (Mayer, 2009; Lukosch et al., 2018). They can be distinguished based on the purpose
they serve (Shubik, 1983; Ståhl et al., 1983), leading to following taxonomy:

(1) Training games – with a wide use and acceptance in industry, military and
education, and the aim to train specific skills without too much conceptual detail.

(2) Teaching games – broader in scope than training games, and try to address wider
concepts and more abstract ideas.

(3) Experimentation games – aim at testing theories or hypotheses, and can also be
used to test the effects of certain variables on a given situation.

(4) Research games – are designed and/or used to obtain data or empirical material, dealing
with a more or less realistic situation or scenario, addressing experienced players.

(5) Operational games – to aid decision making, planning and policy implementation in
specific situations.

In simulation games, players enact a certain role in a simulated environment (Duke and
Geurts, 2004). As pointed out by Klabbers (2018), when games are used for research, they
should address players in their capacity of being reflexive actors; while playing being
engaged with introspection, allowing for reflection-in, and reflection-on-action. In the
language of Sociologist Anthony Giddens, games represent a duality of structure as players
of games constitute the emerging social organization, while at the same time the game is the
very medium of its constitution (Giddens, 1993; Klabbers, 2018). Thus, while playing a
game, a player continuously sets new (social) rules, and observes the consequences of his or
her actions and decisions. In games, transfer of knowledge occurs through the player’s
background that influences game play, and through the process of acquiring knowledge and
skills from the game play that can be useful in a specific real context (Copier, 2007). As
Klabbers (2018) discusses, the player is not only a subject, but also on agent or actor, who
demonstrates purposeful behaviour, based on a certain set of skills and knowledge. Such
behaviour can be observed and analysed in a qualitative way.
As such, simulation gaming has a long tradition and proven value in education, policy making and research (Duke and Geurts, 2004; Klabbers, 2006). While games are clearly distinguished from the real world (Klabbers, 2006), their boundary is open to transfers between game and reality, which makes them applicable tools to understand and design real complex systems.

Nowadays, games come in many forms and are based on different technologies. From role-playing games that are based on (almost) no materials, to physical board games, to high-end games that use advanced digital technology. The choice of the applicable game type is based on factors such as fidelity or level of realism that is needed for the purpose of the game, the size of the target group and the quality and quantity of data to collect. Physical board games, for example, have the advantage to enable direct communication and collaboration amongst a relatively small group of players, and allow for open game play, as often rules can be changed by the players (and/or the facilitator) during game play, if necessary. Disadvantages of this type of games are that usually it is difficult to scale them up to a large group of players, and that data collection is limited to observation and reflection. In comparison, digital games are more expensive in development cost and time. On the other hand, data collection and processing can be automated and can be used for quantitative data collection. The implementation and adjustment of scenarios as context and storyline for the game can be easier than in physical games. In some cases, it is not necessary to design complete games, but to make use of the engaging nature of game elements, in order to, e.g., use scenarios to increase the realism of a given exercise, and to foster more realistic behaviour of test persons.

2.3 Gaming as a research method

While in the past simulation gaming has been largely ignored as a research method (Greenblat, 1975), the increasing need to understand complex phenomena slowly turn simulation games into an accepted research instrument (Klabbers, 2006). Especially the use of simulation games to integrate different perspectives, concepts, theories, data, information, methods and techniques from various disciplines makes this method a valuable tool for meaning making and trans-disciplinary research (Klabbers, 2009). As a research method, simulation games are usually combined with other instruments such as questionnaires, tests and debriefing (Kurapati et al., 2015; Lukosch et al., 2018).

As other methods that help in understanding complex problems, simulation games are based on a model. Bradley et al. (1977) characterize the use of models in providing guidelines to decision-makers for effective decisions as operational research. Gaming can thus be described as an approach of operational research, applicable to complex systems. Bradley et al. (1977) categorize tools for operational research into four types: operational exercise, simulation gaming, simulation and analytical model:

1. In an operational exercise, the (research) experiments are directly implemented in the real environment. As discussed above, this is often not possible in humanitarian logistics research, as the real environment can be very dangerous for both participants and researchers as well as for the technology to be tested. Yet, the advantage of an operational exercise is that it can deliver the highest degree of realism.

2. Simulation games are interactive environments that allow for direct engagement and provide immediate feedback to players and researchers. The level of realism is lower than in operational exercises (Bradley et al., 1977), as they represent a more abstract environment. Based on the technology and game process used, it can be easy or difficult to collect valuable data for research purposes. While a pure simulation aims at representing a system as realistic without human interference (Bailey, 1982), a simulation game is a more simplified, yet realistic representation of
a system that can be manipulated by (the decisions of) players. Games are hence characterized by a game layer on top of a simulation.

(3) In simulations, an environment is represented by the use of mathematics or objective representation (Feinstein and Cannon, 2002). Simulation models are inductive and can be used to evaluate the performance of a given system (Bradley et al., 1977). A limitation of most forms of simulation is that the human decision-maker is removed from the representation.

(4) Analytical models are theoretical constructs of a given system, expressed in mathematical terms, usually based on a simplified framework, to visualize complex processes (Choi et al., 2016). Analytical models are easy and cheap to develop (Bradley et al., 1977). Yet, their level of simplification of a given system is usually the highest, hence their level of realism is very low.

Above, we identified gaps and requirements for research methods in humanitarian logistics. Table I compares aforementioned OR research methods based on these aspects, highlighting that simulation games bridge the gap between operational exercises and simulations or analytical modelling.

As in any other method, the validity of the results from gaming of course depends on defining a rigorous set-up and design. Traditional research designs follow four steps: random selection of subjects; random assignment of subjects to different treatment conditions; experimenter manipulation of treatments and experimenter control over the conduct of the experiment (Bachrach and Bendoly, 2011). The strict control over some of these aspects is not given in simulation games. For example, a random selection of subjects can be difficult, when only a limited number of experts is available for a gaming session. Yet, the rigour of the method can be guaranteed, when the process of experimental research is followed. This process can be formulated as conceptualizing the research question; operationalization and design; methodology and collecting data; validity testing and interpretability; and effect and relationship testing (Bachrach and Bendoly, 2011). All steps can and need to be followed when a game is used as instrument.

<table>
<thead>
<tr>
<th>Method</th>
<th>Problem exploration</th>
<th>Type of problem</th>
<th>Ease to reproduce</th>
<th>Contextualization</th>
<th>Data collection</th>
<th>Validation with practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational exercise</td>
<td>High realistic</td>
<td>Based on current practice</td>
<td>Low</td>
<td>High</td>
<td>Risky</td>
<td>Very high</td>
</tr>
<tr>
<td>Simulation games</td>
<td>Realistic</td>
<td>Flexible integration of behaviour and (new) or standard situations, approaches and technologies</td>
<td>High, if rigorous methodology is implemented (see below)</td>
<td>High</td>
<td>Quasi-experimental</td>
<td>High</td>
</tr>
<tr>
<td>Simulation</td>
<td>Abstract</td>
<td>Simulation of new (new) or standard situations, approaches and technologies; assumptions on behaviour</td>
<td>High</td>
<td>Low</td>
<td>Inductive, numeric</td>
<td>Low</td>
</tr>
<tr>
<td>Analytical model</td>
<td>Highly simplified</td>
<td>Data-driven; based on past frequent cases in data-rich environments or standard problems</td>
<td>Very high</td>
<td>Very low</td>
<td>Numeric</td>
<td>Low</td>
</tr>
</tbody>
</table>

Table I. Comparison of OR methods based on requirements for humanitarian logistics research (cf. Section 2.1)
One of the main advantages of simulation games is that they can provide rich output and data. For example, reactions and responses of players in scenario-based role-playing exercises can be recorded, quantified and analysed (Rungtusanatham et al., 2011). As in any other experiment, researchers have to check whether the abstraction of a simulation game influences the results, and how to apply the results to the outside world (Deck and Smith, 2013). Compared to simulations and analytical models, however, the level of complexity and realism of games usually higher.

In sum, games can be seen as operational and interactive representations of a real system, allowing participants and researchers to literally “play” with game elements and observe the consequences. We highlighted above, that there are many choices in game design that influence the validity, type and quantity of data that can be collected through simulation-game-based research and the importance of following design guidelines to develop games for given contexts and research aims. In the following section, we show which design methodology we apply for the use of gaming as research method in humanitarian logistics.

2.4 Designing games for research
To design games for research of complex socio-technical systems, it is crucial to address three aspects: the actor layer, the technological layer and the relationships among actors and between actors and technology (Klabbers, 2018). Especially defining the relationships can lead to interesting game mechanisms, as forms and rules of communication, information sharing, or power relationships can be displayed. Games can be used to research these relationships and can motivate players to change them to improve the real system (Lukosch et al., 2018). In a rigorous way, games can be seen as an artefact in a design science cycle, or to facilitate “research through game design”, as Figure 1 illustrates.

The proposed research through game design process starts with identifying a research gap, and formulating related research questions, as shown in the lower left of the figure. This is mainly a deductive activity. From these theoretical considerations, game requirements are formulated based on theoretical insights and practical considerations. Such rather abstract requirements are then further developed in simple, often paper-based game prototypes. In test sessions with game design and content experts, these prototypes are tested and evaluated. After consolidating a final design, the experimental set-up is developed.

![Figure 1. Research through game design cycle](source: Based on Kurapati (2017))
The data collected in such research cycle can be very different in nature. Typically, game data are collected either directly from the game (scores, decision, actions) or from (structured) observations (validated) material can be used, such as debriefing material, pre- and post-test surveys and other instruments that are related to the research questions. Various approaches towards data analysis can be used, such as content analysis, coding of verbal feedback or Bayesian analysis.

The cycle illustrates that gaming can be seen as part of a whole research design, where a theoretical gap analysis leads to research questions that inform both the design of a game prototype, and the development of hypotheses or a research framework.

3. Methodology
To understand the specific steps and requirements for designing games as a research instrument for humanitarian logistics, we use a case study approach that allows us to explore the intricacies of the method for one of the most prominent cases that call for gaming as a research method: innovation in conflict situations.

3.1 Case study: information technology for humanitarian logistics in conflicts
To illustrate how gaming can be applied as research method in humanitarian aid logistics, and how this field can benefit from gaming research, we focus on information technology developments. Humanitarian organizations are confronted with mounting tensions as they seek to maintain access to populations in need and provide aid to the most vulnerable populations in crisis regions such as the Middle East or Africa. Technological innovation is seen as one of the major game changers to enable humanitarians to “Stay and Deliver” (Egeland et al., 2011). For example, satellite imagery, real-time analysis of camera footage from cars or UAVs and more generally speaking remote sensing and monitoring are seen as promising approaches to help humanitarian organizations to rapidly evaluate access conditions and risks (Comes and Van de Walle, 2016). While in 2015, cash and markets-based interventions only amounted for about 6 per cent of all aid, relief provision is beginning to shift towards virtual distributions through digital payment systems, or “mobile money” (Logistics Cluster, 2015). Orders and shipment logistics can be complemented by social media feeds and analyses of customer buying patterns (Majewski et al., 2010), and biometric identification technologies are increasingly used for refugee management (Jacobsen, 2015).

Real-time tracking and monitoring is expected to improve efficiency and effectiveness of logistics by enabling decision-makers to adapt to the ever-changing context of the operations. As such, technological innovation entails the need to adapt decision processes, coordination and management structures (Comes et al., 2018).

Introducing new technologies or processes in an on-going conflict poses a significant risk, because any deviation from procedures, malfunction, unforeseen use or even possession of technology can cause harm. At the same time, it is important to take into account the specifics of the context, such as the sensitivity of data and information, or the legal and technological constraints, security and logistics guidelines and policies (Van de Walle and Comes, 2015). As such, the challenge of evaluating the impact of monitoring and tracking technologies on humanitarian logistics in conflict is used as example for many other innovations that are currently being explored as new humanitarian technologies.

Van Wassenhove (2006) argues that a humanitarian supply chain needs to be designed to align material and informational flows. To evaluate the impact of innovation on supply chain performance and the use in terms of (improved) decision making and coordination, we therefore analyse a humanitarian supply chain across three layers: in terms of physical movement of goods and people; informational flows; and decision making and planning.
3.2 Game design approach

To explore which technologies could be beneficial for humanitarian operations; and to identify what the impact of the developed solutions is on all the three levels, we developed and used a two games in the context of a European research project that develops technologies and policies for staff safety and logistics support in conflicts. First, we conducted a requirements analysis for the development of a tracking, monitoring and logistics support system. We supported this step with the development and implementation of a board game. Second, we used game elements in a large-scale exercise to evaluate the usability and usefulness of the developed system.

Here, we use the game research cycle (Figure 1) to discuss how the respective games were designed and used. All documentation of the concrete game designs, execution and evaluation are available publicly and openly in the project deliverables on www.itrack-project.eu/page/en/documentation/public-deliverables.php

For the board game, we first conducted a systems analysis of the processes of humanitarian logistics, building upon theoretical knowledge in humanitarian logistics, information management and ICT. Second, we reviewed the proposed solutions from technical partners in the research project. We chose to use the game to explore decisions and preferences of aid workers towards different technical components of the proposed system. This set-up led to a number of game requirements, such as that the game should be placed in the context of a crisis situation, that it should foster the discussion between different humanitarian aid organizations, and that it should be playable within half a day. Based on this identification of requirements, a first paper-based prototype was developed and test-played with game design experts. Based on their feedback, and after some design iterations, the final design of “Plaitra” was developed. As experimental set-up, it was decided to conduct a qualitative study, in which the game served in first instance for making the players aware of the different technical solutions, and to observe their choices in the game. Second, a debriefing structure and questions were developed, following the guidelines by Kriz (2010).

For the exercise, the research aimed at testing a prototype of the technologies and its impact on workflows, communication, decision making, coordination and performance. Here, we used game elements, especially scenario building and role-playing, to support a realistic system test. Again, theoretical articles as well as working reports were analysed to identify current processes and policies in humanitarian logistics. Those were translated into scenarios and role descriptions that related to different system components. A large number of additional research instruments was selected, such as usability test instruments, demographical data collection, questionnaires to evaluate the experienced usefulness of the system, as well as debriefing structures. A combination of qualitative and quantitative data analysis methods was applied to interpret the data collected. The results of this test informed the development of the final, integrated version of the socio-technical system.

4. Plaitra

4.1 Design cycle: needs analysis, prototype development, tests

The physical board game “Plaitra” is the result of an iterative design process, including academics, game designers and experts from the field, following the research design cycle as shown in Figure 2. First, interviews were conducted with humanitarian aid workers to explore what kind of technology is used in conflicts, and to carry out a needs analysis. Via a literature review, we identified requirements for innovations to be of use for humanitarian operations in this context. Based on both empirical work and literature review, research gaps were identified. Second, a game prototype was developed and tested with students of a technical university as well as experts with a background in humanitarian aid (for details, see Schwarz et al., 2017). The main requirement for the game design was that the game
The game should allow researchers to observe the decisions of the players for a technology. Furthermore, the impact of that choice on logistics operations should immediately be visible both for players as well as for researchers.

In the game, players take over the role of humanitarian organizations, who have to efficiently allocate limited resources while dealing with multiple risks, uncertainties and impediments to communication. Additionally, no single organization can cover all humanitarian assistance needed; instead, organizations have to collaborate. Consequently, humanitarian actors have to share information and coordinate their operations in order to ensure a coherent response.

The game material consists of two boards that represent a crisis region, as illustrated in Figure 3. Four teams of two players play the game, while two researchers/facilitators support them. Players have to carry out assessments to indicate the humanitarian needs in particular places. Players can invest in technologies to gather and share information.

We identified three main categories of information that were translated into the game: humanitarian needs, actions of other humanitarians and security situation. In order to let players experience how technology impacts information flows and thereby logistics processes and coordination, the following goals for the game have been identified:

1. The main purpose of the board game is supporting requirements analysis. After game play, a structured debriefing is used to discuss technologies and policies with the players.

2. The technological components that are available for the players in the game represent the components proposed by the technical partners of the research project, and beyond. They include advanced technologies that are not deployed in the field of humanitarian logistics yet. The extensive list of available technologies in the game is designed to make the player aware of the possibilities of technology for the humanitarian field.

3. Information management workflows and processes have been modelled for implementation in the game, which allows us to explore the processes and policies of their use, too.
(4) The role of coordination is addressed in the game. Communication is not allowed in the first rounds of the game. Players need to invest in technologies to be able to share information and coordinate with each other.

(5) Humanitarian responders operate with constrained resources. This has been modelled in the game by disruptive events happening during the game play, and the limited availability of technology at the beginning, but also during the game.

4.2 Empirical cycle: experimental set-up, game session and data collection

We decided for qualitative data analysis of the game session, as we expected only a limited number of test persons being able to participate in a game session, and our research was primarily of exploratory nature. We first created an observer protocol and an in-game observer role to make the role less intrusive. During game play, a journalist notes down observations of player actions and decisions along a pre-structured protocol. Furthermore, journalists can provide some information to the players. In addition, the game session includes a debriefing phase, following the structure of debriefing as proposed by Kriz (2010).

We invited 16 humanitarian practitioners with experience in the field to take part in a full-day game workshop. The 16 players were randomly distributed to two parallel sessions that took place at a University in Finland. In each session, a facilitator as well as a journalist joined. The game play started with a briefing, introduction to gaming, purpose and main rules of the game. After that, the players played 16 rounds with the game (see for an impression Plate 1).

The observers stayed during the whole game play and wrote down their observations. After game play, players first filled in a questionnaire about their experience of the game play. Then, all 16 players gathered for a plenary debriefing that was facilitated by a researcher who was not involved in the game play. After the plenary debriefing, the players...
discussed in smaller groups which technology would be useful and usable in humanitarian aid logistics. The results of these discussions were collected, too.

### 4.3 Results

Via the questionnaires, we collected experiences with the game, and how useful the players valued the game as instrument itself. The outcome of this research step was foremost positive. This feedback showed that the game design was perceived as engaging, purposeful, and – despite the high level of abstraction – realistic. Some comments from the questionnaires and debrief allowed us to improve the fidelity and realism of the set-up and workflows.

Through a combination of performance measuring of the play itself, observation of the discussion during the games, the de-brief sessions conducted after the game play, a number of issues were raised that are relevant for the further discussion of technology innovation:

- the general scepticism against technology innovation particularly at operational level;
- the need to address secondary impact of using technology in the operating environment;
- the need to support decision making under security threats during convoys; and
- the need for decentralized communication structures among operational staff; and the need to align technology and workflows and processes.

These results show that the research through game design approach allowed for broader insights than the choices of players alone. Especially, the combination of research instruments, namely game play, observation, questionnaire and debriefing, provided rich material that allowed for above mentioned conclusions. To specifically address the last point in the list, the simulation exercise was designed, again using the game design research cycle.

### 5. Simulation exercise

Based on the requirements from the game, a literature review and a series of interviews, a tracking, monitoring and logistics support system for humanitarians in conflicts was developed[1]. To test the usefulness and impact of this system, the research through game design cycle was conducted a second time, taking the results from the board game as a starting point. For the second iteration, a computer supported simulation exercise was held at the campus of Delft University of Technology in April 2018. This exercise aimed at creating a safe and realistic environment to integrate software testing activities with
humanitarian logistics and coordination. Humanitarian logistics professionals as well as technology developers joined the exercise. As for the board game, we will illustrate below how we implemented the research through game design cycle in our design choices for the exercise.

5.1 Design cycle: exercise requirements, tests and overall design
The first step in the design of the simulation exercise was to define the requirements for the exercise. The exercise itself was meant to close the first development cycle of the integrated version of the tracking, monitoring and logistics support system and to inform the second development phase with additional requirements. Two sets of requirements for the exercise were identified: first, an evaluation framework was developed that addressed the individual technological components, as well as the integrated platform. An inventory of all technological components and related hard and software needs was made, and we chose to evaluate their usability with help of existing and accepted instruments.

Second, the purpose was to create a realistic stress test for the system beyond the limitations of a clean, experimental test situation. To this end, scenarios, understood as game elements to increase the fidelity or realism of the exercise, were developed, to enable participants to test the system in a realistic quasi-experimental environment. Different locations were chosen and decorated into realistic mission control room, warehouse and checkpoint (Plate 2). In addition to the experiment materials such as laptops and mobile phones, other facilities used to increase the fidelity included a convoy of three vehicles, radios and a UAV.

The exercise was monitored at both the system and the process level. The system was monitored at the back-end and fine-tuned immediately when necessary. Operations at all three exercise locations were filmed through webcams and all communications made in the system were logged for post exercise analysis.

5.2 Empirical cycle: realization of the exercise and data collection
The simulation exercise was carried out in April 2018 with participants from the project consortium, humanitarian organizations and EU civil protection. The usability tests focussed on testing each component. The participants were asked to fill in various surveys to evaluate the user experience (Laugwitz et al., 2008), the components’ usefulness and ease of use (Davis, 1989), as well as the ethics and privacy issues addressed by the system. The usability test was completed with a short debriefing for direct comments and feedback to the tech partners.

In order to effectively test the integrated system, the simulation exercise adopted scenarios of basic logistics workflows that were combined with a collection of special injects to represent various field situations. The special injects covered issues from the perspectives of logistics procedures, humanitarian information management and security risk management. All exercise data, including communication and system operations,
were logged automatically on a secure local server for analysis. A debriefing session was held at the end of each day to discuss issues encountered from the exercise and collect feedback on both the system and user behaviour. At the end of the week, a final reflection meeting was organized to summarize the progress made and the lessons learnt throughout the simulation exercise.

5.3 Results
All participants viewed the simulation exercise valuable and as an insightful way of testing technology. The scenario-based testing approach allowed participants to experiment new technology in a realistic and safe environment. The exercise week also brought the technology developers and end users together and shortened the feedback loop between the test lab and the fields. In addition, playing logistics themed scenarios and injects also provided a platform to reflect specific policies and protocols in carrying out missions. In the exercise, especially the realistic documents used for information management as well as the realistic communication protocols applied added to a realistic feeling. They contributed to a realistic, while safe test environment in the context of humanitarian aid logistics.

6. Synthesis
Humanitarian logistics requires both anticipation-based strategies that rely on extrapolation of trends and forecasted scenarios (Laguna Salvadó et al., 2018) as well as approaches that foster resilient, flexible and agile supply chains (Charles et al., 2010; Oloruntoba and Gray, 2006). The role of (new) information and communication technology (ICT) has widely been described as essential (Altay and Labonte, 2014; Comes et al., 2019) – but it is yet to be explored how ICT can support robustness and resilience in humanitarian operations.

For our case of ICT in conflict situations, we were able to create realistic and at the same time safe research conditions. Table II illustrates how different research questions were addressed for both games. In both games, we were able to address and evaluate the impact of innovation on supply chain performance and on decision making and coordination. Following Van Wassenhove (2006), we did this on and across three layers: in terms of physical movement of goods and people; with regard to informational flows; and in relation to design choices

| Table II. Comparison of key choices for the board game and simulation exercise |
|-----------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Corresponding research gap        | Board game: Plaitra                                           | Simulation exercise                                                                                           |
| Research framework                | Theory building; reproducibility; collaboration with practice  | Theory building; contextualization; collaboration with practice |
| Assumptions                       | Requirements elicitation for technology innovation, such as for tracking and monitoring technologies | Testing and evaluation of impact of innovation on individual and team performance |
| Fidelity                          | A board game can represent logistics and communication processes to enable experts to make choices explicit | A realistic exercise allows the actions of humanitarians to be observed so their usability and usefulness in the field can be measured |
| Needs to be run in a limited time; few players; relatively easy to set up and transfer; low cost | Several hours; extensive in set-up, high requirements in preparation, planning and technology, including multiple volunteers; high cost |
| Data collection                   | Notes of the players; observations; video; debrief            | Logs and messages as documented in the system; observations; video; debrief |
| Main types of result              | System requirements                                           | Performance testing, usability, perceived usefulness |

Design choices
to decision making and planning. In the following, we will discuss the most important differences in the design choices and their implications.

In the Plaitra board game, physical movement was represented with lego blocks, both simulating trucks as well as assets of aid supply. Players were able to track their assets and get direct feedback on movements, and aid supplied to people in need. Additionally, players had to handle realistic forms to manage the logistical processes. The movement of lego blocks – assets – was used as direct feedback from the game, but also to show the difference on the assumed and actual situation. This direct feedback of the game enabled the players to immediately evaluate the effects of their decisions. Thus, game play allowed showing consequences of decisions and actions not only on one individual layer, but also across the three layers.

In the simulation exercise, physical movement could be simulated even more realistically. Boxes and sacks had to be carried from a warehouse through a physical checkpoint back to the warehouse. The goal of this exercise element was mainly to increase the fidelity of the exercise, which was appreciated by the participants. Especially the realistic scanning of assets, and again, the combination with realistic forms that had to be used, supported the realism of the exercise. Different technology was used to track assets and people during the exercise. Using technology had the advantage to automatically log information flows to be used for evaluation after the exercise. During the exercise, technology was used in the planning and as decision support tool. It allowed participants as well as research works to immediately observe consequences of their decisions. This second case shows how all three layers of humanitarian aid logistics can be addressed by gaming as a research method.

The use of the board game Plaitra illustrates how a relatively limited and simplified game session can contribute to explorative research. In a qualitative way, choices and preferences of experts towards an innovation in the field were identified. The biggest challenge here was to provide a game that was realistic enough to foster realistic choices, while simplify processes in a way that an engaging game play was realized. Thus, the challenge here lied in the design cycle of the research development.

In the exercise, the greatest challenge we faced was located in the empirical cycle, namely the data collection. The exercise itself could relatively easy be developed based on empirical data and information from the field. Yet, as a very realistic and rich test environment was developed, that required a high number of resources (personnel and materials) for conducting and evaluating the field exercises.

7. Discussion and conclusions
In this paper we argue that (simulation) gaming is a research method that complements the existing OR methods in providing a realistic and experimental environment for problem exploration. Research can be conducted in a contextualized yet safe way, as scenarios and roles are implemented in the game environment. Different types of data can be collected within a quasi-experimental set-up. When experts are involved in the development of the game as well as the game session itself, validation with practice is high. Yet, researchers who would like to use games as a research method have to carefully follow a rigorous design process. Most importantly, balancing the complexity required to provide a realistic and engaging set-up with simplification of tasks for reproducibility and valid data collection.

We chose gaming as a research method approach, to address some of the limitations of current research in humanitarian logistics on the four main aspects as introduced in Section 2.1. In the following, we discuss the implications of our findings from the case along these challenges:

1. Problem definition driven by standard problems: by using gaming as a method, we are able to address ill-defined problems (Westera et al., 2008), and explore and understand the impact and use of innovations and how it translates to coordination and performance. Results of qualitative (game) data analysis can thus inform theory building and testing.
(2) Lack of contextualization: games can represent the complexity and uncertainty of a crisis or disaster, yet in a safe environment. A novel technology or policy; or an extreme or dangerous scenario can thus be tested in a safe and at the same time realistic environment that allows for valid results to be translated into the field.

(3) Difficult data collection: gaming as a research method allows for quasi-experimental study-set up, and for a controlled data collection that integrates the behavioural aspects of decision making, processes and coordination structures.

(4) Lack of validation with practice: games can both be developed and played with experts. An early inclusion of experts in the development process ensures the verification of the design of the game. The participation of experts in the game play process itself guarantees validity of the results collected through game play.

7.1 Implications for practice
As discussed prototypically for Plaitra, games have a great potential to connect research and innovation for practice if they are useful for training purposes. We think that this is a unique way to use the power of engagement and the “fun” factor of the games that players generally agreed on for both research and practice.

However, these games have to go beyond the traditional exercises that focus on situations that can be anticipated or that have occurred before to prepare responders and logisticians for the response. In a more and more uncertain and complex world, the exact conditions that field logisticians will be confronted with are harder and harder to predict, and particularly the impact of new technologies on the future operations is hard to foresee. In such uncertain situations, different types of preparation are necessary, that relates to general skills such as flexibility, adaptability, creativeness, communication and decision making. Results of such empirical research can help to support actors in both ways.

Design recommendations for practice:

1. Be aware of the dynamic and uncertain nature of the field and make these characteristics a vital element of the game to be used.

2. Games are only one method to gather a certain type of data related to the human factor. Make sure to include data from other sources to develop a complete picture of a problem.

3. Games are dynamic and the players create their own reality. Let them explore and observe, use the observations to increase the feedback of the game.

7.2 Outlook and implications for research
We have argued that gaming as a research method has potential to contribute to theory building and exploration of new emerging technologies; in situations of limited access and high risk; or for rare and extreme situations. Gaming as a method particularly allows us to explore the interplay between an intervention (e.g. a policy, process or technology) and work practices, decision making and team performance.

Design recommendations for research:

1. Ensure that design and empirical cycle in the research process are well related.

2. Start with formulating a problem, based on theory (and practice), and define game requirements including data to collect.

3. Go beyond designing a game as isolated tool. In some circumstance, it can be useful to use game elements instead of a complete game. Carefully consider and choose additional research instruments including a reflection moment.
Gaming as a research method can open the path to new insights and models, but because of the natural restrictions in numbers of players and experts, duration of play, facilities and equipment, gaming is an addition to other research instruments such as field studies or optimization and simulation. Here, approaches need to be explored that enable a translation of the data and insights collected through the games into valid theories and models, and that embed these insights back into a new cycle of game design and testing.

**Note**


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**Further reading**


**Corresponding author**
Heide Lukosch can be contacted at: H.K.Lukosch@tudelft.nl
Using collaborative research methodologies in humanitarian supply chains

Yasmine Sabri
Aston Logistics and Systems Institute, Aston University, Birmingham, UK
Mohammad Hossein Zarei
Faculty of Business and Law, School of Strategy and Leadership, Coventry University, Coventry, UK, and
Christine Harland
School of Management, Politecnico di Milano, Milan, Italy

Abstract
Purpose – The purpose of this paper is to develop an existing collaborative research methodology process (Sabri, 2018), contextualise it for application in humanitarian supply chains and test it empirically.
Design/methodology/approach – Building on collaborative research methodology and humanitarian supply chain literature, the Sabri’s (2018) collaborative research methodology process is further developed to comprise eight phases of collaborative research contextualised for the humanitarian supply chain domain. The process is applied in a collaborative research case of academia–practitioner knowledge co-creation in a humanitarian supply chain setting, focussing on environmental sustainability improvement. The collaborative case analysis suggests a number of refinements to the elements of the process. This study undertook two cycles of academia–practitioner collaborative research.
Findings – In testing the process, a noticeable improvement in the collaboration among different humanitarian stakeholders was observed, leading to improved stakeholder management. The implementation improved the sustainability awareness and social inclusion of the affected population. Rurality, remoteness, security issues and resistance of field staff against change were among the main challenges for supply chain researchers to engage in collaborative research in the humanitarian domain.
Originality/value – The paper addresses the rigour–relevance–reflectiveness debate in the humanitarian supply chain domain. A collaborative research methodology process derived from action research is further developed using humanitarian literature, and then it is applied in a humanitarian logistics case focussed on environmental sustainability. The present collaborative research process facilitates engaged scholarship among the humanitarian stakeholders, as the researchers’ roles move from observatory to participatory knowledge broker.
Keywords Sustainability, Humanitarian logistics, Humanitarian supply chain, Action research, Collaborative research
Paper type Research paper

1. Introduction
The need for better coordination and collaboration in humanitarian supply chains is acute; this is primarily due to the high uncertainty at the demand and supply sides (Van Wassenhove, 2006). The particularities of these uncertainties make coordination and collaboration in humanitarian supply chains different to that in traditional, non-humanitarian settings (Gatignon et al., 2010). Therefore, more research on how to improve coordination and collaboration in humanitarian supply chains is required.

Despite recognition of the need for more research, concerns have been expressed about the limitations of ongoing research in humanitarian supply chains because of the proliferation of use of particular research methodologies. In the humanitarian supply chain domain, simulations, modelling and qualitative case studies are dominant methodologies.
(Kunz and Reiner, 2012). However, their appropriateness for addressing multidimensional challenges of this complex, uncertain environment has been the subject of debate (Näslund, 2002; Näslund et al., 2010). Using the same, limited range of research methodologies can lead to “produce[ing] similar questions and answers” (Gammelgaard, 2004, p. 479). The same notion is expressed in Näslund (2002, p. 327):

If researchers within a certain academic discipline do the same kind of research as everyone else within the discipline, then how useful will that research be?

There might be usefulness in this kind of research, even though “not useful enough” (Gammelgaard, 2004, p. 483). The intent behind this research is not to undermine or replace other research methodologies, as all types of research works are needed (Näslund, 2002) since they reflect how logistics and supply chain researchers view reality from different perspectives (Gammelgaard, 2004). However, knowledge of humanitarian supply chains cannot grow and achieve the hopes it holds, for its researchers and practitioners, if they continue to create that knowledge using the same methodologies (Näslund et al., 2010).

A further concern with humanitarian supply chain research is the rigour–relevance gap (Bartell et al., 2006; Jahre et al., 2015; Kunz and Gold, 2017; Sohn, 2018), which has increased interest in the use of research methods that might help close this gap. Collaborative research methods (CRM) in humanitarian settings involve research collaborations between academics and practitioners, practitioners and affected populations, academics and affected populations, and academics, practitioners and affected populations. To enable the creation of practically relevant and theoretically based knowledge, frameworks and models, research in humanitarian settings would benefit from a proactive approach of academia–practitioner collaboration to research across university, institutional and organisational boundaries (Bartell et al., 2006; Prasad et al., 2017). As such, collaborative research methodologies with their participatory focus bridge two worlds, academic concepts and practitioners operating models (Chang et al., 2010), and create contextually relevant knowledge (Sohn, 2018).

Therefore, Engaged scholarship as “[…] a collaborative form of inquiry in which academics and practitioners leverage their different perspectives and competencies to coproduce knowledge about a complex problem or phenomenon that exists under conditions of uncertainty found in the world” (Van de Ven and Johnson, 2006, p. 803) appears to be a very relevant research methodology for humanitarian supply chain research.

In the present research, we use an existing collaborative research process (Sabri, 2018) and contextualise it to apply to a humanitarian logistics problem. The collaborative research methodology process presented here builds on similar earlier processes from the supply chain and operations management domain (see e.g. Coughlan and Coghlan, 2002; Näslund et al., 2010). Moreover, we incorporate learning from the collaborative humanitarian field experience reported in prior literature (see e.g. Chandes and Paché, 2010; Jahre et al., 2012, 2015; Pedraza-Martínez et al., 2013; Prasad et al., 2017). Through analysis of 17 collaborative research projects in the broader humanitarian setting, themes from these projects are used in the contextualisation of the methodology process.

To test the developed process, we apply it in a humanitarian logistics case relating to environmental detriment caused by packaging in humanitarian supply chains. Environmental sustainability has not been sufficiently addressed in humanitarian supply chains in practice; Eng-Larsson and Vega (2011), Sarkis et al. (2012), Haavisto and Kovács (2014), Abrahams (2014) and Kunz and Gold (2017) call for more research on this topic in humanitarian logistics research, highlighting that as humanitarian operations increase globally, so does the environmental burden caused by them. The attention of scholars in the humanitarian arena has largely been, to date, directed to disaster relief, focussing on improving preparedness and response (Leiras et al., 2014). The urgency of humanitarian response to disasters may be perceived as outweighing the need for sustainability (Cravioto et al., 2011).
We apply the developed process in a single case with two cycles of collaborative research between academic and practitioner partners in a humanitarian supply chain setting. After the case analysis, we refine elements of the process and provide insights on lessons learnt from the research.

The contributions of the present research are threefold. First, to the best of our knowledge, this study is novel in providing a comprehensive process for collaborative research in humanitarian supply chain settings. Second, we provide empirical findings on how collaboration between academics and practitioners helped to improve sustainability of the management of packaging in humanitarian logistics supply chains. Third, we identify the implications, benefits and challenges of engaging humanitarian supply chain researchers and practitioners together in a collaborative research project. In so doing, the outreach of humanitarian logistics research is increased (Kovács, 2012), and decisions in humanitarian crises can be based on appropriate evidence (Pedraza-Martinez et al., 2013; Sandvik and Lemaitre, 2013).

The paper is organised as follows. First, we examine collaborative research in Section 2. Next, Section 3 discusses collaborative research in humanitarian supply chains and proposes a collaborative research process. The application of the process to a humanitarian case is shown in Section 4. Then, the findings and refinements to the process are discussed in Section 5. Finally, Section 6 concludes the paper and summarises theoretical and practical contributions.

2. Collaborative research methodologies
Basing practice decisions on research evidence has a long history in the fields of law, medicine and public policy; however, it has entered the field of management more recently (Pfeffer and Sutton, 2006). The process of evidence-based decision making involves formulation of the research question, gathering appropriate research findings and evidence, assessing the validity, quality and appropriateness of the evidence to the problem in hand, presenting the evidence in a way that is useful to the decision-making process, and then applying it to that decision-making process (Gray, 2004; Kovner and Rundall, 2006). There are various approaches to evidence-based management that follow similar processes from problem identification to decision and evaluation (Robbins, 2008). Engaged scholarship emerged as a way to enable co-creation of knowledge and to facilitate the engagement and integration between members of the academic- and practice-based research team (MacLean et al., 2002; Van de Ven and Johnson, 2006). For management research to be termed collaborative, two parties or more need to be involved in the knowledge co-creation process, of which at least one is a practitioner (Pasmore et al., 2008). This type of collaborative management research is positioned close to the Scandinavian tradition of interactive research (see e.g. Ellström, 2007; Svensson et al., 2007). The co-creation of knowledge entails having shared objectives, jointly deciding on the research purpose and mutually framing the research questions. It may also require co-designing of action plans and co-evaluation of the project outcomes (Shani et al., 2012).

2.1 Types of collaborative research methodologies
Shani et al. (2004) identified eight types of collaborative research methodologies: action science, appreciative inquiry, clinical inquiry, developmental action inquiry, intervention research, participatory inquiry, table tennis research and action research. Collectively, they are concerned with action, intervention and transformation that lead to theory building and knowledge co-creation. Some of the outlined eight types are viewed by other scholars as a participatory approach to inquiry and the research process; Bradbury (2013, p. 3) questioned whether action research is a methodology of its own:

Action Research is not a method, but an orientation to inquiry, with many schools, theories and practices.

Hence, it could be applied in the settings of a case study (see e.g. McManners, 2016).
2.2 Collaborative research in humanitarian supply chains

The application of collaborative research methodologies in humanitarian supply chain research has been very limited. In some instances, when adopted, researchers have not explicitly reported using a collaborative research methodology, such as Tomasini and Van Wassenhove (2009), where it is evident that collaboration methodologies and coordination schemes can significantly reduce costs and enhance the preparedness and response of humanitarian supply chains. In other cases, researchers specifically identified use of a type of collaborative research; in the Appendix, we present 17 collaborative research projects in the humanitarian domain. In Chandes and Paché’s (2010) study, the research team used observant participatory action research as a methodology; one of the team members was embedded (employed) in the practitioner environment. Jahre et al.’s (2012) study used action research with more than 50 interviews and 27 site visits. Rigour was ensured by cross-referencing data from multiple sources and having two researchers conduct the interviews and site visits swapping roles between participatory and observatory researcher. In Pedraza-Martinez et al. (2013), participatory research was used to co-identify the research problem, develop optimisation models for vehicle routing and fleet management in the humanitarian field and implement these in humanitarian organisations (HOS). Jahre et al.’s (2015) empirical study ensured research rigour through triangulation of multiple methods for data collection and analysis, and using multiple researchers with different roles. The research project had cycles of interventions, and the research team, including humanitarian practitioners, had reflective sessions to discuss data analysis and needed intervention.

Collaborative research in humanitarian settings has involved collaborations between combinations of academics, practitioners and affected populations. The focus of this paper is on academic–practitioner collaboration. Sandvik and Lemaitre (2013) used a case-study design combining traditional methods of legal analysis, ethnographic observation, and participation amongst university researchers and a research committee set up by an NGO. Refstie and Brun (2011) used co-identification of a research problem and co-analysis by academics and practitioners in focus groups. Chang et al. (2010) used multiple rounds of action research intervention with reflective sessions involving researchers and practitioners. Prasad et al. (2017) used a mixed-method approach between action research and non-linear integer programming-based simulation, with a team of researchers and officers of an NGO. From these studies, evidence of the following challenges are summarised in Table I.

Despite these challenges, many benefits of collaborative research in humanitarian settings are reported, as summarised in Table II.

3. A process for collaborative research in humanitarian supply chains

Collaborative research processes are cyclical, and the outcomes are co-evaluated on multiple iterations through phases of planning, intervention, taking action and reflectiveness, which can lead to transformation (Canterino et al., 2016). A collaborative research methodology should contribute to theory building of the supply chain domain (Coughlan and Coghlan, 2002) through high-level involvement of both researchers and practitioners (Schein, 2006).

Prior research has provided various collaborative research methodology processes based on action research in the supply chain and operations management domain (Coughlan and Coghlan, 2002; Naslund et al., 2010; Sabri, 2018), as well as the humanitarian field experience reported in a number of collaborative research projects (see e.g. Chandes and Paché, 2010; Jahre et al., 2012, 2015; Pedraza-Martinez et al., 2013; Prasad et al., 2017, and Appendix). Here we combine learning from both these domains to develop a collaborative research process oriented to research in humanitarian supply chain settings. This process is based on
the phases proposed by Sabri (2018) and expands elements specifically for the humanitarian logistics context.

In line with other CRM processes, this research method process starts by forming a collaborative team, understanding the research problem’s context and purpose, then proceeding to data collection, practitioners’ orientation, collaborative data analysis, joint planning for action, implementation and evaluation and ongoing monitoring (Table III).

4. A collaborative research case – sustainable humanitarian supply chains

4.1 Context

This case is on research and practice of environmental sustainability of humanitarian supply chains. Environmental sustainability has not been sufficiently addressed in humanitarian supply chains (see e.g. Eng-Larsson and Vega, 2011; Sarkis et al., 2012; Haavisto and Kovács, 2014; Abrahams, 2014; Kunz and Gold, 2017). Because of the increasing scale of global humanitarian operations and the urgency of humanitarian logistics, an increasing environmental burden is occurring, such as the consequential cholera outbreak in Haiti (Cravioto et al., 2011). Green practices may not simply be

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<tr>
<th>Challenges of academic–practitioner collaborative humanitarian aid research</th>
<th>Sources</th>
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</thead>
<tbody>
<tr>
<td>Inconsistency of data and knowledge quality between different observers</td>
<td>Jahre et al. (2012), Kieser and Leiner (2012), Hamet and Michel (2018)</td>
</tr>
<tr>
<td>Coordination, linguistic and communication barriers including varied technical terminologies</td>
<td>Lykes (2013), Pedraza-Martinez et al. (2013), Tanabe et al. (2015, 2018), van den Muijsenbergh et al. (2016), Kunz and Gold (2017)</td>
</tr>
<tr>
<td>Reflective long-term collaborative research is time consuming, and most HLSCM research works focus on urgent supply</td>
<td>Pedraza-Martinez et al. (2013), Jahre et al. (2015), Sohn (2018)</td>
</tr>
<tr>
<td>Remoteness of many humanitarian aid locations</td>
<td>Rutta et al. (2005), Nelson et al. (2010), Pedraza-Martinez et al. (2013), Prasad et al. (2017)</td>
</tr>
<tr>
<td>Highly contextualised research impedes generalisability of findings</td>
<td>Touboulic and Walker (2016)</td>
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Table I. Challenges of collaborative research in humanitarian settings

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<tr>
<th>Benefits of academic–practitioner collaborative research in humanitarian settings</th>
<th>Sources</th>
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<tbody>
<tr>
<td>Collection of richer and “better data”</td>
<td>Pedraza-Martinez et al. (2013)</td>
</tr>
<tr>
<td>Enhanced information exchange and stronger supply chain competence</td>
<td>Jahre et al. (2012)</td>
</tr>
<tr>
<td>Bridging the gap between academic and practitioners’ terminology and perceptions on the humanitarian domain, enhancing trust and engagement and solving real-life problems</td>
<td>Pedraza-Martinez et al. (2013), Refstie and Brun (2011)</td>
</tr>
<tr>
<td>Bridging the relevance gap between humanitarian logistics practitioners and academics</td>
<td>Kunz and Gold (2017)</td>
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Table II. Benefits of academic–practitioner collaborative research in humanitarian settings
<table>
<thead>
<tr>
<th>Collaborative project phases</th>
<th>Collaborative research features/elements</th>
<th>Contributions*</th>
</tr>
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<tr>
<td>3. Data collection (by humanitarian logistics and supply chain researchers)</td>
<td>Triangulation of research methods (e.g. combining interviews, focus groups and questionnaire/survey)</td>
<td>Coughlan and Coghlan (2002), Canterino et al. (2016), Näslund et al. (2010), Shani et al. (2004), Sabri (2018)</td>
</tr>
<tr>
<td></td>
<td>Triangulation of data collection from multiple sources (e.g. practitioners documents and website, respondents from the affected communities, archival data, legal proceedings and court report)</td>
<td>Sohn (2018), Jahre et al. (2012, 2015), Sandvik and Lemaitre (2013), Refstie and Brun (2011), Sundel (1999)</td>
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<tr>
<td></td>
<td>Collecting qualitative (e.g. observations, focus group discussions) and/or quantitative (e.g. surveys) data</td>
<td>Näslund et al. (2010), Sabri (2018), Jahre et al. (2012, 2015), Sandvik and Lemaitre (2013), Rutta et al. (2005), Nelson et al. (2010)</td>
</tr>
</tbody>
</table>

*Continued...
<table>
<thead>
<tr>
<th>Collaborative project phases</th>
<th>Collaborative research features/elements</th>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collecting data in formal (meetings, interviews, questionnaires) and informal settings (coffee breaks, lunch)</td>
<td>Potential reflective sessions to discuss and update data collection techniques</td>
<td>Coughlan and Coghlan (2002), Näslund et al. (2010), Sabri (2018), Sohn (2018), Pedraza-Martinez et al. (2013), Sandvik and Lemaitre (2013), Sundel (1999), Chandes and Paché (2010), Lykes (2013), Lykes and Scheib (2016)</td>
</tr>
<tr>
<td>Although most of the studies data were collected by the entire team, but we still recommend data to be mainly collected by researchers to ensure integrity and rigour</td>
<td>Obtaining informant consent in the case data are directly collected from affected population respondents</td>
<td>Coughlan and Coghlan (2002), Canterino et al. (2016), Näslund et al. (2010), Shani et al. (2004), Sabri (2018), Sohn (2018), Pedraza-Martinez et al. (2013), Sandvik and Lemaitre (2013), Refstie and Brun (2011), Chang et al. (2010), Tanabe et al. (2015, 2018)</td>
</tr>
<tr>
<td>Researchers to prepare and present preliminary analyses (preliminary coding, technical reports and synthesising of group discussions)</td>
<td>The structured data are communicated to the research team and to the practitioner's personnel</td>
<td>Coughlan and Coghlan (2002), Näslund et al. (2010), Sabri (2018), Sohn (2018), Pedraza-Martinez et al. (2013), Sandvik and Lemaitre (2013), Chang et al. (2010), Tanabe et al. (2018)</td>
</tr>
<tr>
<td>The structured data are communicated to the research team and to the practitioner's personnel</td>
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<tr>
<td>Data are collaboratively analysed by researchers and practitioners (and other involved stakeholders)</td>
<td>Triangulation of researchers in the analysis phase</td>
<td>Coughlan and Coghlan (2002), Näslund et al. (2010), Sabri (2018), Jahre et al. (2012), Sandvik and Lemaitre (2013), Sundel (1999), Refstie and Brun (2011), Tanabe et al. (2015, 2018), Lykes and Scheib (2016)</td>
</tr>
<tr>
<td>Establishing a logical chain of evidence by researchers</td>
<td>Co-identification of what needs to change, and strategies and practices for change management</td>
<td>All</td>
</tr>
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(continued)
<table>
<thead>
<tr>
<th>Collaborative project phases</th>
<th>Collaborative research features/elements</th>
<th>Contributionsa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practitioners to execute the intervention plan (or to facilitate the implementation with local authorities in the humanitarian field)</td>
<td>Practitioners to execute the intervention plan (or to facilitate the implementation with local authorities in the humanitarian field)</td>
<td>Coughlan and Coghlan (2002), Näslund et al. (2010, 2011), Chang et al. (2010), Sandvik and Lemaitre (2013), Refstie and Brun (2011), Jahre et al. (2015), Chandes and Paché (2010), Tanabe et al. (2015, 2018), Manikas et al. (2017)</td>
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<tr>
<td>Researchers to ensure that the applicability, re-applicability and transferability conditions are met</td>
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<td>Coughlan and Coghlan (2002), Näslund et al. (2010, 2011), Chang et al. (2010), Sandvik and Lemaitre (2013), Refstie and Brun (2011), Jahre et al. (2015), Chandes and Paché (2010), Tanabe et al. (2015, 2018), Manikas et al. (2017)</td>
</tr>
<tr>
<td>The impact of the implementation to be co-evaluated and co-reviewed by researchers and practitioners</td>
<td>The impact of the implementation to be co-evaluated and co-reviewed by researchers and practitioners</td>
<td>Coughlan and Coghlan (2002), Näslund et al. (2010, 2011), Chang et al. (2010), Sandvik and Lemaitre (2013), Refstie and Brun (2011), Jahre et al. (2015), Chandes and Paché (2010), Tanabe et al. (2015, 2018), Manikas et al. (2017)</td>
</tr>
<tr>
<td>Joint reflective sessions and co-planning for future action cycles (if needed), which include continuous refinement of the proposed solutions</td>
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</tr>
</tbody>
</table>

Notes: We use the term “Humanitarian Field” to refer to the location where the collaborative research process takes place, which also includes the local premises of humanitarian organisations in the affected locations. The term “Researchers” in the framework mainly refers to university-based scholars or academic researchers. “Sources in italic come from supply chain, operations management and organisational management domain. The others are from humanitarian domain.
transferred from commercial sustainable supply chain management and applied to humanitarian logistics due to the fundamental differences between these settings. Such differences make it imperative to collaborate with humanitarian practitioners to develop contextualised green practices that fit the specificities of humanitarian logistics. Hence, the researchers were driven by the following research question:

**RQ1.** How can researchers and humanitarian practitioners collaborate to improve the environmental sustainability of humanitarian logistics, considering the specificities of humanitarian context?

### 4.2 Methodology

**Overview.** This case applies the phases in our collaborative research methodology process. It is focussed on collaborative research between an academic partner and a large international HO. The HO is headquartered in a developed country with many regional and national delegations around the world. Its purpose is to help populations affected by natural disasters and armed conflicts by providing food and shelter. This collaborative research focusses on improving environmental sustainability of the HO’s operations in its supply chains.

Although embedding environmental sustainability into humanitarian logistics was the main area of investigation of mutual interest, managing packaging waste was chosen as an initial area of focus because of growing concerns in the HO regarding the amount of waste generated by their operations and the way it was disposed. Concern was growing especially in developing countries and crisis-impacted regions with limited resources for recycling and waste management. In the same line, the criticality of packaging in the humanitarian supply chain has been highlighted by previous research works (Sohrabpour *et al.*, 2012; Regattieri *et al.*, 2018), exemplified by past adverse consequences in the field. For example, empty water bottles were left in the environment after consumption by beneficiaries in Afghanistan (Haavisto and Goentzel, 2015) and large-scale disposal of ready-to-eat meals in hard plastic containers delivered to Haiti caused environmental problems (Sarkis *et al.*, 2012).

The collaboration for this research lasted 19 months during which two collaborative research cycles were completed. The first cycle was completed in nine months and unsustainable operations were identified, focussing a pilot study on one area with the highest perceived environmental impact. The second cycle spanned 10 months, evaluating outcomes of the first cycle and improving the implementation of the pilot cycle.

**Forming the collaboration team.** In total, three large HOs were targeted as potential research partners with an assumption that larger scale operations may give rise to greater environmental impact. Only one was willing to engage in collaborative research. From the HOs side, they wanted information on the background of the researchers and their previous projects with other organisations. The research team was comprised of two researchers with backgrounds in supply chain management and engineering with specific expertise in humanitarian logistics and environmental sustainability. The practitioner team consisted of three members: the chief logistics manager, the logistics coordinator of Africa (the region with the highest environmental concerns), and the environmental and sustainable development advisor. The CRM team was, therefore, a hybrid community of inter-disciplinary researchers and expert individuals from the HO.

**Understanding the problem and context.** A memorandum of agreement was signed, specifying the goal, scope and responsibilities of each party, confidentiality of data, the expected duration and deliverables of the project. On this basis, the main responsibilities of the practitioner team were providing access for the researchers to organisational data,
operations sites, providing detailed feedback on the recommendations of the researchers, and the implementation of approved action steps in the field. A CRM-based methodology was selected, and upon the confirmation of the analysis, the researchers conducted a review on green disposal methods for packaging within a two-month period.

**Data collection.** In the first cycle of research, after signing the memorandum of agreement, the HO arranged for more than 20 interviews of 40–60 min within four days of a visit between the researchers and the heads of logistics, warehousing, procurement, research and development, and water and sanitation. The interviews were conducted using open-ended questions. The interview protocol was developed on the basis of the problem statement and research question. The interviewees were asked about their responsibilities, how they thought their responsibilities connected to environmental sustainability, what were the major sustainability concerns as well as the potential solutions to address those concerns. All the interviews were audiorecorded to be coded later. Another visit was planned to a refugee camp in Kenya to observe end-of-life management of packaging *in situ*. In addition to the qualitative data gathered from the visits, the researchers were granted remote access to several organisational databases through which quantitative data about the HO’s operations were gathered. The practitioner team contributed to data gathering by granting access and helping the researchers in sensemaking of organisational data whenever there were ambiguities. Although data collection was a continuous process throughout the partnership, initial data collection from different sources took about two months.

In the second cycle, two joint meetings were held in the headquarters; more interviews were conducted with the HO staff. Following perceived success in the first cycle, the HOs expanded remote access to the researchers of their databases.

**Practitioner orientation.** Based on the collected data from the headquarters and the field, the researchers conducted a preliminary environmental analysis of the HO’s packaging. The assessment included all the environmental impact categories from last-mile distribution to end of life. The practitioner team assisted the researchers by answering queries and providing further data on the fate of packaging. The research team presented the results of environmental impact assessment during an online meeting.

From the second cycle, based on the collected data from suppliers and the field, the researchers developed a cradle-to-grave environmental analysis for packaging, starting from suppliers to disposal.

**Collaborative data analysis.** In the first cycle, a joint meeting was held at the headquarters where the research team presented the problem, a synthesis of the collected data and the methodology used to develop green practices, involving a literature review, setting of benchmarks, followed by contextualisation of practices for the collected data. Specifically, humanitarian factors that might impact on implementation of sustainable practices were jointly analysed. The joint discussion led to a shared understanding of the issue before proceeding to co-develop action steps (Shani *et al.*, 2018).

In the second cycle, greening solutions were proposed to redesign the packaging. These were sent to the practitioner team to elicit feedback prior to another joint meeting. The practitioner team sent the solutions to internal quality control advisors as well as suppliers. In this cycle, the CRM team focussed on collaborative sensemaking about any actions that appeared to have been less successful in the first cycle.

**Joint planning for action.** Based on feedback from the first cycle, it was jointly decided that the researchers should focus on the design of packaging for food ingredients since changing medical products’ packaging was more difficult due to medical regulations and high standardisation.

In the CRM process, the researcher and practitioner teams engaged in conversational inquiry to generate a shared understanding and planning for action (Canterino *et al.*, 2016).
This involved discussing possible scenarios for action, assigning responsibilities for implementation and defining details of the action plan (Shani et al., 2018). The action plan focussed on incinerating food packaging waste local to the refugee camp.

**Implementation and evaluation.** Instructions were communicated to local staff and an incinerator was installed near the refugee camp. Implementing the action plan in the field is the most important step that influences not only the practical outcomes but also the impact of using CRM (Shani et al., 2018).

**Monitoring.** Evaluating the quality of a CRM study involves a continuous effort by researchers to achieve a balance between scholarly rigour, reflectiveness and relevance (Canterino et al., 2016). In this project, the researchers considered scholarly rigour from the initial stages of research design. During the first cycle, the interviews were designed on the basis of the research question while they captured the inherent characteristics of the HO’s operations. Since conducting CRM in organisations requires distinct quality criteria (Coghlan and Shani, 2014), rigour, reflectiveness and relevance were assessed during and after each cycle, whose results are reported in findings below.

### 4.3 Findings

**Forming the team.** For the research to be successful, it was crucial that the practitioner partners were committed to intense collaboration from the outset. Of the three HOs targeted, only one expressed this commitment. The choice of organisational partner was critical before attempting to commence collaborative research. As academic access to corporate elites to conduct research is challenging (Welch et al., 2002), it is an unusual situation for academics to choose between partner organisations, but it is essential in collaborative research. This choice was a two-way process with the practitioner partners examining the suitability and credibility of the proposed academic partners. This resulted in confidence forming prior to the commencement of research. This confidence building extending into the field team: as field staff members were recruited in the first cycle of research, there was less resistance by the time the second cycle was conducted. Early involvement of practitioners who may be involved later in implementation has been found to be an important element of collaborative research in other settings (see e.g. Suarez-Balcazar et al., 2005).

**Understanding the problem and context.** Conflicting objectives between urgent response to save lives and engaging in environmental sustainability were a source of ongoing tension in the research, as illuminated in interviews:

> Some people here still argue that our job is saving lives and environmental sustainability is not our mission. (Logistics manager of the HO)

The cyclical approach of CRM requires the review of the outcomes and the lessons learnt from the previous cycle (Shani et al., 2018). The implemented actions and their outcomes from first cycle were reviewed at the beginning of second cycle to revisit the shared understanding of the problem and context. The practitioner team reconfirmed that packaging waste was a pressing concern:

> We are facing [a] large amount of packaging in the field mostly made from plastic. I think it is a great starting point. (Logistics coordinator of Africa)

**Data collection.** Learnings from the first cycle revealed that significant volumes of packaging waste could be avoided through better packaging design. Therefore, in the second cycle, the attention of the CRM team turned towards collecting data from suppliers. Three major suppliers of food ingredients were selected by the practitioner team and connected to the research team. The researchers collected data from the selected suppliers...
using a questionnaire about technical specifications of the packaging used, followed by three one hour interviews with production managers about packaging design, quality and waste during production.

Practitioner orientation. In a joint meeting with the practitioner partners, the research team presented a summary of action steps from the first cycle and evaluation of outcomes, and proposed corrective measures to improve sustainability.

Collaborative data analysis. In the analysis, the practitioner team dismissed some of the proposals because it perceived them as inappropriate to the HO’s supply chain. For example, the proposal to export packaging waste to a neighbouring country with a recycling facility was rejected. Although this practice is used in commercial supply chains, using it in humanitarian supply chains is more difficult due to tensions at the borders, lack of support from authorities and poor import/export legislation:

Even within a country, we have problems moving waste from remote areas to the capital for recycling. Let alone transporting waste across the borders. The governments would not allow to import packaging waste. (Logistics coordinator of Africa)

Other impeding factors were poor recycling facilities in developing countries and regions impacted by a crisis, lack of robust national regulations, limited beneficiaries’ awareness of proper disposal methods and the HO’s negligence to design reverse logistics properly. Additionally, expired products were a major problem, as they required separation of the content (e.g. food or medicine) from the packaging prior to recycling.

Comparing analysis with the benchmarks set for packaging waste in the project revealed that many refugees receiving food products were far from waste collection points in the camp; the practitioner team was not previously aware of this problem. The existing waste collection points and bins were designed by the HO several years back when the population of refugees in the camp was far less. Based on these new insights, the CRM team jointly assessed requirements for additional waste collection points and optimal locations for them.

As for packaging design, analysis of the questionnaires and interviews with suppliers revealed room for improving sustainability of packaging through reducing use of plastic or substituting with cost efficient greener alternatives. While agreeing with the proposed solutions, the practitioner team argued that such changes should not be expected overnight but could be developed through long-term collaboration with suppliers.

Joint planning for action. The action plan contained three main steps to tackle the disposal of waste. First, the CRM team proposed to raise beneficiaries’ awareness about the proper waste disposal at the time of food distribution. The plan proposed training field staff to show beneficiaries how to dispose of packaging after consumption and where their closest waste collection point was. The second action proposed providing financial incentives to people collecting packaging waste; this engaged the local populations in the camp, providing social and economic benefits in addition to environmental gains. The third action focussed on disposing of expired products through incineration and landfill, taking care to avoid leaching of organic waste into underground water through use of cement where water tables were high. This third action resulted in the formation of disposal instructions for packaging and expired products with non-hazardous material. The HO management team agreed to assign budget to buy a mobile high-temperature incinerator to implement this action point.

Upstream in the supply chain, three actions were planned with respect to suppliers. First, suppliers were asked to include visual presentation on the packaging of how to dispose of it after consumption. Second, compliance over the coming years with Forest Stewardship Council certification was requested of suppliers. This focussed on recycling cardboard
materials for reuse as shipping boxes, eliminating plastic from gross boxes and carton liners, and encouraging use of biodegradable packaging. Third, take-back clauses were added to new contracts with suppliers.

**Implementation and evaluation.** Downstream in the supply chain in the refugee camp, the number of communal storage bins for domestic waste was increased. Efforts to encourage beneficiaries’ awareness of waste disposal were intensified through adding education workshops and targeting instructions on waste disposal to heads of families. Efforts on reverse logistics planning were greatly improved, minimising open-air incineration and increasing transport of waste to the newly installed incinerator, as highlighted in the dialogue below:

Do you think it will have less environmental impact than burning them locally? Because it adds a shipment. (HO Logistics manager)

Yes, sending by a truck emanates way less emissions than burning large quantities of packaging in open air. (Researcher)

That’s interesting because to me, I would have been clueless, but for you it’s easy ’cause you know it has higher impact with the low temperature burning. Do we have some sort of evidence or graph on that? (HO Logistics manager)

Yes, that is in the environmental analysis report. (Researcher)

Super! I think we should include that in our guidelines to the field. (Logistics manager)

This dialogue illustrates how co-inquiry evolves in the context of application through the engagement of CRM members (Coghlan and Shani, 2014) and how researchers can play a role in presenting academic knowledge to practitioners to bring about change in organisations (Shani et al., 2018).

Local staff members were already dealing with large amounts of expired items (e.g. therapeutic food) due to the influx of unsolicited international donations following a past crisis in the region. Before incineration, outer-box packaging was removed, since it was made of cardboard that could be easily recycled or reused. The instructions mandated that at least two permanent, non-volunteer staff members should accompany and supervise the disposal process to mitigate risk of pilferage. Despite increased costs for transportation and incineration, the exercise was perceived as successful.

The financial incentive for waste packaging collection was successful for polypropylene packaging but less so for other types of packaging that tended to be more contaminated by food leftovers and mud, and had to be cleaned before weighing and subsequent payment.

Before starting the project, the growing mounds of food packaging waste and emergency supplies were palpable in the camp, posing health concerns; septic tanks and pit latrines became blocked and malaria and yellow fever carrying mosquitoes bred more rapidly. During the four-month period, implementation revisions and tweaking were required, but broadly, the implementation phase was viewed as successful.

Implementation was rolled out to more delegations in the south and east of Africa. Gradually visible results in reducing packaging waste were observed. However, reluctance was experienced, reemphasising the importance of early involvement of field staff in the co-creation of action steps.

Suppliers made good progress. All packaging were revised to include instructions on proper disposal. The reduction of plastic and the use of greener substitutes were ongoing but being achieved gradually.

**Monitoring.** Monitoring was performed through examining rigour, relevance and reflectiveness, as presented in Table IV.
<table>
<thead>
<tr>
<th>Criteria (from Sabri, 2018)</th>
<th>Mechanisms used in the presented case</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rigour</strong></td>
<td>Assured through</td>
</tr>
<tr>
<td>Understanding of underlying mechanisms of phenomena: “how things work”</td>
<td>Comprehensive literature review</td>
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<td></td>
<td>Survey of organisational reports</td>
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<td></td>
<td>An orientation visit of the research team to the HO at the beginning of the project</td>
</tr>
<tr>
<td>Researchers to be involved in the research process; not just observing</td>
<td>The researchers were a part of the CRM team and were directly involved in decision making and devising action steps regarding the environmental sustainability of the HO</td>
</tr>
<tr>
<td>Hypothesis testing and research reproducibility, highlighting the role of “context”</td>
<td>The role of humanitarian context was highlighted through developing sustainable action steps that considered humanitarian specificities</td>
</tr>
<tr>
<td>Objective review with other scientists</td>
<td>The research case was qualitative in nature and did not include hypothesis testing</td>
</tr>
<tr>
<td>Analysis and deeper interpretation for causality</td>
<td>The research case was qualitative in nature and did not include hypothesis testing</td>
</tr>
<tr>
<td>To be publishable</td>
<td>The peer-review process and publication in the <em>Journal of Humanitarian Logistics and Supply Chain Management</em> confirm the publishability of results</td>
</tr>
<tr>
<td>Triangulation of methodologies</td>
<td>Different sources of data were used for triangulation of data:</td>
</tr>
<tr>
<td></td>
<td>Interviews with staff at the HO</td>
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<td></td>
<td>Review of organisational reports and website</td>
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<td>Remote access of researchers to organisational databases</td>
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<td></td>
<td>Field observations</td>
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<td></td>
<td>Interviews of field staff with beneficiaries</td>
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<td></td>
<td>Questionnaires and interviews with suppliers</td>
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<tr>
<td></td>
<td>Within CRM methodology, other methodologies such as environmental impact assessment were deployed</td>
</tr>
</tbody>
</table>

**Reflectiveness**

To achieve social impact and theoretical significance

Social impact: the impact was ensured through implementation of sustainable solutions in the field. A notable social impact was creating jobs for plastic waste collectors.

Theoretical significance: the research question was derived from literature review and theoretical foundations.

Greater knowledge of other scientists work

All the researchers involved in the research team had practical experience as well as sufficient understanding of other scholars’ works due to their academic background in the fields of supply chain management and sustainability.

Longitudinal studies

The collaboration reported in this paper lasted about 19 months and it is still ongoing at the time of manuscript preparation including follow-up observations for packaging and collaboration for other products.

Collaboration with other researchers

The members of the research team were researchers who were internally collaborating to produce sustainable recommendations regarding the case to be discussed with the practitioner team. Moreover, the results were reviewed by external researchers who were not a part of the CRM team.

*Table IV.* Rigour, relevance and reflectiveness criteria in the present case study (continued)
5. Discussion

The inclusive nature of collaborative research impacted suppliers, affected populations, local humanitarian workers, the international HO and the research team. During the research process, trust has increased amongst members of the collaborative research team. As a result, better coordination and decrease of adverse effects of uncertainty were observed, improving management across the stakeholders in this complex network of actors.

In contrast to propositions of previous studies (cf. Sabri, 2018), as depicted in Table V, there was no evidence of adverse impact of the changes on donations or post-disaster management. However, these are more influenced by the crisis itself, rather than the logistics response to the crisis. Overall, the improvement of waste management processes at the affected location and improvements in the packaging design and process at suppliers were substantially enhanced. Awareness of the affected population had noticeably increased, leading to improved social inclusion in the efforts. Implementation of the CRM process, contextualised for humanitarian supply chains, was viewed as successful.

However, several challenges of using collaborative research methodologies were encountered in this research. First, forming the team took substantial time and effort to engage HOs and negotiate the nature of the engagement with them. As this research project was not granted funding, only access to rich data, the costs of these efforts were borne by the researchers and their universities.

Trust is a cornerstone in successful collaborative research. One of the HOs approached was interested in the research problem but was unwilling to collaborate more than being interviewed and engaged in observational research. This may be because of lack of trust in the
researchers or in the methods and shared responsibilities of collaborative research. Trust was crucial to project continuation (here, to the second cycle of research) and future research. After this research, the HO actively pursued further discussions for future collaborative research.

Tweaks and changes to the CRM process used were made. In the initiation phase of this research project, to manage the stakeholder’s expectations, the research team and HO signed a memorandum of agreement, so as to have a clear explanation of the scope and the aim of the research. Furthermore, to avoid any conflicts, this memorandum identified the CRM team members, their roles and the range of their intervention during the different phases of the research project. The memorandum provided clear identification of the deliverables of the research team and the expected time horizon for the collaboration. Adding to the process, a requirement for a detailed, signed memorandum was perceived to be vital to the success of using CRM.

In the data collection and data analysis phases, there was no manipulation by the management team as its genuine intent was to solve the issue from its root causes; as such, it provided researchers with full access to high-quality data and facilitated their field visits. Explicit mention in these phases that data access, collection and analysis should not be manipulated by the practitioner partners sends a clear signal of the need for openness in collaborative research.

Implementation challenges that impacted on the collaborative research included the following:

- unpredicted factors that impact action plans, such as budget restrictions;
- frequent movement of employees in HOs, making it difficult to maintain a long-term collaboration; and
- being prone to procrastination by practitioner partners until feasible results are visible, making the collaborative research very time and resource consuming.

The monitoring phase was performed by an internal member of the research team, rather than triangulation with an observer researcher, as proposed in the CRM process. This project suffered from the lack of funding, so persuading a third-party researcher to engage without funding proved unsuccessful. Triangulation of methodologies and
engagement of external inter-disciplinary researchers are very challenging in practice; planning more in advance for this might help, but there is no simple solution for conducting collaborative research in highly resource-constrained settings, such as humanitarian supply chains.

Although this research used academic–practitioner collaboration in the CRM process, unexpectedly during application of the research process affected population engagement became a feature of the research (through incentivising collection or waste and providing education to improve waste disposal). This was not anticipated at the outset of the research, highlighting the need for flexibility in use of CRM. The engagement and collaboration gave rise to these changes, emphasising the challenges of planning and controlling collaborative research projects. Another important observation was a noticeable resistance of the humanitarian field staff to change. In this research, the second cycle was conducted more easily in the refugee camp where the field staff members were already involved in the first cycle, as compared to implementation in other countries where field staff members had no prior involvement.

Collaborative research is much more time consuming than conventional research approaches. Case studies may be conducted in a few months in non-engaged scholarship, but a CRM-based case study sometimes requires years to build trust, devise action steps, complete cycles of implementation, observe and reflect on the changes.

The in-depth nature of engaged scholarship in a single case study over time in a deep, extended collaboration is appreciated for the richness of research findings (Dyer and Wilkins, 1991), but developing theoretical constructs leading to theory building may require reflectiveness across a number of such cases (Eisenhardt, 1991). As such, it is recommended as more appropriate to early-stage exploratory research or late-stage theory testing (Yin, 2017). However, single-case-study research is still plagued with criticisms of idiosyncratic nature of the sample of one (Stuart et al., 2002).

A particular challenge of collaborative research in humanitarian supply chains lies in the nature of humanitarian aid being reliant on donations. The disclosure of action research results and reporting any shortcomings of practitioners in publications can impact the social image of the practitioner organisations.

5.1 Summary of refinements to the collaborative methods process
In the first phase of understanding the context and forming the research team, we suggest signing a memorandum of understanding that clearly defines the role of each actor in the team and a potential timeline for the research project. This helps in expectations management of each party (i.e. the researchers and practitioners) and better management of the research cycles.

To overcome the implications of the frequent rotation of humanitarian officers in the field, the practitioner orientation phase should include a step in which researchers should make sure that there is a mechanism for internal knowledge sharing to orient the substitute practitioners and align them rapidly with the objectives of the collaborative research project. Electronic communication technologies such as webinars or recorded online trainings can be of help here. Moreover, researchers should keep track of all the collected data through recording interviews and reflective sessions, taking photos (e.g. from plastic waste in the refugee camp in the presented case) and other measures of data storage. This is important, especially due to volatility and fast-changing nature of the humanitarian logistics context.

In the "joint planning for action" phase, it is suggested to consider it as a composite of two main sub-steps. First, different scenarios of collaboration under different possible situations that might arise in future should be developed. This pertains to the uncertainty within the humanitarian context and differentiates application of CRM-based methods in
humanitarian logistics from commercial logistics. Second, unlike commercial logistics settings, it is not a dyad of practitioner–researcher collaboration that results in the co-creation of actionable knowledge, but the “triad” of HOs managers–field staff–researcher and even the “tetrad” of HO managers–field staff–affected population–researcher. If the actions are planned in the absence of, or without communicating with field staff, there are high chances of failure in implementation because some peculiarities of the field may not be seen and field staff members might be reluctant because they were not involved earlier.

6. Conclusions
6.1 Contribution to theory
The central thesis of this paper is to challenge the prevalent understanding of knowledge generation in the humanitarian supply chain domain, previously based on use of a limited range of research methodologies (Kunz and Reiner, 2012; Näslund, 2002; Näslund et al., 2010). Collaborative methodologies have been shown here to be perceived as appropriate to humanitarian supply chain research (Sohn, 2018; Sabri, 2018; Prasad et al., 2017), but, to date, only generic collaborative research methodology processes have existed (Coughlan and Coghlan, 2002; Näslund et al., 2010). This paper contributes a CRM process, contextualised for research in humanitarian supply chains through integrating existing generic processes with findings from collaborative research conducted in humanitarian settings. The resulting eight-phase process was tested and refined in an exploratory in-depth case. The positive impact of the research on humanitarian logistics and affected populations supports the efficacy of the process. The process, therefore, contributes to supply chain management theory, in testing the use of CRM in supply chains, but more specifically to humanitarian logistics theory through provision of a unique process contextualised to that setting.

6.2 Contribution to practice
Humanitarian logistics managers within the research learnt from the collaborative research process and outcomes, making substantial logistics improvements to the environmental sustainability of food packaging design and disposal. Collaboration across the various stakeholders relating to the environmental detriment caused by food packaging improved as a result of using CRM; this collaboration led to a positive, practical impact. Supplier development improved as a result of the joint initiative to redesign packaging and its reuse in the supply chain. This exploratory research can be built in the humanitarian logistics field through further application of this new CRM process, and increasing collaboration with academia to solve problems in the field. A greater understanding and awareness of the power of academic–practice collaboration to help solve the many wicked problems faced in humanitarian settings should provide new avenues for supporting improvement initiatives. Highlighting attention on the humanitarian logistics aspects of crises, and the potentially powerful role that can be played by suppliers and logistics in preventing spill-over burdens of humanitarian aid to local societies (e.g. increased risk of malaria, yellow fever and cholera) and environments (e.g. polluting local water supplies) encourages action beyond the immediate crisis to consider long-term implications.

Engagement of locally affected populations (in what became a tetradiac, or four party, collaboration of academics, HO managers, local field staff and affected populations) impacted their lives through reduction of hazards affecting health and through economic and social inclusion. Their awareness of the importance of sustainable development relating to donated food improved; however, in some of the African nations where this was rolled out, this awareness did not lead to a substantial reduction in the problems of waste disposal.

It is likely that the long-term collaborative nature of this research and the implementation of the CRM process are more appropriate to post-crisis logistics
situations and long-term crises, such as tackling poverty or migrants, but less so for rapid response situations.

6.3 Limitations and future research
A single, exploratory case does not provide statistical generalisability of the findings. However, the findings provide analytical generalisability and transferability to relevant domains. Further application in other aspects of humanitarian logistics of the CRM process provided here would enable more general understanding of the appropriateness of CRM. However, the resource intensity of using CRM in environments constantly in flux, subject to great uncertainty, as are those in humanitarian settings, combined with lack of research funding, prohibits substantial application. High and rapid staff turnover in the field, challenges of engaging large numbers and variety of stakeholders and uncertainty of convergence of donations exacerbate complexity and resource demands on humanitarian logistics researchers. The nature of collaborative research entails higher commitment from both researchers and practitioners. The risks to researchers operating in difficult conditions with threats to their safety and security are not insignificant. It is unsurprising, therefore, that methods used in humanitarian logistics research have been more “hands off” and less collaborative.

References


Humanitarian supply chains


Further reading


Corresponding author
Mohammad Hossein Zarei can be contacted at: mohammadhossein.zarei@polimi.it

(The Appendix follows overleaf.)
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<tr>
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<tbody>
<tr>
<td>Jahre et al. (2012)</td>
<td>Academia–practitioner</td>
<td>A project between academics and UNICEF Uganda and The Global Emergency Group on drug-supply chains in Uganda. Analysing the causes and possible solutions to frequent stock shortages</td>
<td>Uganda</td>
<td>2009–2010</td>
<td>Action research embedded in a case study</td>
<td>50 interviews and 27 site visits</td>
<td>Interviews were performed by two researchers, one participatory and the second is observing. One is a humanitarian logistics practitioner and the other is a logistics researcher. Cross-referencing data by using various sources. The analyses were discussed with the stakeholders and recommendations for improvements were suggested.</td>
<td>“The field context was challenging, with 5,000 km at a speed of 30 km per hour on dirt roads, wearing bulletproof vests, and helmets” (Järe, 2010)</td>
<td>Better forecasting and inventory management through integration of the supply chain, reducing complexity by eliminating stocks, and providing better information exchange and stronger supply-chain competence</td>
<td>1. Co-identification of the scope of the project 2. Data triangulation in both formal and informal settings 3. No formal practitioner orientation 4. Collaborative analysis of data, triangulation of researchers 5. Co-developing of intervention plans 6. Practitioners execute the intervention plans 7. Monitoring (observant researcher)</td>
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<tbody>
<tr>
<td>Sohn (2018)</td>
<td>Academia–practitioner</td>
<td>A project between academics and Zambia Meteorological Department on the use of weather information and early warning systems for humanitarian supply chains</td>
<td>Zambia</td>
<td>2 years</td>
<td>Field research embedded in a case study</td>
<td>Interviews, field notes, organisational reports and other relevant secondary data were reviewed and analysed. Soon after the field visit, the author was required to compile a report on the project which consisted of preliminary findings from the field that were mainly based on the author’s memoing and field notes</td>
<td>1. Safety and security issues in the field, high levels of geographical dispersion have led to a limited academic engagement 2. The short time window of “immediate response” does not allow researchers to embark on collaborative research projects (most HLSCM research focuses on immediate response) 3. Field research is time consuming</td>
<td>1. Providing evidence-based insights and to better plan the future response in practice 2. Maximising the conceptuality and relevance to the real-life situation</td>
<td>1. Understanding the context and geo-political situation in Zambia beforehand commencing the research 2. Co-identification of the research with Zambia meteorological department 3. Data collection in formal (e.g. interviews with guides) and informal settings (e.g. over lunch) 4. Focusing on the end-user of the meteorological data (i.e. social impact and reflexivity) 5. The researcher prepared interview guides and updated them with preliminary analysis, before each interview practitioners received minimal orientation 6. The researcher</td>
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<tbody>
<tr>
<td>Pedraza-Martinez et al. (2013)</td>
<td>Academia–practitioner</td>
<td>A long-term collaborative project between academics and several international humanitarian organisations: International Committee of the Red Cross (ICRC); the International</td>
<td>Various countries (Kenya, Mozambique, Uganda, among others)</td>
<td>2007 till past 2013</td>
<td>Field work embedded in a case study (case study as per the authors), Long term prescriptive and collaborative research using</td>
<td>1. Qualitative and quantitative data 2. Interviews with staff, field trips and archival quantitative data on vehicle use</td>
<td>Statistical analysis for quantitative and archival data Not mentioned for qualitative data</td>
<td>1. The language used by academics is different than that of practitioners, leading to distorted evidence and a challenging sense-making of the data 2. Remoteness</td>
<td>1. Maximising contextualization 2. Higher practitioner–academic engagement leads to collecting richer and “better data” 3. The continuous reflection enabled the</td>
<td>1. Academic team was immersed in the practitioner system (i.e. field), closely working together and building trust over the years 2. The research problem (hence, question) evolved during field visits and was</td>
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<tbody>
<tr>
<td>Federation of Red Cross and Red Crescent Societies (IFRC); the World Food Programme (WFP); and World Vision International (WVI)</td>
<td>Optimization models</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>and rurality of the &quot;field&quot;</td>
<td>academics to ask more sophisticated questions and to perform deeper analyses; hence, solving real-life problems with significant societal impact on the local communities</td>
<td>co-identified by the way of discussion with practitioners</td>
</tr>
<tr>
<td>3. A team was formed by academics with extensive engagement from the ICRC staff</td>
<td>4. Building a relationship by the way of enhancing trust and engagement. Moving from &quot;the academics Team&quot; to trusted partners</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4. Data triangulation from different sources (primary interviews and secondary archival), also quantitative and qualitative</td>
<td>5. The academic team collected the data, the practitioners facilitated access to personnel and archives due to high level of trust</td>
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<td>5. The academic team collected the data, the practitioners facilitated access to personnel and archives due to high level of trust</td>
<td>4. Data triangulation from different sources (primary interviews and secondary archival), also quantitative and qualitative</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5. The academic team collected the data, the practitioners facilitated access to personnel and archives due to high level of trust</td>
<td>6. Preliminary analysis was performed (exploratory phase) and the practitioners system was continuously updated</td>
</tr>
</tbody>
</table>

Table AI.
### Collaboration Context/Project Description

<table>
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</table>

Sandvik and Lemaitre (2013)

A collaborative research project between academics and a local NGO in Colombia that caters for internally displaced women "Liga de Mujeres Desplazadas"

May 2010–June 2011 Field research embedded in a case study and a survey

Qualitative and quantitative methods Interviews with 14 Liga leaders A collaboratively developed census of 126 member households (end beneficiaries) Ethnographic observation and participation with a collaborative

Qualitative analysis of interviews Statistical analysis of the survey Content analysis of legal documents and court reports

Legal and juridical challenges related to the situation of internally displaced communities, especially women

1. Co-creation of knowledge between academia and practitioners has led to a plethora of benefits to the end beneficiaries. They managed to improve the national legal and administrative framework to recognise the rights of IDP and receive better services from the local authorities.

7. Triangulation of methods (statistical analysis and qualitative analysis) and triangulation of researchers from different universities

8. Recommendations (prescriptions) were developed and some of them were implemented, and evaluated

1. The research team made sure to establish a very deep understanding of the context of the north Colombian region, the geopolitical situation, the legal and administrative frameworks and the juridical situation of internally displaced people

2. The research objective and the methodology
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<tr>
<td></td>
<td>Extensive field notes from participant observation of legal proceedings and meetings</td>
<td>Interviews, audio clips and statements obtained from the Liga’s three successive websites</td>
<td>approach</td>
<td>The co-created knowledge has also led international humanitarian organisations (WFP) to be more engaged in the situation and increase the food aid 2. Proposing local beneficiaries of humanitarian aid as agents in the production and management of knowledge, rather than just aid recipients. “Knowledge is, in fact, power” (p. S46)</td>
<td>(survey) were co-developed with the Liga research committee 3. Data gathered in formal (interviews, survey, websites) and informal settings (field trips and observations) 4. Triangulation of data sources (primary from interviews, survey responses and legal meetings) and secondary (Liga website, legal proceedings, court reports) 5. Triangulation of methods (in-depth interviews, survey, field observations and ethnography) 6. The Liga team received orientation on initial data analysis and an initial report was presented to them 7. The methodology was amended after</td>
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<tbody>
<tr>
<td>Sundel (1999) Academia–practitioner</td>
<td>Contracted collaborative research between academics and the UNHCR (United Nations High Commissioner for Refugees)</td>
<td>Cyprus/Northern Cyprus</td>
<td>Not mentioned</td>
<td>Field research embedded in a case study and a focus group (workshop)</td>
<td>Qualitative and quantitative methods, preliminary meetings, survey, in-depth interviews, site visits, workshops and focus groups</td>
<td>Security issues reluctance of local communities to collaborate with research team</td>
<td>Building a relationship between two segregated local communities</td>
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</table>

8. The Liga team helped in the interpretation of data

1. Research is imitated by a practitioner, research problem is based on a critical real life situation in Cyprus and Northern Cyprus, and caters for the needs of local communities to have a mental health facility that can be shared between the two segregated communities due to a political conflict
2. Deep involvement of the two researchers, where one of them was recruited as a consultant by practitioners
3. Data gathered

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</thead>
<tbody>
<tr>
<td>Relstie and Brun (2011)</td>
<td>Academia–practitioner–affected population</td>
<td>A collaborative research project between academics, a national NGO and forced migrants in Uganda</td>
<td>Uganda</td>
<td>Started in 2007</td>
<td>Participatory action research</td>
<td>Interviews with key officials from NGOs and local and national government. In addition, individual interviews, focus group discussions, and observation.</td>
<td>Qualitative data analysis (implicit)</td>
<td>Not mentioned</td>
<td>Bringing together researchers, practitioners, local NGOs, local authorities, and local communities to solve real-life problems, provide humanitarian aid and to co-create knowledge and provide advocacy on the status of</td>
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<tbody>
<tr>
<td>Prasad et al. (2017)</td>
<td>Academia–practitioner</td>
<td>Action research project between academics and Sodhana Charitable Trust operating in rural Andhra Pradesh, India</td>
<td>Not mentioned</td>
<td>Action research</td>
<td>Data collected on women’s health from multiple age groups through a detailed instrument with over 100 questions</td>
<td>Simulation analysis</td>
<td>Improving the healthcare services in the rural villages of India</td>
<td>3. Jointly preparing for action (briefing papers) 4. The collaborative nature of the project provided the participants with an opportunity to be more than just a source of information 5. Involvement of the participants in initial findings analysis in focus groups, hence jointly planning for required action</td>
</tr>
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</table>

1. Transformative participatory research, with a main goal to solve a real life challenge (improving healthcare in rural India) 2. A team of researchers and practitioners working closely together, with knowledge sharing and trust 3. In contrast to (continued)
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<tbody>
<tr>
<td>Chang et al. (2010)</td>
<td>Academia–practitioner</td>
<td>Action research project between different Taiwanese universities and Taipei City Government in Taiwan</td>
<td>Taiwan</td>
<td>3 years</td>
<td>Participatory action research</td>
<td>Field observations, meetings semi-structured in-depth interviews, focus groups and an online discussion forum. Members of the research team volunteered as non-paid members in the NGO</td>
<td>Qualitative data analysis (implicit)</td>
<td>Accurate identification of the crucial needs and also new potential problems that need to be addressed in the Future</td>
<td>--------------------------------------------------------------------------------</td>
<td>1. Formation of a research committee that incorporates both researchers and practitioners to co-identify the scope of the collaborative research project. 2. Triangulation of different sources of data. 3. Reflective sessions. 4. Briefing practitioners with preliminary analysis and joint data analysis. 5. Cyclical rounds of intervention and implementation.</td>
</tr>
<tr>
<td>Jahre et al. (2015)</td>
<td>Academia–practitioner</td>
<td>Action research project between academics and International Federation Red Cross Red Crescent (IFRC)</td>
<td>Haiti, Turkey and Ivory Coast</td>
<td>2010-2011</td>
<td>Action research - embedded in a case study settings</td>
<td>Field observations, field trips, in-depth interviews</td>
<td>Qualitative cross-case analysis for the three case studies by categorization and pattern matching</td>
<td>Disseminating of results from action research projects in scientific journals is challenging, both because of time constraints</td>
<td>Solving real life problems and building new knowledge.</td>
<td>1. Co-identification of research problem and forming a research team with the IFRC. 2. Field visits to better understand the context. 3. Unit of analysis.</td>
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<tr>
<td>Chandes and Paché (2010)</td>
<td>Academia–practitioner</td>
<td>A collaborative research project between academics and Cooperation Logística Solidaria, Lima, Peru</td>
<td>April 2007–December 2008</td>
<td>Participant observation method</td>
<td>Interviews, archival data</td>
<td>Qualitative data analysis (implicit)</td>
<td>Not mentioned</td>
<td>The collaborative nature allowed a privileged position to the researchers in terms of data collection and providing rich data analysis</td>
<td>The collaborative nature allowed a privileged position to the researchers in terms of data collection and providing rich data analysis</td>
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<tr>
<td>Rutta et al. (2005)</td>
<td>Practitioner-affected population</td>
<td>A collaborative research project between academics and the International Federation of the Red Cross (IFRC), UNHCR and Burundian and Rwandan refugees</td>
<td>Tanzania</td>
<td>2002-2003</td>
<td>Participatory field assessment</td>
<td>Interviews, focus groups and quantitative data</td>
<td>Four groups of assessment teams, various qualitative methods (e.g. content analysis)</td>
<td>(Implicit) issues related to refugee camps, rurality and remoteness, healthcare and security issues.</td>
<td>1. Beneficiary-centered approach to solve real-life problems.</td>
<td>1. Overcoming lack of beneficiary involvement, hence, 2. Active</td>
</tr>
<tr>
<td>Nelson et al. (2010)</td>
<td>Academia-practitioner-affected population</td>
<td>A collaborative research project between academics, International</td>
<td>Tanzania, Kenya</td>
<td>Not mentioned</td>
<td>By-person factor analysis</td>
<td>Interviews, focus group discussions and free</td>
<td>Interviews, focus groups</td>
<td>(Implicit) issues related to refugee camps, rurality and remoteness,</td>
<td>1. Triangulation of data sources and types (quantitative and qualitative)</td>
<td>1. Triangulation of quantitative and qualitative methodologies</td>
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<tr>
<td>Tanabe et al. (2015)</td>
<td>Practitioner-affected population</td>
<td>A participatory research project led by the women’s Refugee Commission and a number of local humanitarian aid NGOs</td>
<td>Kenya, Nepal, and Uganda</td>
<td>November–December 2013 (Kenya), December 2013–January 2014 (Uganda), August 2014 (Nepal)</td>
<td>Qualitative participatory methods</td>
<td>Focus group discussions and interviews, using maximum variation principle</td>
<td>NVivo 10 and Excel</td>
<td>Language barrier, translation services were procured for the different languages used by refugees</td>
<td>1. Inclusion of refugees in the research, hence, offering better healthcare services and improving their rights</td>
<td>1. Formation of a multidisciplinary research team 2. Reflective sessions (daily debriefing meetings) 3. Inclusion of different stakeholder 4. Triangulation of data sources 5. Collaborative data analysis with all the stakeholders in discussion groups 6. Intervention</td>
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Table AI.

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<th>Main features of collaborative research plans are co-developed with the research team</th>
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<tr>
<td>van den Muijsenbergh <em>et al.</em> (2016)</td>
<td>Academia-affected population</td>
<td>Editorial, guiding paper n/a</td>
<td>n/a</td>
<td>Mixed quantitative-qualitative participatory action research</td>
<td>Making sure of obtaining informed consent beforehand commencing the data collection</td>
<td>n/a</td>
<td>n/a</td>
<td>Safety, language barriers</td>
<td>n/a</td>
<td>1. Involvement of affected communities 2. Participatory nature 3. Triangulation of data sources 4. Triangulation of methods</td>
</tr>
<tr>
<td>Lykes (2013)</td>
<td>Academia-affected population</td>
<td>A participatory research project between academics and survivors directly affected by armed conflict in Guatemala and their families in the USA</td>
<td>Guatemala, USA</td>
<td>Started in 1996 (Photo-) participatory action research Storytelling, community mapping and collective drawings</td>
<td>Documentation analysis</td>
<td>n/a</td>
<td>n/a</td>
<td>linguistic and ethnic barriers</td>
<td>n/a</td>
<td>Participatory nature, researcher is embedded in the field and the different stakeholders including the aid beneficiaries are included in the research process</td>
</tr>
<tr>
<td>Tanabe <em>et al.</em> (2018)</td>
<td>Practitioner-affected population</td>
<td>A participatory action research project led by a group of researchers from Women's Refugee Commission's Sexual and Reproductive Health Program and</td>
<td>Kenya, Nepal, and Uganda</td>
<td>2013-2014 Participatory action research</td>
<td>Focus group discussions and interviews, using maximum variation principle</td>
<td>Nvivo</td>
<td>1. Language barrier 2. Limited accessibility due to damaged infrastructure 3. Safety issues</td>
<td>1. Developing the relationship through the collaborative research process; enhancing collaboration and power sharing among the humanitarian stakeholders 2. Identifying the</td>
<td>1. Cyclical, multi-phases research 2. Research findings inform different stakeholders (NGOs, UN agencies, local policymakers, and affected communities) 3. Establishing a</td>
<td>(continued)</td>
</tr>
<tr>
<td>Source</td>
<td>Collaborative research actors</td>
<td>Collaboration context/project description</td>
<td>Location</td>
<td>Duration of collaboration</td>
<td>Collaborative research methodology</td>
<td>Data collection</td>
<td>Data analysis</td>
<td>Methodological and/or contextual challenges</td>
<td>Benefits of collaborative research in humanitarian settings</td>
<td>Main features of collaborative research</td>
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<td></td>
<td>representatives from the affected community</td>
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<td></td>
<td></td>
<td>priorities of each actor</td>
<td>3. Engaging the humanitarian aid recipient as participatory actors rather than respondents; hence, helping them overcome marginalisation.</td>
<td>research team inclusive of representatives from different stakeholders</td>
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<td>4. Developing a protocol for participant recruitment and obtaining informant consent for the entire duration of the research project</td>
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<td>5. Reflective sessions (debrieing the stakeholders of preliminary analysis, group discussions with participatory activities)</td>
<td>5.</td>
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</tbody>
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(continued)
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<tr>
<th>Source</th>
<th>Collaborative research actors</th>
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<th>Location</th>
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<th>Collaborative research methodology</th>
<th>Data collection</th>
<th>Data analysis</th>
<th>Methodological and/or contextual challenges</th>
<th>Benefits of collaborative research in humanitarian settings</th>
<th>Main features of collaborative research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lykes and Scheib (2016)</td>
<td>Academia-affected population</td>
<td>A collaborative research project between academics and Latinas and African-American women in the aftermath of hurricane Katerina in New Orleans</td>
<td>USA</td>
<td>2006-2009</td>
<td>(Photo-) participatory action research</td>
<td>Storytelling, visual techniques such as photo narratives</td>
<td>Critical bifocal analysis</td>
<td>1. The participatory project was time consuming and required great deal of effort from the local communities 2. Law enforcement is not strong during and after disasters</td>
<td>1. Enhancing self-confidence of the African-American and Latina women in the aftermath of hurricane Katerina</td>
<td>1. Participatory nature 2. An engaged research team with diverse membership that includes university-based as well as community-based researchers 3. Triangulation of different data sources and types 4. Putting forward recommendation (prescriptions)</td>
</tr>
<tr>
<td>Manikas et al. (2017)</td>
<td>Academia-practitioner</td>
<td>A collaborative research project between a group of academics and a humanitarian NGO (Idaho Foodbank)</td>
<td>USA</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>Providing humanitarian organisations with low-cost software tools</td>
<td>Providing humanitarian supply chains</td>
<td>Required effort from the local communities and great deal of time consuming during and after disasters</td>
</tr>
</tbody>
</table>
The transformative community-based humanitarian service ecosystem

Yolanda Obaze
Schroeder School of Business, University of Evansville, Evansville, Indiana, USA

Abstract

Purpose – The purpose of this paper is to explore the humanitarian service management categories that influence long-term transformation within complex community-based service ecosystems.

Design/methodology/approach – This study utilizes mixed methods to present a dynamic model that provides insight into the complexities of supplying, distributing and transporting charitable resources to underserved communities. The interdisciplinary study draws on the theory of service-dominant logic and service science, presents critical elements of transformative service research and uses system dynamics approach to propose a visual causal loop model.

Findings – This study develops a dynamic model for studying humanitarian service and value propositions in underserved communities. This paper combines the extant literature to emphasize key humanitarian service categories that influence, and are influenced by, service exchanges within community-based contexts.

Research limitations/implications – This paper is limited in providing quantitative methods in analyzing the case study data. However, the research is still helpful in providing acumen via the causal loop diagram to specifically look into each variable and see their cause and effect relationships in the community-based ecosystem. The research represents an opportunity to model the humanitarian aid and relief scenarios to help make more effective decision-making interventions.

Practical implications – The model serves as a managerial tool to determine critical services that optimize resource utilization within the community-based service ecosystems. Insights from this research are broadly applicable to the contexts of humanitarian logistics and supply chain management (HLSCM) solutions for community-based ventures.

Originality/value – This paper conceptualizes how the management of service-for-service exchanges, logistics services and charitable donation management provides transformational humanitarian services and value propositions within underserved communities. This study further provides fundamental contributions by addressing research gaps in the HLSCM domain by supporting service research and the community-based context.

Keywords System dynamics, Transformative service research, Service-dominant logic, Service ecosystems, Systems thinking, Humanitarian logistics and supply chain management

Paper type Research paper

Introduction

There is an increasing interest in service research for understanding how to solve societal challenges within underserved communities (Bittner, 2017; Kovács and Spens, 2011, 2014; Anderson et al., 2013; Heaslip, 2013; Overstreet et al., 2011; Ostrom et al., 2010), and for advancing research on dynamic and complex service ecosystems (Naumann et al., 2017; Letaifa et al., 2016; Chandler and Lusch, 2015). Over the past decade, the service literature extends research on the study of organizations that focus on service deliveries as compared to product-centric distributions (Spohrer and Maglio, 2008). Yet, few studies focus on the humanitarian service deliveries that alleviate environmental, social and economic challenges within impoverished communities (Heaslip, 2015; Özpolat et al., 2015; Ayeni et al., 2014; Heaslip, 2013; Kovács et al., 2010; Kovács and Spens 2011). In addition, although there is research on service ecosystems in business environments (Barile et al., 2016), little is known about the development of ecosystems that support humanitarian services (Heaslip, 2015; Letaifa, 2014) and foster long-term transformation within underserved communities (Drakaki and Tzionas, 2017; Letaifa et al., 2016; Özpolat et al., 2015; Heaslip, 2013; Kovács and Spens, 2011; Kovács et al., 2010; Tomasini and Van Wassenhove, 2009).
Consequently, the consideration to manage service ecosystems may be particularly relevant to community-based enterprises (CBEs) (Peredo and Chrisman, 2006). It is mainly because CBEs, also known as humanitarian aid providers, face complex issues when seeking transformation (Obaze, 2016). Transformation refers to the ability to use services to alleviate the suffering of vulnerable people and to co-create value by influencing long-term uplifting changes within the community. Furthermore, research shows that as the proliferation of services increase to enhance transformation, so does the inherent problems that cause complexities within the service ecosystem (Özpolat et al., 2015; Chandler and Lusch, 2015; Patrício et al., 2011), such as functional silos, ineffective donation management, information asymmetry, waste, shortages due to errors in delivery and increased vulnerability in the ecosystem (Obaze, 2016; Özpolat et al., 2015). Nonetheless, CBEs present the ability to manage service factors that influence transformation. Thus, providing insights into the humanitarian service ecosystem and describing the complex nature of the ecosystem could contribute to theory and practice.

The purpose of this research is threefold. First, the study examines the humanitarian service management categories that enable long-term transformation. Second, the study examines how these service categories influence transformation within underserved communities. In addition to accomplishing the first two aims, using a case study approach, the research visually describes the formation and complex nature of the humanitarian service ecosystem that supports transformation. It is proposed that identifying the critical humanitarian service management categories and observing how they enable transformation, supports the need to understand the transformative community-based humanitarian service ecosystem.

To advance this idea, the main contribution of the paper is to conceptualize the connection of three main categories for the effective management of humanitarian services which include supply chain management (structured service-for-service exchanges), logistics management (service-centric designs and practices) and charitable donation management (operand and operant resource integration) into an ecosystem model. The study contributes to this conceptual development by using extant theory in three stages: first, building on the humanitarian logistics and supply chain management (HLSCM) literature, this study combines the theoretical perspectives of service science and service-dominant logic (S-D logic) to explore the humanitarian service ecosystem gap. Second, transformative service research (TSR) and Blocker and Barrios (2015) view on value propositions are used to describe how the identified humanitarian service categories provide transformation (see Figure 1). The final

![Figure 1. Theoretical frameworks for the humanitarian community-based transformative service ecosystem]
stage of the conceptual development uses system dynamics (SD) methodology to empirically
develop a visual causal loop diagram (CLD). Using data collected from a North Texas CBE, the
developed system thinking diagram applies as a learning tool for future researchers and
practitioners. The diagram connotes a simpler comprehension of the ecosystem as compared
to mainly viewing such systems as mainly complex (Naumann et al., 2017).

The following sections outline the rest of this paper. First, the paper reviews the HLSCM
literature. Through the theoretical lens of S-D logic and service science that views service as
a critical element in meeting needs within an ecosystem, the study identifies three key
humanitarian service categories. Next, the TSR framework is used to describe how the
categories provide transformative propositions. Then, the conceptual model is developed
and presented using the SD method. The paper concludes with findings, limitations,
implications for practice and future research opportunities.

Theoretical background

*Humanitarian logistics and supply chain management (HLSCM) within underserved communities*

HLSCM research to date has evolved from the traditional military setting frameworks
(Rutner et al., 2012), to the business frameworks (Mentzer and Kahn, 1995) and to a more
recent humanitarian relief arena that considers both individual and societal vulnerability
(Kovács and Spens, 2007; Oloruntoba and Gray, 2006). For instance, the humanitarian
context adapted the definition of business logistics management by changing the view
of the “end-customer” in the supply chain to describe the term “end-beneficiaries.”
End-beneficiaries are referred to as people facing vulnerability (Tomasini and
Van Wassenhove, 2009) and or considered as “victims of disasters” (Kovács et al., 2010).
Kovács et al. (2010) defined humanitarian logistics as “the process of planning,
implementing and controlling the efficient, cost-effective flow and storage of goods and
materials, as well as related information, from point of origin to point of consumption for the
purpose of meeting end-beneficiary’s requirements.” Similarly, other researchers affirm that
end-beneficiaries in the supply chain refer to vulnerable end-consumers (Tomasini and Van
Wassenhove, 2009) lacking the purchasing power of needed resources (Kovács et al., 2010)
and faced with varied types and levels of disasters (Drakaki and Tzionas, 2017).

Building on the evolution of the humanitarian context, there are still gaps that exist.
Little research describes key humanitarian service elements and categories (Heaslip, 2015;
Kovács and Spens, 2011); the complex nature of seeking transformation (Letaifa et al., 2016),
within the service ecosystem that involves end-beneficiaries and local logistics service
providers in the co-creation of value (Heaslip, 2015); and the application of humanitarian
services that go beyond the post-disaster response and global humanitarian aid frameworks
(Tomasini and Van Wassenhove, 2009), especially within developing countries (Ayeni et al.,
2014); and sustainable humanitarian aid as employed within community-based contexts
(Kovács and Spens, 2011).

Furthermore, research now highlights the importance of discovering the provision of
humanitarian aid within underserved communities. First, that there are different
connotations of disaster, societal challenges, crises and vulnerability when providing
humanitarian aid to end-beneficiaries, specifically in underserved areas (Drakaki and
Tzionas, 2017; Kovács et al., 2010). For instance, Kovács and Spens (2011) state that there is
a gap in identifying new societal challenges within the community-based supply chain
design and in addressing urbanization trends. Simultaneously, Obaze (2016) investigated
the issues of food insecurity as a prevalent humanitarian supply chain challenge within
impoverished communities. The author describes underserved communities as
impoverished, disaster-stricken and remote urban areas where organizations fail to reach
and serve many vulnerable people with simpler and available offerings. In historically
impoverished communities, research describes such systemic challenges like food insecurity as disasters (Barrett, 2010).

At the same time, among other fields such as the disaster management arena, the term disaster continues to evolve. Research acknowledges that disasters encompass all levels, types and intensity of societal challenges (Yadav and Barve, 2015) and require varied types of responses: pre-, post- and during a disaster to transform the undesired situation (Tomasini and Van Wassenhove, 2009). Disasters are said to describe challenges that embody all types of social vulnerabilities resulting from failed social systems (Yadav and Barve, 2015). Drakaki and Tzionas (2017) describe disasters as “transitions to change that involve vulnerability and require the community to engage in extraordinary efforts.” Interestingly, the authors mention that while there is no universally accepted term for disasters, new structures and strategies are needed to address these “social phenomena that destabilize the social system, causing the norms to fail.”

This further implies that as varied levels of disasters affect functioning systems, and “test the reactivity” of systems (Tomasini and Van Wassenhove, 2009), they require a system – an ecosystem of services to achieve transformation (Letaifa et al., 2016). Concurrently, these extant investigations initiate a service ecosystem discourse on addressing systemic challenges within underserved communities. In sum, the gaps in the literature indicate that the HLSCM field is still evolving and has ample opportunities for new contributions. Thus, this research proposes the importance for understanding the humanitarian service ecosystem that addresses and transforms challenges within underserved communities.

Humanitarian services, service science and S-D logic

Service is described as the resource, process, action and practice that is provided to help those in need (Naumann et al., 2017; Obaze 2016; Anderson et al., 2013), and used for the benefit of another (Vargo and Lusch, 2010). The humanitarian relief-related literature categorizes services as success factors that enable humanitarian aid and influence relief to vulnerable people. Haselkorn and Walton (2009) define humanitarian services as the ability to establish and use effective and sustainable infrastructure to help those in need by providing food, shelter, improved medical care and other resources. Thus, humanitarian services reflect transformational qualities, by either design or potential, to influence societal well-being and co-create value (Heaslip, 2013).

However, although the application of services is not novel in the humanitarian contexts, yet there are observed gaps in identifying the transformational humanitarian service categories, especially within ecosystems (Kovács and Spens 2011; Heaslip, 2015). Service research reveals that services are said to be transformational when they are structured, long-term and sustainable, connected within an ecosystem, include end-beneficiaries into the management and planning processes and co-create value (Letaifa et al., 2016). Importantly, theoretical service frameworks enable researchers to evaluate the relationships between service, transformation and the service ecosystem’s ability to co-create value.

For instance, service science is defined as “an emerging interdisciplinary field that focuses on fundamental science models, theories and applications that drive service innovation, competition, and well-being through co-creation of value” (Ostrom et al., 2010). Past research suggests that service science explains the origin and growth of service systems and provides unique service professionals and researchers with an understanding of service ecosystems (Maglio and Spohrer, 2008; Vargo et al., 2008; Maglio et al., 2006). Furthermore, service science advocates the focus on service ecosystems that have a process (Qiu, 2009) or multiple processes (Sampson, 2012) typically organized, ordered and structured to meet a particular need through all available means, people, information and technology (Vargo et al., 2008).
Also, there is now a handful of service literature that is concerned with the study of service and value propositions within complex ecosystems (Naumann et al., 2017; Chandler and Lusch, 2015; Patrício et al., 2011). The general theory of S-D logic affords foundations for embedding services and value co-creation. The theory highlights the importance of connecting different types of services, suppliers, users and beneficiaries within any system (Vargo and Akaka, 2009). Importantly, this systems thinking view describes service ecosystems as "a relatively self-contained, self-adjusting system of resource-integrating actors, connected by shared institutional logics and mutual value creation through their service exchanges" (Vargo and Lusch, 2010; Barile et al., 2016). However, they are few S-D logic frameworks that describe social and humanitarian systems (Heaslip, 2015). Thus, S-D logic presents a service-centric ecosystems view on connecting all human actors, specifically end-beneficiaries into the humanitarian service ecosystem to co-create value.

Evidently, S-D logic can assist the literature in describing how humanitarian aid is developed and managed when meeting “individual and dynamic” end-beneficiary needs (Heaslip, 2015). Among the main principles of S-D logic, Vargo and Lusch (2008) state that:

The central notions of S-D logic are that fundamental to human well-being, if not survival, is specialization by individuals in a subset of knowledge and skills (operand resources) and exchanging the application of these resources for the application of knowledge and skills they do not specialize. This shift in focus from operand to operant resources has implications for understanding social interaction and structure that are markedly different from the ones suggested by a focus on the exchange of operand resources and potentially has ramifications for understanding exchange processes, dynamics, structures, and institutions beyond commerce.

The authors’ further present ten key service propositions that are fundamental to understanding the service implications that enable transformation (see Table I). Notably, the central tenets of S-D logic favor a service ecosystems view that affords structured service-for-service exchanges, deliver operant and operand resources and focus on economic and social, individual and societal resource integrators, such as end-beneficiaries, in the provision of transformation. In sum, from the S-D logic view: a focus on service provision is important, networks of organizations are encouraged to include all members (end-beneficiaries and social and economic suppliers) within the system, co-creation is emphasized (Barrios and Blocker, 2015; Vargo and Lusch, 2004b, 2008) and the service ecosystem view that embeds varied services (Barile et al., 2016) actualizes transformation (Letaifa et al., 2016).

**Humanitarian service categories**

Past researchers identify key factors relevant for categorizing the successful management of humanitarian services. For instance, Oloruntoba (2010) identifies key factors, also termed as key success factors, as “elements that are vital” for achieving emergency disaster relief. Extant factors identified were adopted from various management studies into the humanitarian (Oloruntoba, 2010; Pettit and Beresford, 2009) and disaster management fields (Yadav and Barve, 2015).

Relevant to the humanitarian context, Pettit and Beresford (2009) identified ten success factors in the emergency relief arena. The factors include strategic planning, supplier relations and collaboration, capacity planning, supply chain strategy, information management, technology utilization, transportation planning, continuous improvement and inventory and resource management. Oloruntoba (2010) further categorized some of these factors into the emergency relief arena by using a case study approach. The author examined the response phase of a global disaster that took place in Australia and identified five overlapping factors. Oloruntoba categorized the five factors into two headings: factors influencing the preparedness and readiness of the relief supply chains, and the unity of direction and cohesive control from responding government disaster management agencies.
<table>
<thead>
<tr>
<th>No.</th>
<th>Premise</th>
<th>Explanation/Justification</th>
<th>Humanitarian Service Implications</th>
</tr>
</thead>
<tbody>
<tr>
<td>FP1</td>
<td>Service is the fundamental basis of exchange</td>
<td>The application of operant resources (knowledge and skills), &quot;service,&quot; is the basis for all exchange. Service is exchanged for service</td>
<td>Service is important. Beyond the focus on the donation of products – donated knowledgeable and skilled services should also be exchanged</td>
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<td>FP2</td>
<td>Indirect exchange masks the fundamental basis of exchange</td>
<td>Goods, money, and institutions mask the service-for-service nature of exchange</td>
<td>Charitable giving masks the service-for-service nature of the exchange. All donations in the humanitarian context are important. However, a focus on the indirect exchange of donated services, especially from donated skills and knowledge is critical. Thus, the transformation of end-beneficiaries by providing operand resources masks the provision of operant resources that provide additional service-for-service exchanges</td>
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<td>FP3</td>
<td>Goods are distribution mechanisms for service provision</td>
<td>Goods (both durable and non-durable) derive their value through use – the service they provide</td>
<td>Value of goods is evident in the supply chain. However, services that allow beneficiaries to access the goods and in turn be able to provide services of their own are also important</td>
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<tr>
<td>FP4</td>
<td>Operant resources are the fundamental source of competitive advantage</td>
<td>The comparative ability to cause desired change drives competition</td>
<td>Humanitarian services, volunteers, people’s skills and knowledge, competent information systems, and other value propositions provide a competitive advantage. The focus on the provision of operant resources (skills and knowledge), especially from the transformation of the end-beneficiary provides an advantage</td>
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<tr>
<td>FP5</td>
<td>All economies are service economies</td>
<td>Service (singular) is only now becoming more apparent with increased specialization and outsourcing</td>
<td>All humanitarian organizations and enterprises are service organizations and need a focus on connecting humanitarian service factors to provide services and meet needs</td>
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<td>FP6</td>
<td>The customer is always a co-creator of value</td>
<td>Implies value creation is interactional</td>
<td>End-beneficiaries receiving services from humanitarian organizations can also provide services. Humanitarian community-based supply chains that involve all end-beneficiaries in the process are imperative to encourage value creation. Also, the ability to transform the end-beneficiary to becoming a supplier of value presents the service-centric view of humanitarian aid that suggests that the end-beneficiary is always a co-creator of value</td>
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<td>FP7</td>
<td>The enterprise cannot deliver value, but only offer value propositions</td>
<td>The firm can offer its applied resources and collaboratively (interactively) create value following acceptance, but cannot create/deliver value alone</td>
<td>CBEs can only offer value propositions. No independent supply chain organization has the power to create or deliver value. Involving the provision of resources from all participants in the supply chain, including end-beneficiaries, offers value. Service organizations cannot act alone. Collaboration with all stakeholders, including end-beneficiaries increase the donations of skills and knowledge</td>
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<td>FP8</td>
<td>A service-centered view is inherently customer oriented and relational</td>
<td>Service is customer-determined and co-created; thus, it is inherently customer oriented and relational</td>
<td>Relationships with end-beneficiaries are critical for the supply chain. All parties involved in the service ecosystem include both suppliers and customers</td>
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<td>FP9</td>
<td>All economic and social actors are resource integrators</td>
<td>Implies the context of value creation is networks of networks (resource-integrators)</td>
<td>The focus of the transformative service ecosystem that includes all social and economic suppliers, comprising of transformed end-beneficiaries is resource integration. Resource integration refers to service encounters that allow all agents in the ecosystem to become involved in value co-creation</td>
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<tr>
<td>FP10</td>
<td>Value is always uniquely and phenomenologically determined by the beneficiary</td>
<td>Value is idiosyncratic, experiential, contextual, and meaning laden</td>
<td>Value can be created and co-created by including and connecting all beneficiaries in the service ecosystem</td>
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Source: Adapted from Vargo and Lusch (2008)
Additionally, Yadav and Barve (2015) building on past research, identified 12 critical factors in disaster management. The authors, using interpretive structural modeling, systematically classified the critical factors into clusters of dependence. The factors include risk and need assessment, procurement and donation management, coordination and collaboration with other relief organizations, capacity building, information and communication technology, disaster-resilient infrastructure and transport facilities, strategic planning for emergency relief supply system, agile humanitarian supply chain, government policies and organizational structure, forecasting and early warning systems, inventory management and continuous improvement.

In overview, while these factors apply to the humanitarian aid arena, the authors failed to capture the service-centric and ecosystem perceptions of using these factors. Furthermore, the authors categorized the studied humanitarian supply chain as unstable, unpredictable, inflexible and short-lived. The studies did not capture the inclusion of end-beneficiaries as potential service providers and mainly focused on the product-centric delivery of relief resources. Thus, building on the extant literature, this research broadly categorizes the critical factors into three main service management categories: supply chain management, logistics management and charitable donation management. More specifically, the categories are proposed to address the humanitarian service-centric exchanges, processes and provision of integrated resources that influence long-term transformation within underserved communities.

Supply chain management (SCM). The central premise of the S-D literature reinforces a focus on services as compared to product distribution. S-D logic emphasizes on service-for-service configurations that connect all people, products and technology within and among service systems. This service-for-service perspective refers to the service interaction within and among all members of the systems such as firms, suppliers, end-customers (end-beneficiaries) and other stakeholders (Vargo and Lusch, 2008). From this view, SCM is suggested to support the service of building value-added supply chain structures that manage relationships in meeting impoverished end-beneficiary needs (McLachlin and Larson, 2011; Overstreet et al., 2011), and the ability to use strategies to form service-for-service interactions and exchanges, especially with end-beneficiaries, to influence sustainable transformation (Letaifa et al., 2016).

SCM supports building appropriate community-based supply chain[1] structures and strategies. SCM is defined as “the systematic, strategic coordination of the traditional business functions and the tactics across business function within a particular company and across businesses within the supply chain, to improve the long-term performance of the individual companies and the supply chain as a whole” (Mentzer et al., 2001). In the humanitarian context, Oloruntoba and Gray (2006) state that SCM presents a “planned approach; that a longer-term, strategic perspective is adopted; and that it is important to coordinate functions” in the supply chain. Mentzer et al. (2001) define supply chains as a set of three or more organizations involved in the flow of people, products, services, finances and information.

Importantly, Tomasini and Van Wassenhove (2009) state that SCM is “a key factor in the overall effectiveness of any humanitarian response.” Furthermore, the authors suggest that SCM services foster preparedness, response and collaboration strategies within the supply chain. Research shows that SCM, as a strategic service, enhances supply chain structures; embody long-term relationships with all stakeholders, including end-beneficiaries; and supports supply chain member selection, collaboration, information and preplanning strategies, and technology utilization to influence sustainability (Maull et al., 2012). Thus, this research proposes using SCM as a service management category to build supply chain structures and strategies that foster different economic and social service-for-service exchanges that include suppliers, distributors and especially end-consumers coming together to achieve combined organizational objectives.
Furthermore, in the community-based context, this research suggests SCM as a service that influences transformation by including end-beneficiaries in the service management process. Thus, increasing dynamic interaction, shared information, knowledge and other resources with the inclusion of end-beneficiaries into the strategic planning and preparedness stages of service provision influences long-term transformation (Letaifa et al., 2016; Muall et al., 2012).

Logistics management. Research recognizes logistics management as a subset of SCM (CSCMP, 2018; Lummus et al., 2001). This research views logistics management as the service-centric process and design that is included in the supply chain to allow for the “well defined and cost effective provision” of needed resources (Lummus et al., 2001). In this view, logistics management is described as the service-centric process that is triggered when SCM plans, strategies and structures influence the need for resources.

In addition, S-D logic recognizes that service-centric processes offer effective operand and operant resources. Operand resources are physical resources on which a service is performed to produce an intended outcome (Vargo and Lusch, 2004a). Operant resources refer to value, core competencies or organizational processes that all human agents in the system offer through the knowledge and skills that can transform the system and produce an intended outcome (Vargo and Lusch, 2004a).

Importantly, research shows that logistics management is the value-adding service-centric processes that enhance the collection, consolidation, storage, handling, controlling and movement of donated operand resources to meet end-beneficiary needs (Obaze, 2016). Furthermore, the service-centric process and design support the long-term and efficient management of operand resources by using various activities that include distribution, inventory, transportation and demand management (Van Wassenhove, 2006). Accordingly, the council of supply chain management professionals (CSCMP, 2018) defines logistics management as “that part of supply chain management that plans, implements, and controls the efficient, effective forward and reverses flow and storage of goods, services and related information between the point of origin and the point of consumption in order to meet customers’ requirements.” This definition further supports the notion for a systematic view that connects logistics management to supply chain management by implementing SCM strategies and structures to enhance logistics processes that meet end-beneficiaries’ needs.

Lummus et al. (2001) define logistics as the movement of physical goods from one location to another. In the humanitarian context, Kovacs and Spens (2007) state that logistics “has always been an important factor in humanitarian aid operations.” The authors state that humanitarian logistics “encompasses a range of activities including preparedness, planning, procurement, transport, warehousing, tracking and tracing and customs clearance” to alleviate the suffering of vulnerable people. Empirical studies show that logistics as a service-centric process enhances the distribution of humanitarian aid (Heaslip, 2015), and denotes the type of transformational qualities, either by design or the potential to influence the well-being of society (Blocker and Barrios, 2015). Particularly, when providing timely and appropriate aid to those in need (Kovács and Spens, 2011), logistics management categorizes a set of service-centric processes that meet welfare needs when and where needed to aid transformation.

Charitable donation management. Finally, this research posits charitable donation management as the third humanitarian service management category. Charitable donation management refers to the management of systems, services, strategies and processes that allow service providers to accept and distribute charitable resources over a period of time and in an ongoing manner (Spector, 2004). Here, the service management focus integrates charitable resources that include donated operand and operant resources from all stakeholders, including end-beneficiaries in an on-going manner.
S-D logic suggests the primary use of services is to offer resource integration. Resource integration refers to service encounters that increase value co-creation through the provision of both operand and operant resources. Primarily, resource integration implies that all human agents, including end-beneficiaries, should be involved in the provision of operand (products) resources and operant (human skills and knowledge) resources to increase value co-creation (Blocker and Barrios, 2015).

As it is, service-for-service exchanges that deliver integrated resources enable competitive advantage (Lusch et al., 2010; Vargo and Lusch, 2008; Vargo et al., 2008). For instance, Pettit and Beresford (2009) suggest that in the humanitarian context, the provision of both product and human resources are essential in providing disaster relief. The authors stress the issue of human resource management in providing humanitarian aid and its advantages to enhance effectiveness. Concerning transformation, Barrios and Blocker (2015) state that value co-creation is enhanced when human agents provide a “portfolio of resources as well as their capabilities” into the supply chain.

Thus, when operand resources are provided to transform vulnerable end-beneficiaries, the inclusion of the transformed end-beneficiaries as potential service providers of operant resources influences value co-creation. The idea is that charitable donations management allows services providers to not only focus on donated product provision to alleviate the suffering of vulnerable people, but also to focus on the management of crucial service encounters that enable better interaction, information sharing and donated knowledge exchanges with and from transformed end-beneficiaries within the supply chain to enhance value co-creation. Therefore, presenting charitable donations management, with a service-centric view of managing donated operand and operant resources presents new insights into ways humanitarian services can influence transformation within underserved areas.

In sum, the appropriability of donations management provides a resource integration perspective that increases the service management of both operand and operand resources into the ecosystem. This further extends the donated product-centric distributions to a service-centric view. Thus, transformation increases when the service ecosystem provides donated resource integration and allows all human agents, especially transformed end-beneficiaries in the community, to donate, transact, collaborate and co-create value in an ongoing manner (Letaifa et al., 2016).

Notably, these preceding factors are not new to HLSCM research. However, this research presents these extant HLSCM concepts in a service-centric view for achieving long-term transformation. Theoretically, mainstream service domain scholars support this shift in perspectives. Thus, in the next sections, the paper explores how the service categories are interconnected in a service ecosystem to achieve transformation.

Transformation, transformative service and value research
Transformation refers to the ability to co-create desired and uplifting changes within the community, and to alleviate the suffering of vulnerable people. The concept of transformation denotes the recent attempt to describe aggregate and multiple ways humanitarian services are connected in an ecosystem to influence transformative value propositions. Spohrer and Maglio (2008) describe services as the action of working together to transform situations. In this community-based context, and building on the service research premise, varied service factors influence transformation when embedded in an ecosystem.

Extant studies discuss the relevance of transformation within the service ecosystem (Letaifa et al., 2016; Blocker and Barrios, 2015). Accordingly, TSR focus on the relationship between service encounters, transformation and social well-being (Ostrom et al., 2010). TSR is defined as “the integration of consumer and service research that centers on creating
uplifting changes and improvements in the well-being of consumer entities: individuals, communities and the ecosystem” (Anderson et al., 2013). A primary assumption of TSR is that services and its value propositions are conceptualized into having transformational qualities (Ostrom et al., 2010) and are critical for understanding the dynamics of the service ecosystem (Chandler and Lusch, 2015).

Accordingly, research shows that interconnected services and value propositions play a vital role when exploring how service ecosystems create transformation. Blocker and Barrios state that value propositions occur in dynamic social systems where communities are prompted to learn, adapt and use creative services to support uplifting changes. The authors suggest that services become transformational when embedded into systems, promote relational benefits, service design, service practices and social structures. According to Blocker and Barrios (2015), the use of services to provide value propositions is presented by connecting four main sections of the transformative value framework.

Building on the framework, this paper argues that when service factors, such as SCM, are used to build appropriate structures that foster supply chain relationships and strategies to involve all stakeholders, and include logistics services and charitable donation management into the structure, transformation is influenced (McLachlin and Larson, 2011; Overstreet et al., 2011). For instance, the first section of the transformative value framework supports the idea of structured service-for-service exchanges. Blocker and Barrios state that embedding service structures with service design, service practices and human agents propagate uplifting change.

Accordingly, Stock et al. (2000) describe supply chain structures as “groups of firms across the extended enterprise” that include all suppliers and customers in crafting strategies, plans and coordination mechanisms. Furthermore, Awaysheh and Klassen (2010) highlight that the use of SCM to build supply chain structures, especially when designed and integrated to address social issues, emphasize transparency, information sharing, dependency and distance as main proponents for operational and efficient performance. Thus, this research suggests that the use of SCM, as the sustainable and efficient management of structured service-for-service exchanges, provides value propositions that enhance transformation when the structures are further designed, practiced and integrated.

In addition to structure, this research supports employing logistics service designs and practices in the humanitarian ecosystem. Kovács and Spens (2011) state that in the onsets of disasters, humanitarian logistics needs to be “designed and deployed” immediately to successfully distribute resources to disaster victims. Leading to the next two sections of Barrios and Blocker’s framework that describe the implementation of service design and practices within structures, the framework constitutes using appropriate structures to support service design and practices to transform undesired situations. Thus, it is essential for service-centric processes, such as logistics management to be designed and practiced in the ecosystem to efficiently provide donated resources.

The final section of the value proposition framework warrants a service-centric perception of managing charitable resources by utilizing human agents in the service ecosystem. This value propositions further reflects creating uplifting changes and co-creating value in the community by including end-beneficiaries, as human agents, into the service supply chain. Blocker and Barrios suggest that value propositions take place when human agents provide operant resources. Here, the implication is that, although human agents provide operand resources when embedded in connection with the service design, practices and structure to influence transformation, human agents can also provide operant services in these structures to co-create value. Thus, the deployment of integrated resources through the effective use of human skills and knowledge transforms underserved areas (Pettit and Beresford, 2005) when embedded into the ecosystem.
In sum, connecting the three humanitarian service categories to provide value propositions enables transformation. Beyond the use of SCM and logistics management, connecting charitable donations management into the humanitarian service ecosystem increases transformative value propositions when the added humanitarian service category enables value propositions through the sustainable, long-term and efficient service-centric inclusion of end-beneficiaries, as compared to mainly focusing on only product distribution in the service ecosystem. In this way, building on the value proposition framework, embedded SCM services that provide structured service-for-service exchanges; logistics management design and practices; and charitable donations management that utilizes resource integration from human agents within an ecosystem, influence transformation (see Table II).

<table>
<thead>
<tr>
<th>Humanitarian service categories</th>
<th>Service propositions</th>
<th>Value propositions</th>
<th>Illustrative implications for connecting categories in a service ecosystem to influence transformation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply chain management</td>
<td>Service-for-service exchanges</td>
<td>Structure and relationship planning</td>
<td>Increased decisions and behaviors for stakeholders and end-beneficiaries, improved communication, and operational performance</td>
</tr>
<tr>
<td></td>
<td>All stakeholders</td>
<td>Strategic planning</td>
<td>Quality decision making, better communication, and operational performance</td>
</tr>
<tr>
<td></td>
<td>Includes end-beneficiaries</td>
<td>Sustainability</td>
<td>The inclusion of skills and knowledge in preplanning strategies, sustainability, trust, and task transfer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Task transfer</td>
<td>Preparation for additional services, reduced disconnections, reduced trust from disconnection, and reduced information sharing from disconnection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trust</td>
<td>Reduced decisions and behaviors, reduced disconnections, reduced trust from disconnection, and reduced information sharing from disconnection</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced performance</td>
<td>Reduced operational performance from disconnection</td>
</tr>
<tr>
<td>Logistics management</td>
<td>Service-centric processes</td>
<td>Service design and practice</td>
<td>Increased benefits, increased order fulfillment, increased distribution of products, and increased desired fill rate</td>
</tr>
<tr>
<td></td>
<td>Inventory management</td>
<td>Order fulfillment</td>
<td>Increased order fulfillment, higher fill rates, and reduced demand for facilities</td>
</tr>
<tr>
<td></td>
<td>Distribution management</td>
<td>Order handling time</td>
<td>Increased order handling time, reduced demand for facilities, and reduced storage</td>
</tr>
<tr>
<td></td>
<td>Capacity planning</td>
<td>Capacity planning</td>
<td>Reduced demand for facilities, reduced waste, and reduced storage</td>
</tr>
<tr>
<td></td>
<td>Transportation planning</td>
<td>Reduced order handling errors</td>
<td>Reduced order handling errors, reduced wrong choice of vehicles, and reduced waste</td>
</tr>
<tr>
<td>Charitable donations management</td>
<td>Management of operand and operant resources</td>
<td>Resource integration</td>
<td>Product delivery leads to the transformation of human agents, alleviating suffering through product delivery</td>
</tr>
<tr>
<td></td>
<td>Operand products</td>
<td>Product delivery</td>
<td>Focus on transforming human agents, product delivery, and operational efficiency</td>
</tr>
<tr>
<td></td>
<td>Operant services</td>
<td>Service delivery</td>
<td>Focus on including transformed human agents, with the provision of operant resources</td>
</tr>
</tbody>
</table>

Table II. Summary of the transformative community-based humanitarian service ecosystem
Evidently, including service factors and value proposition into service ecosystems can also be complex (Chandler and Lusch, 2015; Patrício et al., 2011). Naumann et al. (2017) describe service ecosystems as complex; and require more insights to understand how the use of services, structures and relationships between diverse organizations engage and enhance the lives of the community. Letaifa (2014) suggests that service researchers need to have a systematic approach to assessing complex service ecosystems. Thus, this research uses the current knowledge of SD methodology to develop a conceptual diagram that describes the research agenda. The diagram provides a visual representation of the delineated humanitarian service categories, transformative value propositions and complex system behavior that is evident in this transformative community-based humanitarian service ecosystem. The following sections present the conceptual diagram and findings of this empirical study.

Methodology

System dynamics (SD)
SD provides the unique ability to understand the complex nature of a service ecosystem. Forrester (1961) introduced SD as the industrial engineering, decision making and modeling method that analyzes complex problems in business and socio-economic systems (Dyson and Chang, 2005). This concept mapping methodology is used to analyze information-feedback, decisions and actions that influence the success of any enterprise (Größler et al., 2008). As a computer-aided approach, SD provides insight into the different variables that exist and are connected in a complex system by using either quantitative or qualitative modeling (Ghadge et al., 2013; Wolstenholme, 1999). This research uses the qualitative SD model, which includes the use of CLDs and archetypal structures, in analyzing the descriptive, judgmental and numerical data (Wolstenholme, 2003) of dynamic and complex system structures (Richmond, 1993; Forrester, 1994).

Causal loop diagrams (CLDs)
Although facing limitations in systems theory (Caldwell, 2012), qualitative modeling presents a relevant and recent trend in the SD literature (Ghadge et al., 2013). Often referred to as systems thinking models, CLDs allow managers to visualize, describe and analyze system behavior within any system (Caldwell, 2012). CLDs provide insight into managerial issues and offer promising learning solutions to complex ecosystem behaviors (Wolstenholme, 1999; Senge and Sterman, 1992). CLDs support research in the social context and provide a method that depicts and simulates dynamic systems, especially in service firms (Größler et al., 2008; Wolstenholme, 1999). To summarize, this study presents some of the challenges faced using the qualitative SD modeling to analyze data. A summary of issues, opportunities and resolutions using this methodology is presented (see Table III).

The modeling process follows some of the standard procedures that are outlined by Wolstenholme and Coyle (1983), Cavana and Maani (2000) and Schwaninger and Grösser (2008). As suggested by extant SD researchers, the validity of the model is best depicted when data from the real system under study is used to build the model. Furthermore, the process of model building and cross-checking should be encouraged to validate the model. Importantly, SD researchers suggest that model validation in systems thinking approaches is “impossible” (Diez Roux, 2011; Barlas, 1996). However, system scientists suggest that by combining qualitative and quantitative replication of the hypothesized variable relationships in the model may enhance model validation (Wolstenholme and Coyle, 1983; Checkland, 1995).

Diez Roux (2011) suggests key processes to enhance the credibility of the developed model. The author proposes pattern replication, combining qualitative and quantitative
<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Issues</th>
<th>Resolutions</th>
<th>Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>The longitudinal process to collect data, design and analyze the model</td>
<td>First, visualize system behavior then quantifying variables identified to simulate relationships</td>
<td>Coyle (2000), Forrester (1994)</td>
</tr>
<tr>
<td></td>
<td>May require some form of quantitative analysis to confirm results</td>
<td>Start with visual diagrams to incite insightful discussion to make the problem clear before a simulation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Quantification of data may increase uncertainty by being non-denumerably infinite</td>
<td>Accept dynamic conclusions to increase the ability to think through the dynamic system</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Case studies depend on intuitive judgment for analysis</td>
<td>Avoid repeating the thought process for analyzing the future model</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Case study data may not apply to a general scenario</td>
<td>Allow model comparison with other case studies</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Allow time to work with practitioners to provide relevance to research</td>
<td>Großler et al. (2008), Senge and Sterman (1992)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Combine consulting and research to provide different insights before finalizing the model</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reiterate findings with experts to confirm and validate findings</td>
<td>Dyson and Chang (2005)</td>
</tr>
<tr>
<td>Time</td>
<td>The complex nature of the system requires more time to analyze implicit and explicit issues and system behavior</td>
<td>Difficult and intense situations are complex</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time constraints prolong the completion of the model</td>
<td>Complexities increase by adding more and different variables (e.g. varied organizations, ephemeral operations, and challenges) into the model</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The inclination to produce an incomplete model due to time constraints will not aid in quality decisions</td>
<td>Adding more variables make it hard to streamline, understand, and capture all and each characteristic(s), behavior and variable in the model</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Increases uncertainties with unanswered questions, tensions and debates between practitioners and academics to reach a conclusion and conflicting terms, concepts, and variables</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seek to capture the root cause and effect of the feedback behavior</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid complications by having arrows run across another arrow in the visual model</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid wandering too far from the original design problem</td>
<td></td>
</tr>
</tbody>
</table>

**Table III.**
Summary of issues, opportunities, and resolutions building a system thinking model

(continued)
knowledge of modeled processes, comparison of model output to various types of external
data and a number of tests and sensitivity analyses that can be used to identify
flaws in the model and to improve the model. In addition, to capture reliability, SD researchers suggest
models “grounded in data and subjected to a wide range of tests” that “lead to more reliable
inferences” about the developed model (Schwaninger and Grösser, 2008; Sterman, 2002;
Cavana and Maani, 2000; Forrester, 1994). Nonetheless, there is the tension in using
qualitative CLDs for model conceptualization (Barlas, 1996; Forrester, 1994).

To be clear, CLDs provide improved visual comprehension of complex structures and
problems by identifying either positive (reinforcing) or negative (balancing) feedback
loops[2] (Blair et al., 2007; Forrester, 1994). Positive (reinforcing) feedback loops indicate a
positive (+) sign and support the increasing effect of an outcome that influences more of the
same behavior. The negative sign (−) shows a decreasing or delayed effect (≠) in the model.
A loop that has at least one negative feedback refers to a balancing loop (B). Alternatively, a
loop with all positive feedback is termed a reinforcing loop (R).

Recent programs such as I-think©, Powersim©, Stella© and Vensim© have been used to
draw CLDs. In this research, the Vensim software, which is a user-friendly interface, is used
to visualize and communicate the causal feedback relationships in the complex system. The
process begins by using the identified problem as a starting point, and then proceeding with
arrows that show causal relationships, either positive or negative, with other variables of
interest. The CLD is refined using this software until provisions for robustness, reliability,
clarity and practicality of the data is satisfied (Wolstenholme and Coyle, 1983; Cavana and
Maani, 2000; Schwaninger and Grösser, 2008). The finalized model is useful for evaluating
other models and for making future comparisons.

Case study description. To understand and hypothesize causal connections, behaviors
and potential disruptions in the service ecosystem, the case study approach is used

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Issues</th>
<th>Resolutions</th>
<th>Citations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highlights variable relationships to allow for simplified learning solutions</td>
<td>Captures a broader context that may have explicit and implicit variable relationships</td>
<td>Counterintuitive results increase conflicting views Focus on increasing the explicit meanings of the model design Iteratively question the purpose of the model to reach an intuitive conclusion Have creative debates and dialogue to highlight intuitive and counterintuitive results of the model Aim to identify the most pressing variable relationship</td>
<td>Daellenbach and McNickle (2005)</td>
</tr>
<tr>
<td>Helps in selecting ideas, variables, and languages for decision making</td>
<td>Complex systems can be counterintuitive by having unknown factors Variable relationships may cause implicit assumptions Explicit model assumptions may cause the model to seem instinctual Variables may have two or more cause and effect relationships</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supports systems thinking and organizational learning process</td>
<td>Models provide counterintuitive results and may increase disagreements on the conclusion Complex models with too many variables may deter insightful discourse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Provides insights into managerial issues</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table III.

Humanitarian service ecosystem

423
Case studies enable researchers to understand aspects of the phenomenon investigated, and to facilitate multiple data collection techniques using field notes, unstructured interviews, focus group meetings with key informants and a variety of archival information as provided by the enterprise (Sjoberg et al., 1991). This ensures data validation by using a triangulation approach (Creswell, 2009; Eisenhardt, 1989). Tellis (1997) asserts that triangulation from accumulated data, investigations, theories and mixed methodologies ensures accuracy and alternative explanations. Therefore, the triangulated approach is helpful in achieving analytical generalization and identifying variables for this study (Yin, 2003).

All transcripts, notes and documents were examined to allow for patterns within data to arise (Strauss and Corbin, 1998). To check for consistency, this research investigates evaluated learning outcomes, addresses established theories and research on relevant literature, employs the assistance of external reviewers at a Northern Texas University to refine the case study protocol. Ideally, data collection conducted through the case study design provides a detailed description of the variables used in the model. The study collected data within a research period of 18 months with the consent of the firm. Site visits began and progressed when key informants at the CBE were contacted. Other participants, sometimes in group settings, were further contacted to confirm observations and conservations during the research phase.

Overall, the research analyzes the service ecosystem of a CBE based in North Texas called DentonS (Pseudonym). It is important to note that the final model highlights the three main service management categories: supply chain management, logistics management and donation management and serves as a preliminary visual representation of the case study. The community-based model begins with the assumption that members of the community have already come together to form the supply chain that includes various donor organizations willing to address the underserved situation.

DentonS operates out of North Texas and serves over 120,000 community members. According to Kouchade (2013), out of the total population, over 90,000 Denton County residents are classified as food insecure resulting from high poverty rates and mental health issues. Located in Denton Texas, DentonS has built a structured supply chain ecosystem that allows suppliers, service providers and community residents to participate in transforming their community. For over 10 years, DentonS maintains a stated mission: “to improve organizational cooperation, increase public involvement and expand community resources.” The mid-size enterprise has under 100 employees and collaborates with other faith-based, non-profit, for-profit and government organizations to provide a plethora of humanitarian services and outreach programs in the community. The organization provides a central location where the various supplier of food, clothing, housing, education, healthcare, mental health, support (social, emotional and spiritual), parenting skills, childcare, legal support, transportation, employment, financial and income services engage in service-for-service exchanges.

As part of the company’s core mission, the company emphasizes on three main motives: collaboration with other local nonprofits in the community, to provide affordable shared office space to other supply chain members and to increase services in one location. The CBE professes to “open doors for people to become self-sufficient.” Self-sufficiency refers to scenarios where a range of struggling individuals that reside in the impoverished community become independent and attain meaningful existence in the community from an array of services (Daugherty and Barber, 2001).

The organization recognizes the complex nature of finding appropriate services where and when needed. The CBE explicitly states that in underserved settings “finding help can be overwhelming. Moreover, when nonprofits are spread out, it can be difficult to find the
organizations that can help, let alone find the transportation” to gain access to the needed resources. However, using their supply chain structure, DentonS enhances community welfare by providing service-centric exchanges and processes. Additionally, the organization also enhances value co-creation by supporting the inclusion of transformed “self-sufficient” end-beneficiaries into its supply chain structure.

The CBE designs their service practices to afford shared resources and services, reduce waste, errors and other complexities and achieve collective goals. Stating that their vision is to have a “one-stop-shop” for social services, the organization allows the effective use of its supply line to increase the service delivery of both donated operand and operant resources. Importantly, the layout of the organization was specifically chosen for this research because the CBE reflects an ecosystem of social services that include structured supply chain systems, designed and practiced service-centric delivery and the ability to manage both operand and operant donations. The organization displays an ability to influence transformation by not only increasing product resources in the community but also operant resources (skills and knowledge) to vulnerable end-beneficiaries and from transformed end-beneficiaries.

The organization provides projects that improve collaboration. The enterprise maintains to “show people in our community where they can get involved, expand our community resources, and create opportunities for many people in need to become self-sufficient when they find the help they need all in one place.” A project introduced called a “circle of support” allows the organization to exponentially increase their value propositions in the community by utilizing “self-sufficient” community members to provide donations back into the community-based ecosystem. Here, long-term transformation is stressed when focal end-beneficiaries contact the CBE, become self-sufficient and are then able to offer donated services back to the community.

For instance, DentonS reports occurrences where end-beneficiaries that initiated contact with the ecosystem had initially only needed food products and or housing. However, after establishing a continuous relationship with the enterprise, end-beneficiaries eventually gain access to other combined operant service providers that are part of the enterprise and offer other services such as employment services, youth mentoring, parenting classes and family support and this allows the beneficiaries to attain self-sufficiency. Thus, the self-sufficient end-beneficiaries are then able to provide donated resources back into the community (Daugherty and Barber, 2001).

Within DentonS’ four main principles: “Our community could work better together to help people get back on their feet”; “People in need would have one place to go to find help and answers”; “Organizations located in one space could share costs and ideas”; and “Organizations could save on overhead and offer more donation that go to services,” the CBE stresses structure, service designs, practices and resource integration that support service-for-service exchanges, processes and resources that transform their community.

In summary, by using the three key humanitarian service categories to establish structure, service design and practices and integrating operand and operand resources, CBEs act as an agent of change. By connecting, controlling and managing their supply chains to go beyond delivering products to the impoverished community, the enterprise provides donated and transformative services and value within the ecosystem. The rest of the paper presents the transformative ecosystem model to illustrate how the service categories identified are interconnected to provide long-term transformation. Primarily, using extant theoretical frameworks and case study data, the model contends for the humanitarian service perspective that supports the use of SCM to enhance structured service-for-service exchanges, logistics management to emphasize service-centric design and practices and charitable donation management to highlight donated resource integration in the ecosystem.
The transformative community-based humanitarian service ecosystem model

Given these findings, transformation denotes the sustainable uplifting change of the underserved and impoverished setting as well as the co-creation of value through the provision of integrated resources. This research synthesizes insights from preceding sections as well as the case study data to describe the transformative community-based humanitarian service ecosystem model. The model begins with smaller formulations of the three service categories conjoined into a more complex structure exhibited in Figure 2. This supports the notion that by increasing and embedding services into the ecosystem, complexities increase. The model displays service variables and feedback behavior that are connected when there is a central need for resources in the service ecosystem to attain transformation.

Structured service-for-service exchanges

To begin, the model displays the decision and feedback behavior that take place to increase the supply of donated resources to impoverished beneficiaries. The model shows the decisions to initiate service-for-service exchanges using evaluation, preplanning, preparation and collaboration strategies to promote quality decision making, transparency, communication, information structures and increased operational performance within the supply chain. Furthermore, the CLD highlights some of the fundamental challenges that the organization faces when deciding to structure their supply chains, such as disconnection and reduced trust.

First, the model shows that relationship management and strategies are used to build the supply chain structure. Supply chain relationships are essential and evaluating such relationships enables the enterprise to increase feedback behaviors such as transparency and operational performance in the ecosystem. Interestingly, this further display the decisions that influence all supply chain members; such as increased trust, collaboration and improved preparation for logistics services. Here, service provisions that support the planning, communication, transparency, information sharing and collaboration strategies from an inter-organizational system of resources, primarily from end-beneficiaries in the supply chain, influence transformation (Heaslip, 2013).

Findings from the case study show that by requiring SCM strategies with various community stakeholders, DentonS reduces issues with asymmetry and disconnection that in turn influence the ability to build trust and increase behaviors, such as information sharing and collaboration in the community-based ecosystem. For instance, the company holds regular meetings with key stakeholders to address issues of disconnection, build trust and enhance their quality decision-making tools as part of their collaboration strategies that will increase the operational performance of their ecosystem. The ecosystem model does not mention a particular supplier. However, it is acknowledged that an ample number of involved stakeholders are engaged and embark on using SCM strategies to donate products and services within the network, ranging from healthcare clinics, banks, government departments (specifically their community-based departments), individuals (residents and skilled professionals such as IT professionals), universities (students and professors from two central universities located in the county) and self-sufficient end-beneficiaries.

Furthermore, the ecosystem model highlights the effect of actively using preplanning strategies to select active and committed suppliers into the ecosystem. For example, selected members of the community are encouraged to become committed suppliers based on their willingness to collaborate, share information and rent office space within a central location. Using the preplanning strategies the organization created a support system, “circle of support,” which increases the access of skilled labor and knowledge from all stakeholders in the community.

As part of their preplanning collaboration strategy, DentonS' motivates able donors to join the ecosystem and efficiently offer their support services (skills and knowledge) to those in need. The sustainable idea facilitates structure by allowing donors to rent out office spaces in
Figure 2. The humanitarian community-based transformative service ecosystem causal loop diagram
a centralized location, increase community interactions, gain access to end-beneficiaries and work directly with other supply chain members to offer a plethora of support services. The idea further allows the transformation and the inclusion of beneficiaries in the ecosystem to increase integrated resources.

Another advantage of promoting structure in the ecosystem allows each supply chain member to determine the exact resources needed in the community and better know how to influence transformation. The collaborative service-for-service structure allows all community stakeholders to impact value propositions by providing efficient services where needed and when needed. The model shows that SCM in the ecosystem further supports the connection of logistics services to influence transformation. Thus, the model proves that CBEs prefer to go beyond only receiving product donations to focus on the provision of efficient service-centric processes. Here, SCM initiates the service-centric delivery when the supply line increases. This leads to the next part of the model that shows the embedded service-centric process, logistics management, highlights decisions that address the complexities such as shortages, waste and errors and the ability to increase the distribution of support services and donated operand resources.

Service-centric design and practices

The logistics sub-model shows the connection and increase of service-centric processes when the supply line of donations increase. The model shows that the preparation for logistics delivery is prompted from the decisions to structure collaborative service-for-service exchanges that increase resource supply to the impoverished. Furthermore, the need for resources from community donors generates an array of logistics services that include inventory management, distribution management and transportation management. It further supports the notion that logistics is not an isolated part of SCM but a connected and essential part of the service ecosystem (CSCMP, 2018). The logistics system focuses on the decisions and services needed to distribute, deliver, transport and manage information and operand products. For example, when the supply of donated products increase, decisions for transportation management are engaged and this further influences the transformed state of the impoverished situation by meeting demand. This is seen in an instance where cold storage units that were donated to the CBE, activated the need for other donated products and service-centric services such as the delivery, storage and distribution of temperature and time-sensitive products to the underserved community. Hence, the model shows that when the need for resources has a positive relationship with the increase for supply line, this increases service-centric processes such as inventory, order, transportation and distribution management.

Importantly, this describes the complex nature of managing and designing service-centric processes. As logistics services increase, complexities such as errors, wasted capacity and shortages also increase. However, this complex behavior is encouraged because of the increased value propositions that address the complexities when meeting demand. For instance, with the increase of order fulfillment in the system, the model shows how transportation, distribution, order and inventory management play critical roles in the service design and practice of influencing the impoverished situation. Here, a decision to increase transportation capacity (vehicles, drivers and other vehicle resources) allows the ecosystem to positively achieve the desired fill rate to meet demand, especially when additional variables are considered such as shipment time and choice of vehicles.

It further suggests that CBEs can influence order fulfillment and or shortages by efficiently connecting, designing and practicing this service category. For example, an observation from the case study highlighted a specific instance where the enterprise delivered whole wheat bread to a gluten intolerant customer. In that specific instance,
although there was the timely provision of the food product to the end-beneficiary, the product delivery accentuated errors in the system when the wrong kinds of products were given to the wrong end-consumer, thereby increasing inventory, waste and excess capacity. The instance among others further showed the importance of designing additional logistics services that not only increase product delivery but reduce errors, excess waste and capacity within the ecosystem. Using additional services, such as capacity planning, enabled the delivery of accurate products to meet demand.

The instance observed, although not depicted in the model, shows how having the appropriate logistics service design and practice within the community-based ecosystem increases transformative value. Furthermore, by considering the addition of other service factors used to reduce complexities in the system, logistics management denotes a set of services that are interconnected to attain transformation. To summarize, logistics service design and practice to meet demand and alleviate end-beneficiary suffering with the accurate, timely and efficient delivery of donated operand products, attains long-term transformation by linking SCM to charitable donations management.

Integration of donated operant and operand resources
The final sub-model describes the notion that the charitable donation system is a fundamental part of the humanitarian service ecosystem. The possibility of planning services that increase integrated resources shifts the focus toward service-centric perceptions of donations management. As the demand for available operand resources increases, the model shows how the management of integrated resources influences the impoverished situation. The model highlights transformation when actions that influence the impoverished situation also influence self-sufficiency in the system.

For instance, the act of providing food products transforms the state of the community – food security. Additionally, by increasing other services, such as providing employment services and other support services to increase employment, these further influences value co-creation by increasing access to skilled labor and knowledge in the impoverished community. Furthermore, this increases public awareness, demand for skilled labor and volunteers and then the donated skilled labor and knowledge in the underserved areas. Thus, as a continuation from the logistics and supply chain system, transformative value is observed when the management of operant and operand resources transform the community and enable a co-creation of services and value.

Charitable donations management highlights the increased operant and operand donations that influence the underserved community. Here, ample resources transcend beyond needing only product donations such as food but also influencing the demand for skilled labor and volunteers that co-create value. The extension into the charitable donation management system provides two main propositions. First, the ecosystem alleviates the suffering of vulnerable people by encouraging structured service-for-service exchanges that supply available resources, increase public awareness and gain better and accurate information about communal beneficiaries to meet demand. Furthermore, the structured systems allow the network to use service-centric processes to supply the resources, reduce errors, waste and lost capacity when meeting demand. As it is, increasing information sharing and knowing what is needed and how to distribute the available resources efficiently and appropriately influences transformation.

Second, the ecosystem co-creates value when the connected service categories reproduce and sustain transformation in the community through operant resources from transformed end-beneficiaries. For example, when DentonS publicizes that they have charitable food products, a new struggling person visits the establishment of wanting food. However, with frequent visits and meeting the immediate need, DentonS builds a relationship with the individual to get more information about them.
With specific information about the individual needs, DentonS crafts strategies with other supply chain members to transform the individual. Using the structured service-for-service system, the enterprise shares information about the individual with the other community network providers. In this case, after ascertaining information on the struggling individual such as having limited access to food due to unemployment, DentonS then provides support services that allow the individual to find the right kind of employment and attain self-sufficiency. Once the enterprise identifies the individual’s skill set, the network provides a vast array of donated services such as job training, resume writing, and education support services to enable the individual to gain employment. Upon gaining employment, co-creation occurs when the individual in the impoverished state becomes self-sufficient and is then able to rejoin the community-based network by donating their time, finances, skills, and knowledge to help others in need.

From this evidence, transformation in the underserved community occurs when humanitarian service categories are interconnected. Linking the three service categories into an ecosystem allows the communities needs to be adequately identified and then met. At this juncture, the service categories present service-centric perspectives that go beyond only product distribution to achieve transformation. From this perspective, as organizations form structures and agree on the service design and practice that emphasizes the uplifting change in an impoverished community, donated and charitable products, as well as human skills and knowledge, are required within the ecosystem. Accordingly, CBEs can accentuate the humanitarian service categories within their community-based ecosystems to advance the greater well-being of society.

**Conclusion**

To summarize, this research implies that in order to achieve transformation, the use of SCM to provide service-for-service exchanges, build structures and strategies, and enhance supply chain relationships should be encouraged. Logistics value propositions and service-centric processes that are designed and practiced to increase meeting needs are essential in the ecosystem, and human agents, including end-beneficiaries, to provide charitable operant and operand resources should be highlighted in the underserved community. Finally, even as donated products are essential in the community-based ecosystem, factors that encourage donated services should be emphasized. Overall, this research proposes the idea for the transformative community-based humanitarian service ecosystem to alleviate the suffering of vulnerable people and to co-create uplifting change by connecting service structures, service design and practice, and integrated resources in the underserved community.

This research makes the following contributions: first, the study examines and validates the theory of S-D logic and service science into the humanitarian context by addressing the need to understand the critical services that impact humanitarian aid as compared to mainly product distributions, and the inclusion of end-beneficiaries into the service ecosystem. The research finds that when humanitarian service providers shift their focus from only forming supply chains that distribute donated products into the service perspective that enhances the well-being of the whole community, then the enterprise can focus on forming collaborative and sustainable service structures that influence long-term transformation. Second, in line with S-D logic, the paper further examines service ecosystems. This paper presents an ecosystem perspective that is useful and practical in learning how organizations connect complex and varied systems that deliver service offerings in humanitarian settings and influence transformation.

By combining theoretical frameworks that focus on service ecosystems, additional insights from TSR frameworks highlight the value propositions provided in the service ecosystem. This demonstrates how the ecosystem – connected services – co-creates value in
social magnitudes. Using TSR, this research proceeds to conceptualize how the connected service management categories attain transformation through structures, service design, service practices and the inclusion of human agents (end-beneficiary).

Lastly, the study draws on the SD methodology to develop a visual representation of the paper’s research agenda. The developed causal loop model is used to understand the complex nature of the service ecosystems (Özpolat et al., 2015; Lane and Smart, 1996). Considering that little studies display graphical information on the performance or dynamic behavior within social systems (Coyle, 2000), this model may help service ecosystem thinkers and the humanitarian community to analyze strategies for subsequent management action (Barile et al., 2016).

By combining the extant literature, the study develops a visual CLD that describes a new perspective on humanitarian services within underserved communities. The descriptive systems thinking model, as a managerial tool, has implications for managerial strategies to determine critical services, decision variables and feedback behavior when seeking to influence, facilitate and optimize resource utilization within underserved communities (Richmond, 1993). Managers within CBEs such as corporate socially responsible managers from private donor organizations can use this newly developed visual representation to understand the implications for practice, such as sharing information, building trust, creating public awareness, providing better offerings for meeting consumer demands, determining efficient demand and supply lines, stressing for improved order fulfillment processes and overemphasizing the demand for skilled labor and knowledge within underserved communities. Perhaps this would improve the operations and performance of the humanitarian community-based supply chain as compared to promoting disconnection within the ecosystem.

In addition to managerial implications, visual CLD has implications for research. Qualitative SD models are useful for analyzing real-world data (Diez Roux, 2011; Wolstenholme, 1993, 1999). These models can be used for enhanced organizational learning (Checkland, 1995), conceptual analysis through case studies (Forrester, 1994) and for scenario planning and modeling (Cavana and Maani, 2000) in the humanitarian context (Heaslip et al., 2012). Importantly, researchers can use systems thinking as a methodology to provide intellectual foundations for discovering and building theory as it relates to real-world problems. Researchers can use this methodology to broaden and deepen research concerning social organizational arrangements that seek to solve complex humanitarian aid problems (Heaslip et al., 2012; Hoard et al., 2005).

Humanitarian logistics researchers could use this modeling process for theory building (Schwaninger and Grösser, 2008), providing descriptive case studies (Wolstenholme, 1999) and analyzing hypothesized causal influences and relationships using mental models that communicate detailed disaster relief and humanitarian crisis situations (Hoard et al., 2005), especially within community-based settings. For example, Figure 2 provides details on causal relationships in delivering services and products to end-beneficiaries. The CLD provides information about what type of data are important to describe the relationships between the preparation for logistics delivery of food products and the measures needed to support supply chain relationships, such as collaboration strategies and transparency, and also to increase donated services, such as volunteer skills and labor, that in turn increases supply of donated food.

Nonetheless, the main challenge researchers may face using this methodology is that building CLDs for model conceptualization may “fail to identify the system elements that produce dynamic behavior” (Forrester, 1994). Building CLDs without quantifiable variables may cause system scientists to challenge the validity of the model (Caldwell, 2012; Checkland, 1995). Perhaps, this will propel humanitarian researchers to learn how to use CLDs to test emerging theories using well identified, quantifiable and testable hypotheses.
The methodology can be used as a standard system thinking model prior to and after simulation analysis (Homer and Oliva, 2001). Researchers can learn how to introduce new variables and their causal effects and relationships within a system’s structure. Then, researchers could decide to proceed with the stand-alone diagram that is intended to provide insight into managerial issues and to test emerging theories with quantifiable feedback variables.

Limitations and future directions

It is apparent that limitations exist with any research. First, the case study research is limited to achieving universal generalizability. However, while this was not the intention of this method, by providing acumen using existing theories and the use of the CLD, it is suggested that the diagram provides general solutions for problems that deal with descriptive data and hypothesize causal influences within complex systems (Homer and Oliva, 2001). Furthermore, by acknowledging that there are limitations in not using quantitative methods in analyzing the case study data, research shows that using the simulation for future research provides more information on the causal feedback behaviors within each variable as depicted in the model (Coyle, 2000).

CLDs can be visual representations used before or after simulation analysis. Detailed simulation modeling can provide quantitative analysis to test and draw possible interferences captured in the qualitative model. By using simulation, future researchers can address the causal feedback identified, specifically look into each variable to see and confirm their cause and effect relationships in the model. As such, the qualitative SD approach provides an interactive tool to depict process feedback, highlight complicated causal relationships and model key variables in the transformative service ecosystem for future validation.

Also, this research acknowledges that the scale for a social service system is broad and needs further development. Future research can look into creating simpler and smaller visual CLDs to describe the sub-models in the ecosystem. For instance, a model can be developed to describe the supply chain interactions of specific beneficiaries and stakeholders within the community-based setting. Furthermore, while this research highlights the need for preplanning strategies to select the active and committed suppliers in the ecosystem, future research can elaborate on the identification, selection and use of other supply chain strategies not mentioned in the model, such as risk hedging, demand and supply uncertainties and use of limited resources (Mentzer et al., 2001).

Considering the limitation of the single case study data generated from interviews and observations provides research constraints. Future research can further analyze the developed model in other supply chain and community-based scenarios to test its applicability. For example, the model mentions the supply of food products. Future research can investigate other CBEs providing similar types or other types of products such as healthcare products. Also, research can focus on environmental considerations within urban communities (Kovács and Spens 2011). Insights from such investigations can uncover solutions to different systematic challenges that disrupt transformation in underserved areas.

Specifically, to address questions that remain about the causality effects of variables in the model. Future researchers can investigate other contexts. Further research can use empirical research to validate the model in a global setting. Ultimately, there are many more areas and related questions that future research can address such as investigating the types of operant resources that transform end-beneficiaries in the underserved community. Also, how the CBE distributes donated operant resources.

In conclusion, this research has the potential to encourage research on long-term transformation within the underserved communities as well as showcase how the humanitarian
service categories: charitable donations management, logistics services and SCM are interconnected within community-based ecosystems. The dynamic model presented, although in the initial stages, provides a conception of understanding, analyzing and assessing the complex nature of transformative humanitarian service and value propositions within underserved communities.

Notes
1. Structures that afford both economic and social supply chain relationships that include all stakeholders. Community-based supply chains involve a mix of social and economic organizations characterized as active members of the community coming together to form systems that provide value-creating services and products to alleviate challenges facing the community (Obaze, 2016).

2. The main tenet of system dynamics, as applied by social systems, is that complex behavior within ongoing exchanges between people, material, finances and information characterizes feedback mechanisms (loops) in a CLD.

References


Further reading


Corresponding author
Yolanda Obaze can be contacted at: yo21@evansville.edu

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Applying the Delphi method to determine best practices for outsourcing logistics in disaster relief

Timo Gossler, Ioanna Falagara Sigala and Tina Wakolbinger
Research Institute for Supply Chain Management, WU (Vienna University of Economics and Business), Vienna, Austria, and Renate Buber
Institute for Nonprofit Management, WU (Vienna University of Economics and Business), Vienna, Austria

Abstract
Purpose – The purpose of this paper is to determine best practices of aid agencies for outsourcing logistics to commercial logistics service providers (LSPs) in disaster relief. Moreover, it evaluates the application of the Delphi method for research in humanitarian logistics.

Design/methodology/approach – The paper is based on a two-round Delphi study with 31 experts from aid agencies and a complementary full-day focus group with 12 experts from aid agencies and LSPs.

Findings – The study revealed 12 best practices for outsourcing logistics in disaster relief and a compilation of more than 100 activities for putting these practices into action. Experts consider a proper balance between efficiency and compliance, a detailed contract and a detailed service request most important. Additionally, the Delphi method was found to be a promising technique for research on humanitarian logistics.

Research limitations/implications – By critically examining the Delphi method, this study establishes the basis for a wider application of the technique in the field of humanitarian logistics. Furthermore, it can help to prioritize future research as the ranking of practices reflects the priorities of practitioners.

Practical implications – The paper provides guidance to practitioners at aid agencies in charge of outsourcing logistics.

Originality/value – This research is one of the first in the field of humanitarian logistics to apply the Delphi method. Moreover, it addresses the lack of literature dealing with approaches for building successful cross-sectoral partnerships.

Keywords Outsourcing, Humanitarian logistics, Delphi, Logistics services, Private Sector Partnerships

1. Introduction
Outsourcing logistics in disaster relief operations provides considerable benefits to aid agencies, such as cost efficiency, flexibility and scalability (Baharmand et al., 2017; Cozzolino et al., 2017; Thomas and Fritz, 2006). Therefore, many aid agencies make strong use of outsourcing, and multiple billion US$ are spent every year by aid agencies on logistics services (Binder and Witte, 2007; L’Hermitte et al., 2016). Commercial logistics service providers (LSPs) are an integral part of any disaster relief operation, both at the international and the local level (Sánchez Gil and McNeil, 2015; Vega and Roussat, 2015).

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However, many organizations fail to build successful collaborative relationships with LSPs (Bealt et al., 2016). Often, they are dissatisfied both with the perceived performance and the related costs (Cottam et al., 2004; Schulz, 2009). The success of outsourcing engagements is affected by specific challenges of the humanitarian environment. For example, aid agencies’ high staff turnover and unpredictable funding cause issues for building relationships with LSPs (Thomas, 2003; Van Wassenhove, 2006). Likewise, different cultures and working styles cause frictions during the collaboration (Nurmala et al., 2017). In the light of these challenges, aid agencies seek guidance on how to best leverage the advantages of outsourcing while reducing the risks and downsides of such engagements. Their scope of action is wide in this regard, covering activities such as provider selection, contract negotiation, performance evaluation or supplier management (Bagchi and Virum, 1996; Gould, 2003; Sink and Langley, 1997). Some approaches in these areas, called best practices, consistently show results superior to those achieved by other approaches (Business Dictionary, 2018; Supply Chain Council, 2008). Taking a more strategic and structured approach to outsourcing by replicating such best practices can help aid agencies to be more successful in outsourcing engagements (Bealt et al., 2016). Therefore, in response to aid agencies’ need for guidance, we address the following research question:

RQ. What are best practices of aid agencies for ensuring the success of outsourcing logistics to commercial LSPs in disaster relief?

Since academic literature in this regard is very sparse and did not address the same level of detail as our study (Bealt et al., 2016; Nurmala et al., 2017; Vega and Roussat, 2015), answering our research question required an exploratory approach. Moreover, the environment of disaster relief is well known for its lack of performance data and indicators (Abidi et al., 2014; Beamon and Balcik, 2008; Schulz and Heigh, 2009). Therefore, we decided to leverage the knowledge of humanitarian practitioners who have personal experience in engaging LSPs and, consequently, expert knowledge about advisable practices. As the responses of individuals are necessarily judgmental and situational, individual opinions need to be combined in order to develop a comprehensive picture. The Delphi method is particularly suited for exploratory research under such conditions (Okoli and Pawlowski, 2004; Akkermans et al., 2003; Meredith, 1993; Turoff, 1970). It is an anonymous and iterative technique for facilitating and structuring communication among a group of experts with the objective of either transforming individual opinions into group consensus or identifying systematic dissent among participants (Dalkey and Helmer, 1963; Hasson et al., 2000; Rowe and Wright, 2011). While common surveys are best at investigating “what is”, Delphi studies excel in asking “what […] should be” (Hsu and Sandford, 2007). Consequently, it is very appropriate for our type of research question and has already been leveraged in this context in other disciplines (e.g. Ager et al., 2010).

The Delphi method brings a number of further advantages for research in humanitarian logistics. First, it allows to account for the worldwide dispersion of humanitarian experts, since it can be conducted remotely and asynchronously. Second, the method does not require the expert panel to be statistically representative of any population, because the expertise of the panelists is more important than their number (Ludwig, 1997; Okoli and Pawlowski, 2004; Powell, 2003). This makes the approach more feasible in the humanitarian environment than large-scale surveys with representative samples, which are prone to struggle with the non-transparent group of existing aid agencies (Vega and Roussat, 2016). Third, the Delphi approach guarantees anonymity of responses (McKenna, 1994) and encourages humanitarian experts to express their true opinions. Given the competition between aid agencies and the importance of each organization’s reputation, practitioners might be reluctant to do so in case of non-anonymous research methods. Fourth, the Delphi method resolves group interaction effects such as the dominance of powerful individuals (Dalkey et al., 1972; Goodman, 1987;
Despite the described benefits, only a few studies in humanitarian logistics have applied the Delphi method to date (Cottam et al., 2004; Mari Ainikki Anttila, 2014; Richardson et al., 2016; Sahebi et al., 2017). Therefore, as a secondary objective in addition to our content-oriented research question, we critically explore the applicability of the research method and its ontological, epistemological and methodological assumptions.

In summary, our research contribution is twofold. First, we determine a set of best practices, which can help humanitarian organizations to be successful when outsourcing logistics. To provide concrete guidance to humanitarian practitioners, our focus is on the compilation and discussion of detailed activities for implementing the best practices in disaster relief operations. Second, we shed light on the application of the Delphi method as a promising method for empirical research in humanitarian logistics. The critical debate of our research design is intended to support other researchers to successfully leverage the method for their own research. It has to be noted, however, that an all-embracing discussion of the Delphi method would require a designated paper. This paper focuses on the most important aspects in reference to our own study.

This paper is structured as follows. In the next section, we briefly review the relevant literature. In Section 3, we describe our research design and discuss its trustworthiness from a methodological perspective. In Section 4, we present the results of the empirical study, which we then discuss in Section 5 in view of existing literature. We close the paper with a summary and an outlook in Section 6.

2. Literature review

The existing literature on outsourcing in humanitarian logistics can be grouped into four categories. The first group of papers investigate the benefits, risks, barriers and enablers of cross-sector collaboration and partnerships between aid agencies and LSPs. Representatives of this stream of research are Balcik et al. (2010), Bealt et al. (2016), Cozzolino (2012), Maon et al. (2009) and Nurmala et al. (2017, 2018). The second group of studies focus on specific challenges of cross-sector partnerships, such as service contracts (Egan, 2010), cultural barriers (Dowty and Wallace, 2010) or cooperative purchasing initiatives (Pazirandeh and Herlin, 2014). The third group of articles explore the role of LSPs and outsourcing in humanitarian operations. Examples for this class of papers are Abidi et al. (2015), Baharmand et al. (2017), Cottam et al. (2004), Cozzolino et al. (2017), Heaslip (2013), Sánchez Gil and McNeil (2015) and Vega and Roussat (2015). The fourth group of studies are mathematical models which examine the efficiency of outsourcing (Nagurney et al., 2011; Wang et al., 2016), the tendering and selection process (Bagchi et al., 2011; Paul and Wang, 2015; Trestrail et al., 2009), and routing decisions of service providers (Huang et al., 2015).

While none of the previous studies has investigated how aid agencies can best ensure the success of outsourcing logistics, some of them mention relevant recommendations as a by-product of their research. Aid agencies should build close relationships with service providers to enable smooth planning and communication (Cottam et al., 2004). To achieve this, they should establish bi-directional data and information exchange, leveraging information technology and ensuring the protection of sensitive data (Balcik et al., 2010). In the best case, aid agencies should establish long-term strategic partnerships, which do not only involve the sharing of resources, but also the sharing of risks (Maon et al., 2009). Building this type of partnerships requires to understand which type of partnership mechanism applies for which situation (Nurmala et al., 2018) and to employ a high level of commitment, resolution, communication and partner focus (Cottam et al., 2004). Since different cultures and working styles can imply challenges for building partnerships (Nurmala et al., 2017), aid agencies should create internal awareness for cultural differences,
for the expectations of the service provider and for the rationale behind both aspects (Dowty and Wallace, 2010). They should also adapt to the commercial sector by allowing more decentralized decision-making (Baharmand et al., 2017) and increasing the standardization of their processes (Bealt et al., 2016).

It can be beneficial for aid agencies to combine corporate resources (Maon et al., 2009) and engage in collaborative purchasing of logistics services (Pazirandeh and Herlin, 2014). However, mutual trust among the partners, a harmonized and coordinated tender process, an integrated approach to contracting, and harmonized agency processes and policies are important prerequisites for collaborative purchasing to be successful (Pazirandeh and Herlin, 2014). Alternatively, it can be advantageous to rely on 3PL or 4PL vendors for consolidating demand and managing the sub-contracting of providers (Cottam et al., 2004; Abidi et al., 2015). Aid agencies need to be clear and transparent on their requirements (Bealt et al., 2016) and consider a provider’s proven track record, existing relationship network, local knowledge and territorial coverage (Baharmand et al., 2017). They should not rely on single providers, but pursue multiple sourcing (Pazirandeh and Herlin, 2014) and build a network of partnerships (Nurmala et al., 2018). Finally, humanitarian organizations should ensure to have formal service contracts in place, which in the best case are set up in advance of a disaster (Baharmand et al., 2017), transfer the responsibility for the safety of goods to the provider (Baharmand et al., 2017) and are in line with local legislation and practices (Cottam et al., 2004).

In contrary to the field of humanitarian logistics, a number of dedicated studies have investigated success factors for outsourcing in the context of commercial logistics. They highlight the importance of planning the outsourcing engagement up-front and jointly with the provider (Goles and Chin, 2002; de Grahl, 2011; Hauptmann, 2007; Lambert et al., 1999; Selviaridis et al., 2008) and the benefits of establishing close working relationships with open communication and information exchange (Frankel et al., 1996; Goles and Chin, 2002; de Grahl, 2011; Lambert et al., 1999; Leahy et al., 1995; Qureshi et al., 2007; Selviaridis et al., 2008; Tate, 1996; van Laarhoven et al., 2000). They also emphasize the need for aligning expectations, clearly defining requirements and being thorough in the contract negotiations (Frankel et al., 1996; Hofenk et al., 2011; Lambert et al., 1999; van Laarhoven et al., 2000). Organizations should set up a written agreement or contract, which defines clear ground rules (Frankel et al., 1996; Tate, 1996) and includes provisions for adjustments and exit (Leahy et al., 1995; Selviaridis et al., 2008; Tate, 1996). Contracts and financial incentives are one possibility to manage provider opportunism (Hauptmann, 2007; Selviaridis and Norman, 2015), especially when leveraged together with joint operating controls and a strong performance orientation (Lambert et al., 1999; Leahy et al., 1995; Qureshi et al., 2007; Selviaridis et al., 2008; van Laarhoven et al., 2000). Nevertheless, organizations should build relationships with mutual trust and understanding (Frankel et al., 1996; Goles and Chin, 2002; Lambert et al., 1999; Leahy et al., 1995; Qureshi et al., 2007; Selviaridis et al., 2008; Tate, 1996). This requires to select a service provider which is highly compatible with respect to capabilities, culture and reputation (Frankel et al., 1996; Goles and Chin, 2002; Hauptmann, 2007; Lambert et al., 1999; Leahy et al., 1995). Moreover, it requires the engagement to provide benefits to both parties and to include the mutual sharing of risks (Goles and Chin, 2002; de Grahl, 2011; Lambert et al., 1999; Leahy et al., 1995; Selviaridis et al., 2008).

In summary, the related literature on humanitarian logistics mentions a number of promising activities for aid agencies engaged in outsourcing, but provides a neither comprehensive nor integrated picture. The relevant literature on commercial logistics, in turn, gives a broader perspective, but describes only high-level factors, which are too abstract for being implemented by aid agencies. For example, the corresponding papers do not explain how relationships with mutual trust and understanding can be built or how a strong performance orientation can be established. Moreover, the insights from commercial logistics cannot be applied to the humanitarian context without adaptations because of the
sector’s well-documented specifics (Kovács et al., 2009; Van Wassenhove, 2006). Accordingly, multiple researchers point out a need for dedicated research, especially empirical studies, on how aid agencies and LSPs can build successful outsourcing relationships (Bealt et al., 2016; Nurmala et al., 2017; Vega and Roussat, 2015). We address this gap with respect to both content and methodology by determining best practices for outsourcing logistics in disaster relief based on a Delphi approach and by compiling and discussing detailed activities for implementing these practices.

3. Research design
We conducted a two-round Delphi study between November 2017 and March 2018 with 31 experts from humanitarian organizations. It was administered electronically using the Calibrum Surveylet Software (Aengenheyster et al., 2017) and can, consequently, be called e-Delphi (Hasson and Keeney, 2011). After the finalization of the Delphi study, in April 2018, we conducted a complementary full-day focus group with ten experts from humanitarian organizations and two experts from LSPs (Morgan and Krueger, 1997; Morgan, 1996; Kitzinger, 1995). The purpose of the focus group was to perform a member check on the results, that is, to validate the outcome of the e-Delphi as well as our analysis and interpretation with subject matter experts (Creswell, 2009; Wallendorf and Belk, 1989; Lincoln and Guba, 1985).

3.1 The e-Delphi
The four basic principles of the Delphi method are an iterative and multistage process, some level of controlled feedback, the opportunity for individuals to revise their answers and a certain degree of anonymity (Linstone and Turoff, 1975; Hasson et al., 2000; Powell, 2003; Hsu and Sandford, 2007). While all Delphi studies share these common characteristics, the flexibility of the Delphi method has led to a high diversity of methodological variants (Hasson and Keeney, 2011). One important variant of Delphi design is the Policy Delphi, which differs considerably from the classical Delphi (Turoff, 1970). Its prime objective is not to seek consensus for decision-making or forecasting under uncertainty, but to identify and evaluate potential solutions for a selected issue and to reveal arguments for and against each solution (Turoff, 1970). Accordingly, its approach is rather qualitative, even if quantitative questions might be applied to evaluate the different alternatives. Determining best practices for outsourcing logistics in disaster relief requires to identify and evaluate different ways of managing activities such as provider selection, contract negotiation, performance evaluation or supplier management. We have, therefore, built our research design on the principles of the Policy Delphi.

Number of rounds. Delphi results tend to show only slight or even no improvements after the second iteration (Woudenberg, 1991). At the same time, the risk of biased results increases with the number of conducted iterations because of participant fatigue and drop-outs (Hasson et al., 2000). Accordingly, most Delphi studies consist of two or three rounds (Diamond et al., 2014). It is generally advisable to limit the Delphi study to the minimally sufficient extent and verify its results through follow-up explorations (Delbecq et al., 1975). We had already achieved a high level of consensus after the second round and perceived participant fatigue to become a relevant risk. Additionally, given our research objective, the explanations of panelists in reference to their second round judgments were considerably more important for our findings than minor changes of quantitative votes in a potential third round. Therefore, we limited the study to two rounds, knowing that any need for clarification could be addressed in the complementary focus group.

Expert panel. While there are no definite criteria for the definition and selection of experts (Hasson et al., 2000; McKenna, 1994; Hsu and Sandford, 2007), it is clear that the expertise and experience of the panelists determine the trustworthiness of the Delphi results
(Hasson and Keeney, 2011; Hsu and Sandford, 2007; Lincoln and Guba, 1985). On a general level, experts are persons working in the relevant field with substantial knowledge of the topic under investigation (McKenna, 1994; Powell, 2003). For our study, we defined an expert as a humanitarian practitioner who had considerable and personal experience in outsourcing of logistics in disaster relief. Such persons possess access to privileged information which is difficult for other people to obtain and process. Accordingly, they are in a position to structure the field of action in a meaningful way and advise others on what to do (Bogner et al., 2014; Bogner and Menz, 2009; Meuser and Nagel, 1991, 2009).

We requested potential participants to only register for the study if they possessed the described type and level of experience. In addition, we validated their expertise in Round 1, asking them to describe their personal experience with outsourcing along a number of dimensions. If their descriptions were coherently elaborated, their experience was seen as a sufficient basis for sharing information and providing advice to others (Stehr, 1994).

Most Delphi studies involve between 11 and 50 experts (Diamond et al., 2014; Hsu and Sandford, 2007). Since our research interest was to explore the perspective of aid agencies, we decided to not include any representatives of LSPs in the expert panel. For recruiting experts from aid agencies, we applied a mix of purposive sampling techniques: criterion-based sampling, snowball sampling and opportunity sampling (Patton, 2002). On the one hand, we approached all organizations which were listed as most important disaster relief agencies by Vega and Roussat (2016) based on the report Global Geneva’s 2015 Top 500 NGOs. Through either personal contacts or central mailboxes and phone lines we asked these organizations for employees who had personal experience with engaging LSPs in disaster relief operations and were willing to participate in our study. On the other hand, we identified relevant experts by asking our existing personal contacts at humanitarian organizations for further qualified participants within their network. In total, we recruited 31 experts from 24 humanitarian organizations who had on average 12 years of experience in humanitarian logistics, both at headquarters and field level (see Tables AI and AII). Their high level of experience, their qualifications and their long-lasting exposure to the problem under investigation contributed to the trustworthiness of our results (Hasson and Keeney, 2011; Lincoln and Guba, 1985).

Round 1. All recruited experts participated in the first round of the study, which was a qualitative online survey[1]. Before releasing the questionnaire to the panel, we pre-tested it with selected practitioners. The survey consisted of three parts (see Appendix 3): first, panelists were asked to describe a situation in which they had worked personally with LSPs, focusing on what they would do either similarly or differently under comparable conditions in the future. This framed the research subject and stimulated the link to the panelists’ experiences (Froschauer and Lueger, 2003). Second, they were requested to list success factors for outsourcing logistics in disaster relief in general. Third, they were prompted to provide specific recommendations with respect to the areas of provider selection, contract negotiation, performance evaluation and supplier management.

We analyzed the responses of the first survey, that is, the textual data, based on the principles of content analysis in NVivo. While NVivo, a leading tool for qualitative data analysis, was used to organize, store and retrieve the data, the actual analysis was carried out manually by the research team. Based on rules of procedure we assigned conceptual labels to the empirical data to explicate, summarize and structure the recommendations of participants (Mayring, 1991, 2000). The coding process combined both inductive and deductive approaches (Fereday and Muir-Cochrane, 2006). During deductive coding we assigned labels which were suggested by existing literature (theory-driven coding). When the suggestions of experts could not be referenced to existing literature, we applied inductive coding, that is, we assigned labels which were suggested by the data itself.
The coding process was organized as an iterative procedure in order to deal with inter-observer variability. First, three researchers with different professional backgrounds individually grouped the activities. Afterwards, multiple meetings were held to compare, discuss and consolidate the different classifications until there was perfect agreement among the researchers.

The analysis of the first round revealed a set of 113 activities which were recommended for ensuring the success of outsourcing by at least one expert. These activities were grouped into 12 higher-level categories, so-called practices, based on commonalities with respect to the objective of each activity.

**Round 2.** For validating the findings from the first round, we fed the anonymized results of our analysis back to the expert panel as part of a rather quantitative second online survey (see Appendix 4). This mix of qualitative and quantitative methods contributed to the methodological rigor of our study (Hasson and Keeney, 2011). As for the first round, we pre-tested the questionnaire before releasing it to the panel. In total, 27 experts participated in this survey (87 percent response rate). They rated both the importance of the 12 practices and the usefulness of the 113 corresponding activities on a four-point Likert scale. By limiting each page of the survey to a maximum of ten questions, we ensured that the response process was very manageable for participants. The design of both Likert scales was based on the recommendations by Turoff (1970). They featured an optimum number of alternatives, ensured consistent cognitive distances between adjacent pairs of points and prompted experts to take a clear position (Leung, 2011; Lozano et al., 2008). In addition to their quantitative rating, experts had the possibility to explain the reason of their judgment in form of an open comment (Singer and Couper, 2017).

Analyzing the replies of the second round, we calculated the mean rating of all items (activities and practices) and determined the level of consensus among the 27 panelists. We identified items lacking consensus by combining two well-established indicators (von der Gracht, 2012): interquartile range ($IQR$) and $r_{ag}$ $IQR$ measures the difference between the lower and upper quartiles. Following the recommendations from Raskin (1994) and Rayens and Hahn (2000), we marked all items with an $IQR$ greater than 1 as “lacking consensus.” $r_{ag}$ is a measure of interrater agreement (James et al., 1993). In line with LeBreton and Senter (2008), we also labeled all items with $r_{ag} \leq 0.30$ as “lacking consensus.” In addition to the quantitative analysis, we applied content analysis to the participants’ qualitative explanations, following the same procedure as in Round 1.

Our analysis revealed a high level of consensus among experts; panelists had expressed controversial views for only 24 activities and 1 practice (see Section 4). There was a considerable level of doubt if a third round could resolve the remaining controversies (Woudenberg, 1991), especially because participant fatigue had reached a potentially risky level (Hasson et al., 2000). We, therefore, decided to terminate the e-Delphi after the second round and to use follow-up explorations for shedding more light on the remaining controversies (Delbecq et al., 1975). The complementary face-to-face focus group was used for this purpose.

### 3.2 The focus group

The focus group (Morgan and Krueger, 1997; Morgan, 1996; Kitzinger, 1995) was used as a member check (Creswell, 2009) and aimed to validate the outcome of the e-Delphi as well as our analysis and interpretation with subject matter experts. Member checks are a crucial technique for establishing credible and trustworthy findings (Lincoln and Guba, 1985). They are an opportunity to reveal latent assumptions of experts, challenge interpretations of researchers and obtain additional information from participants which may be stimulated by the playing back process. Accordingly, member checks should be treated as another
source of data and insights (Silverman (2013) in reference to Fielding and Fielding (1986)). Used in this way, the focus group allowed us to gather additional textual data to enrich the findings from the e-Delphi. Additionally, it enabled us to understand in detail the reasons for the dissent among panelists regarding 24 activities and 1 practice. Debating both benefits and drawbacks of the particular items in a controversial, face-to-face discussion with selected experts allowed us to take a deep dive into the underlying assumptions and contextual relationships (Rowe and Wright, 2011; van de Linde and van der Duin, 2011).

In order to allow fruitful discussions within a diverse group of experts, we limited the number of focus group participants to ten and restricted participation to one representative per organization. Given the administrative and financial challenge of bringing together an internationally distributed group of experts for a face-to-face meeting, we recruited the focus group participants based on opportunity sampling (Patton, 2002). On the one hand, we invited all respondents of the second survey to the focus group. On the other hand, in order to account for the busy schedule of humanitarian practitioners, we offered panelists the opportunity to send equally qualified substitutes from their organizations in case they could not attend themselves. Focus group seats were awarded according to the sequence of registration. To ensure a representative pooling of judgments and experiences (Okoli and Pawlowski, 2004; Powell, 2003; Ludwig, 1997), we carefully monitored the process of participant registration, prepared to correct any potential bias in the sample through purposive sampling (Patton, 2002). In the end, a very competent and diverse group of experts was recruited for the focus group, consisting of five respondents of the second survey and five nominated substitutes (see Table AI). The new participants allowed us to reflect on the findings from an outside perspective and to incorporate new viewpoints into the results. In addition to the experts from aid agencies, we invited two representatives of commercial LSPs to the focus group in order to mirror the perspective of aid agencies. The presence of LSPs helped us to trigger truly controversial discussions. Through such discussions we were able to gain insights into, by then, tacit knowledge and assumptions of experts, which had not been accessible by the previous question-and-answer surveys (Rowe and Wright, 2011; van de Linde and van der Duin, 2011).

The full-day focus group consisted of multiple sessions. In each session, the research team first presented results from the two online surveys. In order to direct the participants' attention to the content, methodological details were not explained. Afterwards, discussions took place among the experts. A member of the research team facilitated the discussions, summarized them and asked participants for validation or corrections. The focus group was audio-recorded, transcribed word-for-word and, afterwards, content-analyzed in NVivo, following the same procedures as for the textual data from the e-Delphi.

3.3 Methodological discussion

Even though the Delphi method entails considerable benefits, it is also subject to constant critique (Hasson and Keeney, 2011). Therefore, we deem it important to discuss the trustworthiness of our research design. Due to the qualitative and post-positivist nature of our study and its underpinning ontological and epistemological assumptions, the concepts of validity, reliability and objectivity are not applicable to our work (Day and Bobeva, 2005; Wallendorf and Belk, 1989). Instead, we will discuss the criteria of credibility, transferability, dependability and confirmability (Lincoln and Guba, 1985), which are well established for qualitative research. In doing so, we will focus on challenges which future Delphi studies in humanitarian logistics are likely to encounter and potential solutions to these challenges.

Credibility. Discussing our results in the face-to-face focus group with a group of experts, partially internal and partially external to the Delphi, contributed to the credibility of our study in form of a member check (Wallendorf and Belk, 1989). This allowed us to take a deep
dive into the panelists’ underpinning assumptions and logics and to refine the results accordingly (van de Linde and van der Duin, 2011). While this was an important part of our research, this might not be possible in other studies on humanitarian logistics due to reasons of time and cost. In the interest of credibility, we also applied triangulation across researchers and sources, for example, by performing content analysis within a heterogeneous team and by reviewing the results in the context of existing literature (Wallendorf and Belk, 1989). Still, incorporating further documents into the analysis, such as actual logistics contracts, could have been a promising extension of the triangulation approach.

Reflecting critically, it should also be noted that our study was executed in English. Since most of the participants were not native speakers, lingual misconceptions might have influenced the results. In general, misconceptions might also have occurred because of formulations in the questionnaires. For example, participants might have been misled by the perception of overlaps in the titles of the 12 practices. We tried to counteract by using simple expressions and unambiguous wording (Frewer et al., 2011; Parente and Anderson-Parente, 2011) and by performing pre-tests with selected practitioners for both surveys (Okoli and Pawlowski, 2004). The pre-tests also helped us to ensure that participants were able to comfortably handle the design, length and complexity of the questionnaires. While we perceived this approach beneficial, further measures could have been applied, for example, debriefing by peers during the development and analysis of the questionnaires (Lincoln and Guba, 1985).

Another limitation to credibility, which is inherent to all Delphi studies, is the influence of the selected consensus measures and the corresponding decision to terminate the study. A vast abundance of approaches exists and different measures might lead to different conclusions regarding the level of consensus (Diamond et al., 2014; von der Gracht, 2012). Our focus was not the achievement of consensus on a quantitative measure, but the identification of a set of important practices. Given this rather qualitative approach, the explanations of panelists in reference to their judgments were considerably more important for our findings than the choice of the consensus measure and the revision of the second round votes in a third round. For other applications in the field of humanitarian logistics, however, we recommend a critical consideration of this aspect. In conclusion, we have a good level of confidence in the credibility of our research. However, “as with most research, findings are never completely definitive but can be strengthened, clarified and enhanced by judicious and sound follow-up research” (Kennedy, 2004).

**Transferability.** We established a heterogeneous expert panel by recruiting participants from diverse organizations and with a broad range of different experiences in disaster relief. Such triangulation through purposive sampling helped to enhance the transferability of results (Delbecq et al., 1975; Linstone and Turoff, 1975; Wallendorf and Belk, 1989). However, we faced limitations in this regard when trying to recruit experts from African or Asian countries, which were due to a lack of accessibility (for the Delphi) and high cost (for the focus group). This might have biased the results toward the perspective of European experts, even though our panel had extensive experience in the field. Future studies should put an extra eye on this topic and identify specific approaches for involving non-European panelists. As another measure for improving transferability, we sought for limiting exceptions throughout our study, which could define the boundaries of our results (Wallendorf and Belk, 1989). For this reason, we asked panelists to justify their judgments and provided them the opportunity to outline the reasoning behind their responses (Nowack et al., 2011). Panelists brought up some relevant boundaries for the transferability of our results on these occasions. For instance, the usefulness of selected activities could be influenced by contextual factors, such as the value of the service purchase, size and funding structure of an aid agency, the geographic context of the service (before or after point-of-entry) or the phase of disaster relief. However, such exceptions do not imply that
our results need to be modified (Glaser and Strauss, 2017; Wallendorf and Belk, 1989). Even when exceptions represent a considerable number, there can be substantial evidence for the acceptance of the results (Lincoln and Guba, 1985). Reflecting all contextual factors of humanitarian logistics in the results would be nearly impossible. Instead, it is important to recognize that the application of the best practices by aid agencies might be subject to slight variations, depending on the contexts. Future Delphi studies could account for this challenge by working with multiple parallel panels of experts, which ensure homogeneity of each panel with respect to the important contextual factors.

**Dependability.** Authors such as Cornick (2006) are confident that the use of a diverse and qualified expert panel would secure the stability and dependability of Delphi results. While we have designed our panel in exactly this way, we still consider it important to recognize the limitations of the Delphi method in this regard. According to the post-positivist paradigm, a single, objective reality does not exist (Lincoln and Guba, 1985). Both people and contexts change continually (Wallendorf and Belk, 1989). Accordingly, there is no guarantee that our results would repeat if we replicated the study with similar persons in a similar context. Therefore, Wallendorf and Belk (1989) recommend to explore the boundaries of dependability by applying a longitudinal approach and repeating investigations months or years later when things should have changed in various ways. By investigating these changes, researchers would be able to assess if the original theory is still applicable or needs to be modified. Given the dynamics of the humanitarian sector, different results in multiple years from now should actually not be surprising. Although this might appear a considerable limitation, this challenge is inherent to all qualitative research approaches. Furthermore, one needs to bear in mind that the Delphi method does not strive to generalize, but aims to provide a snapshot of expert opinion at a specific moment in time (Maceviciute and Wilson, 2009; Thompson, 2009). If researchers take this into account for their interpretation, and combine it with a longitudinal design as far as financial resources allow, dependability should not be a barrier for a wider use of the Delphi method in research on disaster relief.

**Confirmability.** Post-positivists philosophy also qualifies the requirement of confirmability: “There can be no absolute objectivity; at best the researcher can become conscious of and hopefully reduce [...] biases” (Wallendorf and Belk, 1989). Therefore, a clear audit trail of data gathering and interpretation is one of the most important measures for enhancing confirmability in Delphi research (Rodgers and Cowles, 1993; Skulmoski et al., 2007). We established this by transcribing all interviews and focus group discussions, storing all survey responses in a database and recording notes on our analysis in NVivo. Also, to increase confirmability, we leveraged triangulation across researchers by involving multiple researchers in the planning and execution of interviews and focus groups as well as the analysis of textual data (Wallendorf and Belk, 1989). While we consider these techniques appropriate, future studies based on the Delphi method could, nevertheless, apply further measures in this regard. For example, they could make use of external auditors which are supplied with all raw materials as well as their interpretation (Wallendorf and Belk, 1989). Moreover, they could formally determine inter-coder reliability in order to assess the confirmability of the coding process (Mayring, 2000).

4. Results
In the first survey, 31 experts recommended 113 activities for ensuring the success of outsourcing logistics. As described in detail in Section 3, these were grouped into 12 best practices and presented for further evaluation in the second round. In that survey, 27 panelists rated the importance of each practice on a four-point Likert scale (not important, somewhat important, important and very important). Table I shows the mean rating of each practice. Three practices were rated very important (mean rating ≥ 3.50) and nine practices
important \((2.50 \leq \text{mean rating} < 3.50)\). In general, there was consent among panelists \((IQR \leq 1 \text{ and } rwg \geq 0.30)\). Only for the importance of practice P07, no consent was achieved.

In total, 27 panelists also rated the usefulness of each activity on a four-point Likert scale (not useful, somewhat useful, useful and very useful). Table AIII shows the mean rating of each activity. While 35 activities were considered very useful (mean rating \(\geq 3.50\)) and 71 useful \((2.50 \leq \text{mean rating} < 3.50)\), 6 activities were found to be only somewhat useful \((1.50 \leq \text{mean rating} < 2.50)\) and 1 was rated not useful at all \((\text{mean rating} < 1.50)\). For the majority of activities \((89 \text{ activities})\), experts agreed on their usefulness \((IQR \leq 1 \text{ and } rwg \geq 0.30)\). For 24 activities, some level of controversy existed among panelists. In some cases, experts did not agree if an activity was useful or very useful. In other cases, experts had opposing views. While one group considered an activity very useful, another group deemed it not useful at all. These items were discussed in detail during the focus group in order to identify the reasons for this controversy.

We will now describe in detail the 113 activities (Table AIII) which were suggested by the panel for implementing the best practices (Table I). We will use expert quotes from the e-Delphi and the focus group to exemplify the recommendations. Where applicable, we will outline the reasons for existing controversies.

### 4.1 Rank 1: ensure both compliance and efficiency in the procurement process (P03)

The most important practice, according to the experts, is to ensure both compliance and efficiency in the procurement process and to properly balance both. Aid agencies face two requirements, which are often conflicting: speed and compliance. On the one hand, their “main objective is to save lives” \((E19)[2]\) and any delays or inefficiencies in the procurement process put this target at risk. On the other hand, many humanitarian organizations “are donor driven agencies [and] have to, even in the emergency, maintain a level of compliance” \((E25)\) with donor requirements, for example, a fair and transparent, but also time-consuming tender process.

Many times, “the good selection, which […] fulfill[s] all the necessary accountabil[ity] procedures, is in direct opposition to the tight and quick deliveries” \((E35)\). Therefore, experts recommend to align procurement procedures to donor requirements and public procurement regulations, but to allow derogations from these procedures in the case of “sudden-onset scenarios or where [a] beneficiary’s life is at risk” \((E21)\). For example, long-term agreements should be tendered openly and publicly and be awarded based on the decision of a multi-person tender committee. Short-term contracts in the context of emergencies, however,
can be awarded either based on restricted tenders, where a request for proposal is sent to a limited number of suppliers only, or even without competitive bidding based on direct negotiations with selected providers. This is “is quite often by many donors accepted [sic.]” (E35) since they “understand the concept of [a] life-saving emergency” (E25). The challenging part is “to determine when the emergency stops, and at which point the organization has to be ready to roll-out the proper [procedures]” (E25). The danger “is that if you start […] an operation based on derogations, there is a tendency that the organization continues to use derogations, and derogations, and derogations, and never takes that next step to operate in the correct manner” (E5). For example, “in the Syria response […] there were agencies that were keeping emergency response for two years” (E25). Derogation rules can be abused by people in situations of self-imposed urgency, which are due to internal shortcomings and not the disaster itself. Therefore, experts recommend to strictly regulate the use of derogation rules by defining appropriate approval workflows, for example, “senior managers to look into the urgency of the request to determine whether there is a justification” (E25). Moreover, top management should clearly define the duration of the emergency status, potentially also based on external reports. One agency, for instance, only allows exceptions due to emergencies if the particular location at the given time is formally recognized by the European Commission as a crisis situation. Besides defining clear exception rules, organizations should carefully document every purchase from request to decision, also in emergencies. Finally, experts emphasize that, given appropriate preparation and planning (see Sections 4.4 and 4.5), compliant procurement is also possible under time pressure: “I think in 99% of our businesses you can tender this stuff” (E6).

4.2 Rank 2: use a detailed written contract as safeguard (P06)

Contracts serve as safeguards for aid agencies by documenting the agreement with the LSP and providing the legal ground for enforcing the agencies’ claims in case of any opportunistic behavior of the provider. Furthermore, organizations can use contracts as a manual of cooperation and to establish “a very clear understanding and description of the mutual expectations” (E23). Accordingly, experts deem it very important to set up a detailed and written contract: “Contracts […] with logistics service providers, especially in the beginning of […] operations, must be very carefully written” (E2), because “what is not written, is not in the contract” (E19).

According to the experts, the contract should explain the context of the operation and the specifics of a humanitarian mission, such as urgency or uncertainty. It should specify the exact scope and duration of the service, clarifying “the differentiation between included and not included” (E27) activities to forestall any discussions about gray areas of responsibility. In addition, agencies should outline the service provider’s supplementary responsibilities, such as documentation or reporting, and describe guidelines for the collaboration, such as planning or communication procedures. Attaching a code-of-conduct, data protection rules or non-disclosure agreements are considered further useful measures in this regard.

The contract should also include performance indicators and service-level agreements. Only in this way, agencies can “assess […] providers’ service level and performance against contractual agreements” (E24) (see Section 4.8). These should be complemented by specifying the consequences of a failure to fulfill the service-level agreements (e.g. penalties or liquidated damages). Likewise, provisions for other adverse events, such as product damages or theft, should be recorded in the contract. Regulating the responsibility of securing insurance coverage is paramount in this regard.

Further important elements of the contract are the structure of service fees and the applicable payment terms. In this context, aid agencies should, for instance, set safeguards against price increases due to unforeseen circumstances: “Price adjustments after finalizing the contract must not happen. The provider has to handle changing conditions” (E18).
While this approach should be balanced with the objective of creating win–win situations (see Section 4.11), conflicts are occasionally inevitable. Therefore, sufficient provisions for adjusting or terminating the contract are advisable. Likewise, the contract should outline the approach to dispute arbitration, the governing law and the court of jurisdiction.

4.3 Rank 3: be detailed in the request for proposal or request for quotation (P04)
Panelists emphasize that a clear and precise service request is the foundation for a successful outsourcing engagement: “If you do a proper analysis of your needs, and you specify very well what […] you expect from the contractor […] that’s […] going to lead to [a] clear contract and contractual obligations” (E25). Based on a clear understanding of their own requirements (see Section 4.5), agencies should explain these in detail to the provider: “the more info [is] shared, [the] less issues come up at the negotiation and signing stage” (E24). In this regard, it can also help to attach a draft contract with standard terms and conditions to the service request since this “avoids any surprises down the road” (E5). This is, in particular, important for services at the field level; international service providers often prefer to use their own standardized contracts. Experts highlight, furthermore, that is not always “possible to give all exact details upfront” (E21) as the requester might not have all required information either. In these cases, it is important “to give firm and good indications, but [to allow for] some flexibility” (E21).

In addition to detailed requirements, experts recommend to highlight the context of the operation and the specifics of a humanitarian mission in the request to the provider. Moreover, in order to establish transparency, agencies should clearly explain the bidding and selection process (e.g. administrative requirements, timeline and selection criteria). Attaching standardized bid templates and questionnaires for additional information (e.g. customer references) enables a smooth and efficient process for both agencies and service providers. The latter is very important, because “many vendors find the detailed documentation and need for information from them an obstacle” (E28). Extensive bidding requirements can lead to lower response rates from LSPs and hinder the selection of the right provider (see Section 4.6).

4.4 Rank 4: prepare for the engagement of logistics service providers (P01)
Panelists consider it important to make sufficient preparations for the engagement of LSPs: “Bringing things into the country […] has to be arranged before the emergency actually occurs” (E25). Preparation can take different forms. Organizations should, first of all, develop guidelines, process documentations and standard operating procedures, which define how the organization handles outsourcing, for example, regarding the procurement of services or the setup of contracts. Especially in emergencies, such documents “help to avoid confusion” (E22) and allow “to be efficient” (E34), because “if there is no documentation, […] it is going to be a big chaos” (E17).

It is even more important, though, that these procedures are actually put into practice and “not merely for documentation” (E31). This is one of the reasons why experts advise organizations to sufficiently train their employees, for instance, with respect to tender processes or vendor management. Establishing a group of experts in central procurement offices can help in this regard. However, it is highly recommended to also sufficiently train field staff which is interacting with LSPs. As Expert 28 explained, “signing contracts for those people who’re not good professionally is very, very difficult because they don’t understand it. […][E]ven the tender processes are sometimes too complex for them.” Regular team meetings for discussing “lessons learnt” are an important addition to formal training sessions.

Personnel development should be complemented by developing appropriate tools and templates, for example, standardized contracts, checklists for performance evaluations or provider databases. The latter should be fed by regular assessments of service provider
markets, in which new potential providers are identified, market prices are compared and cost structures of providers are analyzed. Expert 8 underlined their importance: “We reduced our cost […] by one million US Dollar over the first year after we started actually doing market assessments.” At best, organizations do not only assess service provider markets, but also run pre-qualification procedures and set up framework agreements covering “as many eventualities, situations [and] supply chain requirements [as possible]” (E21). These long-term contracts usually do not contain any volume commitments and sometimes not even fixed prices. Still, “longer-term framework contracts [are] a very useful tool” (E35). Superseding repetitive and deferring procurement procedures, they allow to “activate the services with short notice” (E21) and with “less administrative [effort]” (E35). Finally, experts recommend exchanging best practices and templates with other humanitarian organizations and engaging professional external support, for example, experts for the tender process or contract design.

4.5 Rank 5: set up and maintain a plan for the engagement of logistics service providers (P02)

Outsourcing does not only require appropriate preparation (see Section 4.4), but also sufficient and adequate planning. It starts with aligning the outsourcing approach to the overall logistics strategy and developing an exact understanding of service needs and requirements. Agencies should “identify gaps in the infrastructure” (E26) and determine how LSPs can best help to bridge them. Conditions in disaster relief operations often change considerably within short time. As one consequence, agencies should budget for the handling of challenges during outsourcing engagements, as those are almost inevitable in the light of rapidly changing circumstances. As another consequence, organizations need to prepare for these eventualities through scenario planning. “If you have the plan in the drawer and [even if it] is 6 months old […], at least you have something, you have a start” (E5). This also implies to source multiple alternative providers for the same service in order to have sufficient fallback options when single providers are not able or willing to provide a service.

Experts recommend complementing these activities by regular risk assessments, which analyze the fit between the outsourcing structure and the potential development of the operational environment. Aid agencies should also involve contracted providers into this process in order to identify “any constraints from their side” (E25). For example, they should “ask LSPs to share their contingency plans for […] any unwanted situation” (E22), such as alternative routes of transportation. Experts even recommend agencies to test these backup plans together with providers, for instance, by routing single shipments on different paths, whenever time allows: “If it’s working, we know that we have a plan B. If it’s not working, […] we have to search for something else” (E10). In addition, organizations should agree with existing partners upon prices for potential future service requirements, as long as the principles of fair and transparent procurement are not violated.

Finally, planning enables aid agencies to negotiate with providers based on consolidated service demands, for example, aggregated across regions, and to coordinate service purchases with other aid agencies. Coordination, at worst, reduces competition for limited capacities. At best, it offers the opportunity to tender services jointly with other agencies increasing an organization’s bargaining power vis-à-vis service providers.

4.6 Rank 6: take actions to ensure the selection of the right provider for the right task (P05)

Experts consider it important to invest time and efforts in the selection of the right service provider, since “without the right provider, [the] right service cannot be ensured” (E19).
The definition of “the right provider” is, however, very context-dependent, since no provider can perform best in all situations. Aid agencies should assess, which type of service provider is best suited under which circumstances, and, instead of just selecting one provider, source a “suit of providers which you can call upon” (E13). This allows the flexibility of working with the best fitting provider in each situation (see Section 4.5).

Experts provided specific recommendations for the selection of the right provider for the right task. Organizations should approach as many LSPs as possible with a service request and allow providers sufficient time to respond. In the case of open tenders, good media support should be secured, for example, through publications in well-established newspapers. When choosing between different service providers, information becomes paramount. However, this can be a major issue in disaster relief operations: “The main challenge is, actually, that we don’t have information to make the right selection” (E8). Accordingly, experts recommend various activities to fill this void of information. Particularly less known providers should be asked to provide customer references together with their proposals. These documents offer the possibility to obtain information about the provider directly from other organizations. In general, aid agencies should make use of their network. By reaching out to other aid agencies, local authorities, donors or product suppliers, they can benefit from a “solid base of […] sources that are already verified by somebody else” (E25) and avoid negative surprises. Experts emphasize the importance of the Logistics Cluster in this regard, because “one of [its] key mandates is information management” (E8).

Once provider proposals have been submitted, requesting bid presentations and questioning LSP representatives in person are considered useful by experts. These activities help to identify the true logistics capability of the provider. Measures such as site visits and physical checks of the provider’s assets have the same objective. Without activities of this sort, agencies face the risk of providers not being able to perform the service at the promised service level and price. Experts explain that “[w]ritten proposals contain false information just to qualify [for] the minimum requirements” (E22) and that providers “on purpose underrate their offers to beat their competition” (E25) or because they “do not know their own costs” (E7). The capability of providers can also be screened by first testing the contractors under less critical conditions before involving them in important operations. Another very useful activity is, according to experts, the execution of background checks on the provider, for example, regarding its independence, legal compliance or financial health. This is particularly critical at the field level, where providers with dubious practices or links to military groups can not only harm an agency’s reputation, but also endanger its employees.

4.7 Rank 7: avoid unnecessary liabilities and risks (P08)

The conflicting goals of service providers and the unpredictability of disaster relief operations inevitably lead to risks for aid agencies engaged in outsourcing. Therefore, panelists regard it as important to avoid unnecessary liabilities and risks. While longer-term contracts help to build relationships with providers (see Section 4.9), experts consider them contraindicated in a number of situations. For example, in the beginning of a relief operation, “when suppliers […] raise the prices and it’s expected that a few months after [wards] the market will start settling down” (E25). Also, in “volatile economic situations, especially [with] rapidly fluctuating exchange rate[s]” (E31) or when “working for the first time with a service provider” (E15), contracts should be set up as short as possible. However, even in these cases, organizations should “make sure that it is more than just a one-time commercial contract, so that the service provider can be used […] in the future” (E2).

If longer-term contracts are set up, organizations should ensure a sufficient level of flexibility by avoiding any kind of volume commitments or exclusivity clauses. Terms of the latter type might require agencies to treat a LSP as “sole source provider unless there is a
capacity issue” (E28). Such agreements are considered risky, because “capacity is different to capability” (E28) and “complementarity of coverage by multiple providers” (E38) is highly important (see Section 4.5). Panelists, furthermore, recommend specifying sufficient provisions for contract termination, for example, due to funding issues or the end of a mission, and to agree upon future price adjustments according to prevailing market prices.

In general, oral communication should always be followed-up in written to have proof of the conversation. This is especially important in situations of high urgency, when organizations might be forced to “hire someone […] without […] a formal contract” (E16). In such cases, experts recommend to, at least, request a written commitment from the provider to adhere to the agreed service fees. If a formal contract is set up, it should either be reviewed by a legal expert or be based on a standard template released by the legal department.

Finally, in particular at the field level, it is important to avoid communicating sensitive data to providers, for example, beneficiary lists or budget details, as this could cause severe security issues. Additionally, agencies should avoid too close personal relationships with providers and always “remain [in] professional distance” (E8). In some cultural areas, “for a private company […] it’s normal to give incentives” (E17) and organizations should make sure to avoid any impression of favoritism.

4.8 Rank 8: run a formal process for performance evaluation (P09)

Bad performance of service providers can be a serious problem for aid agencies, affecting its reputation and the well-being of beneficiaries. “The quality of services may vary not only [within] the country context, but also [for] the same supplier over time” (E16). Therefore, panelists deem it important to run a formal process for evaluating the provider’s performance. According to the experts, there are two main dimensions of performance evaluation: continuous quality control and regular performance reviews. Especially “when working with local 3PL firms, quality control is a major issue” (E6). Agencies should closely monitor and track the execution of activities by the service provider, always involving those employees who have the best visibility of the service. According to Expert 10, this is “something that we are daily doing by calling our colleagues.” Likewise, inspections and audits on service quality and compliance are advisable, although they should be applied carefully as they can “often cause unnecessary delays” (E22).

Besides performing continuous quality control, organizations should conduct a formal review of performance, taking place at specific milestones or in fixed intervals. On these occasions, agencies should use key performance indicators (KPIs) to evaluate the provider’s performance against benchmarks and contractual agreements. However, organizations “need to be careful with KPIs, [and] the key is to use only a few” (E28). Furthermore, they need to account for the fact that disaster relief “is not normal, it’s generally chaos; […] your normal business-as-usual KPIs just don’t apply and shouldn’t apply” (E21). Accordingly, indicators which measure the humanitarian performance of the provider are required. They should cover both quantitative factors, such as timeliness or cost, and qualitative aspects, such as transparency or agility. It can also be helpful to involve the service provider into the definition of the performance metrics as this facilitates an “alignment of expectations between the parties” (E21). Aid agencies should, moreover, maintain a record of performance for each provider, which is fed into a service provider database and stored across operations and engagements (see Section 4.4). This allows to use the information not only for the single performance review, but also “as basis of continuous improvements” or as a “negotiation tool” (E16) for future negotiations. Finally, despite the need for performance management, experts emphasize the importance of “keep[ing] the focus on impact of programming rather than donor priorities [or] shipping metrics” (E29). In the end, the “main performance indicator [is] successful delivery of relief items to the beneficiaries for life saving operations” (E2).
4.9 Rank 9: build mutual understanding and trust with provider (P10)

According to the experts, high levels of trust and understanding between an aid agency and its service providers bring significant advantages. For example, providers are more likely to go beyond their contractual obligations in critical situations when they perceive the engagement to be a trustful partnership: “the relationship is everything” (E28). Consequently, panelists consider it important to build mutual understanding and trust with providers.

Building trust starts during the tender process and “the best tendering approach should involve establishing a longer-term partnership” (E7). Therefore, organizations should avoid too much variation in their supplier base: “We only have about 4 service providers […] that we work with on a consistent basis and have long standing relationship[s] with all of them. […] This aspect of close relationships helps us work together towards a common, mission-oriented goal” (E29). However, this approach “really clashes against this fair, open, transparent scheme” (E5) which is requested by donors and limits the options for building relationships: “Even though we had a fruitful relationship [with a provider], we still have to treat them like everybody else” (E5). Helpful and still compliant measures are personal invitations to public tenders for preferred partners, in order to ensure their participation, and feedback to loosing tenderers, in order to increase transparency and build rapport.

When working for the first time with a provider, aid agencies should explain the specifics of the humanitarian context to the provider’s staff and define relationship managers on both sides, because “building trust in the beginning […] often depends on individuals in [sic.] both the company side and the NGO side” (E14). In this regard, it is also advisable to have selected staff of the provider working within the aid agency for some time, or vice versa. This does not only “bring […] special expertise into the NGO” (E3), but also helps to gain “a better understanding [of] the internal dynamic procedures of the partner” (E35). Due to the risks of close personal relationships (see Section 4.7), panelists deem this measure more suitable at the headquarter level. Experts, furthermore, recommend setting up contracts with longer durations as long as the circumstances allow it and sufficient provisions for termination and adjustments are included (see Section 4.2). In particular for local services, they should review the contract jointly with the LSP, because “in many cases […] suppliers do not even read the contract, they just sign any document to get the contract” (E19).

Overall, experts emphasize that building trust is a “two-way street” (E25). Therefore, agencies should always keep their own commitments, for example, with respect to payments. Moreover, they should be flexible if changes to agreed terms are required. They should “understand the situation of the service provider” and “have a fair manner of treating the partnership, […] not necessarily sticking 100% to the contract” (E8). Aid agencies should, additionally, share projections on future service demands with selected providers to signal their interest in long-term relationships.

4.10 Rank 10: work with provider as an integrated team (P12)

“When you can engage the service provider as a core team member, not as a general support entity, [it] offers the most” (E22). Consequently, panelists consider it important to work with providers as an integrated team. Aid agencies should, first of all, define contact persons and corresponding backups, which are available for phone calls during 24 hours a day. Moreover, they should target to work face to face with the service provider whenever possible, because “as soon as you are working face-to-face for some time, you build trust, you build understanding, and you have [a] better relationship” (E14). However, at the same time, they should take measures to avoid any impression of too close personal relationships or favoritism, especially at the field level (see Section 4.7).

Once the tender process has been finalized, experts recommend involving the provider in the logistics planning of an operation (see Section 4.5). Furthermore, aid agencies should
proactively share all relevant information with the provider and, in general, communicate frequently, honestly and transparently. In time-critical operations such as disaster relief “the common level of agreement is vital” (E22) and “regular communication [...] may minimize the ambiguity and speed up the process” (E31). Additionally, organizations should cooperate with the provider to find joint solutions for challenges and even “help it to best being able to fulfil its contract in a safe and practical manner” (E27). Treating the provider as a team member, according to panelists, also requires investing in the development of its capabilities. Therefore, organizations should not only provide continuous performance feedback to providers and regularly discuss “lessons learnt”, but also involve the vendor’s staff in internal trainings on standard operating procedures and best practices: “for example, we train the drivers in how to drive economically and ecologically” (E2).

Finally, information technology should be leveraged to enable smooth cooperation. Data should be exchanged electronically between IT systems, in best case through electronic data interchange (EDI). If regular information exchange is required, for example, in the case of warehousing services, experts consider it useful to give the provider access to the aid agency’s IT system, as long as the system allows to restrict the provider’s access to the required modules and functionalities.

4.11 Rank 11: design engagement as win–win situation (P11)
In general, panelists agree that the engagement should provide sufficient benefits to both sides, because “partnering with a LSP offers much more [when both] NGO and LSP [...] benefit” (E28). If “both the client and the provider are satisfied with the agreement, [they] will do all efforts to ensure its success” (E23). Accordingly, participants deem it important to design the engagement as win–win situation. However, a lot of controversy exists with respect to the best approach for achieving it. A key reason might be the “historic relationship the humanitarian world was having with the private sector, which has been not too trustful and [has] been very much looking at the private sector [as] someone who just wanted the profit and just wanted to cheat” (E8).

There are still sceptical opinions: “commercial profit is by all means enormous” (E19) and “when emergency situation[s] occur [...] genuine competition seem[s] to disappear” (E21). Nevertheless, panelists consider it useful to agree upon fair service fees which allow for adequate provider profits, because “we engage with the commercial world which needs to generate profit” (E21). Likewise, experts recommend both the use of cost-plus contracts, which link service fees to the actual costs of providers, and the specification of price adjustments according to official cost indices. These are not only fair approaches, which safeguard providers against increasing costs, but also avoid that LSPs charge premium fees to hedge risks or that a provider “reduces the quality of the service [...], because he has to get that [increasing] cost from somewhere” (E16). While experts agree on the advantages of index-based price adjustments, they highlight that the approach is “not easy to manage” as it’s “not very popular when the fuel price goes down and you have to [lower] the rates” (E8).

Panelists also recommend acknowledging a good performance of providers by providing a letter of reference, which they can use in future tenders. Some experts suggest making faster payments, directly extending contracts in case of satisfactory provider performance and guaranteeing fixed minimum payments to providers, independent of the transaction volume. These activities are, however, not considered useful by other panelists. Similarly, a lot of controversy exists with respect to performance-based service fees, which include a bonus for performances above target. Some think that “offering more money for better service never works” (E22) and that it would be very difficult to justify to donors “that we have paid somebody more than what they asked” (E25). Others argue that “imposing penalties for suppliers is default, but giving incentives is not” (E19) and actually “carrot and stick both should be [t]here” (E19). Also, letting the provider benefit from the humanitarian
image through publicity is seen controversially. While it can help to get better and cheaper services, it might not be possible due to donor requirements or security issues. Some argue that, if at all, it should only be granted in case of free-of-charge services.

4.12 Rank 12: set up financial incentives to align goals of service provider (P07)

The importance of setting up financial incentives is seen controversially by experts. While some consider it not important or only somewhat important, others deem it important or even very important. This difference in judgments appears to be due to the complexity and context-specificity of defining appropriate financial incentives.

Without controversy, experts recommend defining adequate documentation by service providers as precondition for payments. Failure in this regard, for example, missing waybills, can lead to serious conflicts with donors. Organizations should also avoid payments in advance of the service, wherever possible. However, such payments may be required, because “in certain cultures, in certain places […] you have to deposit the amount” (E5) and an “advance payment is the only way to get a service” (E8). Likewise, such payments might be necessary if the provider is “just a small company, with little cash flow […] [and] cannot start without this payment” (E35). Therefore, aid agencies should use their best judgment and accept that this is a “risk you have to take […] [and] explain […] to the donors” (E5).

There are also opposing views regarding the use of open-book contracts, in which a provider reveals its actual costs to the aid agency. Some experts have experienced them to work extremely well, because they offer a high transparency and reduce the risk of being cheated. Other experts emphasize, though, that “depending on the culture […] [open-book contracts] may be synonymous to no trust” (E16) and can negatively affect the partnership (see Section 4.9). Furthermore, facilitation payments or bribes can cause challenges for open-book contracts: “if you need to get things through certain areas, customs, there will be certain fees […] that we really can’t substantiate […] because it’s an ineligible cost [for donors]” (E5).

As another financial incentive, experts suggest guaranteeing contract extensions in case of satisfactory provider performance, even though an agreement on the definition of “satisfactory” can be difficult to achieve. Finally, panelists recommend performance-based service fees, i.e. fees that are reduced if performance is below a pre-agreed target. Such penalties can, for example, be defined for late deliveries. However, “you can only apply [penalties] to factors within the 3PL control, which may be limited in a humanitarian context” (E7). In general, penalties conflict with the objective of building mutual trust and understanding (see Section 4.9). Therefore, penalty terms “need to be fair and realistic” (E21) and organizations should carefully weigh their application: “penalties are often […] part of the contract, but […] rarely applied […] Best is to be able to work with the supplier” (E24).

5. Discussion

In this section, we reflect on the results in view of relevant literature on commercial and humanitarian logistics, which has been presented in Section 2. According to the expert panel, the most critical practices for ensuring the success of outsourcing logistics are balancing compliance and efficiency in the procurement process (P03), using detailed written contracts (P06), and issuing detailed requests for proposal or quotation (P04). All of them are considered very important (mean rating $\geq 3.50$).

Practice P03 is not only considered the most important one, but also differs in another regard from the remaining practices: it was the only practice which we could not map during the process of deductive coding, at least to some extent, to success factors from commercial logistics literature (see Table II). The practice seems to be irrelevant in the commercial context (Selviaridis and Spring, 2007). While commercial enterprises are independent of donations, donors play a significant role in the humanitarian environment (Wakolbinger and Toyasaki, 2018). Their requirements have to be considered in many ways when
outsourcing logistics, for example, with respect to the applicable procurement procedures, remuneration forms or payment terms. They impose “a major constraint on our ability and as organizations” (E5). If their requirements are violated, donors can withdraw their funding causing serious financial problems for agencies. As, simultaneously, time pressure and speed play an outstanding role in emergency operations (Van Wassenhove, 2006), it appears plausible that experts consider Practice P03 a very important addition to the elements from the commercial sector, and, in fact, the most important of the 12 best practices. Quite contrary to the experts’ view, the importance of compliance requirements for outsourcing has not been stressed a lot by literature on humanitarian logistics. In general, academic literature has not investigated sufficiently the implications of donors on operational decisions (Burkart et al., 2016). Our results, similarly to Bealt et al. (2016), suggest future research in this regard.

Different than for Practice P03, the relevance of the two other very important practices, P06 and P04, is also highlighted by the existing literature. It is recognized that commercial enterprises should align expectations, provide well-defined requirements and be thorough in the negotiation of a formal contract, which defines clear ground rules and includes provisions for adjustments and exit (Hofenk et al., 2011; Selviaridis et al., 2008; van Laarhoven et al., 2000; Lambert et al., 1999; Frankel et al., 1996; Tate, 1996; Leahy et al., 1995).
Also humanitarian organizations should set-up formal contracts, ideally in advance of disasters, and be clear in their requirements toward service providers (Baharmand et al., 2017; Cottam et al., 2004; Bealt et al., 2016). As humanitarian organizations and LSPs have inherently diverging objectives and motivations (Nurmala et al., 2017), aligning expectations is potentially even more important than in the commercial context. A detailed service request and a detailed contract, as a manual of cooperation (Hauptmann, 2007), can help to clarify both requirements and expectations. Our results go beyond these high-level insights and provide clarity on how aid agencies can reflect these objectives within the content of contracts and the process of service requests. Specific requirements of the humanitarian context become obvious on this level of detail. For example, at the time of the service request, not all required information might be available, and both the aid agency and the provider need to show flexibility in negotiating the service.

A major recurring theme in literature on humanitarian logistics is the importance of preparedness for disaster relief (Jahre et al., 2016). This also applies for the field of outsourcing. By investing in training, relationship building or the setup of service agreements in advance of relief operations, the engagement of the private sector in the response phase can be improved considerably (Bealt et al., 2016; Quero, 2012; Tomasini and Van Wassenhove, 2009; Zyck and Kent, 2014). Our results mirror this perception: according to the expert panel, adequate preparation (P01) and planning (P02) are important practices for ensuring the success of outsourcing. Experts suggest that preparation should cover guidelines, documentation, training, staff development, tools, templates, information gathering and relationship building. While aid agencies recognize the importance of these activities, most of the organizations never or only occasionally make such preparations (Bealt et al., 2016). Donor priorities and a corresponding lack of preparedness funding are certainly among the main reasons for this apparent contradiction (Jahre et al., 2016).

Therefore, low-cost preparedness activities with a high return on investment are of special interest to aid agencies. Our results contain some promising recommendations in this regard, for example, regular assessments of provider markets, which require moderate effort but can lead to significant cost reductions.

The literature, both from the commercial and humanitarian field, also highlights the importance of organizations building close relationships with LSPs and establishing long-term partnerships (Cottam et al., 2004; Maon et al., 2009; Bealt et al., 2016; Nurmala et al., 2017). Especially trust is frequently mentioned as one of the most important preconditions for successful outsourcing relationships (Bealt et al., 2016; Frankel et al., 1996). Our results, on the one hand, confirm this judgment by literature. Experts consider it important (2.50 ≤ mean rating < 3.50) to build mutual understanding and trust with providers (P10), to work with providers as an integrated team (P12), and to design outsourcing engagements as win-win situations (P11). On the other hand, our results relativize the role of partnerships and trust to a certain extent. Panelists perceive these practices (P10, P11 and P12) considerably less important than, for example, setting up detailed and formal contracts.

The relationship of trust and contracts is certainly a controversial one. It is subject to a continuous academic debate since Macneil (1978) first differentiated classical, neo-classical and relational contracts. It remains often contested if contracts and trust function as complements or substitutes, and which of the two is more important (Boyson et al., 1999; Frankel et al., 1996; Hofenk et al., 2011; Poppo and Zenger, 2002; Spekman and Davis, 2004). Trust is a very complex concept itself, subsuming deterrence-based trust, calculus-based trust and relational trust (Rousseau et al., 1998). Our results suggest that in the humanitarian context contracts are more important, but still need to be complemented by trust: “One thing is to have a good contract, which is the basis and you need to have that, but we need to live beyond the contract in a professional manner” (E5).
There are various potential reasons for why experts consider detailed contracts more promising for ensuring the success of outsourcing logistics than establishing trust-based partnerships. The main one appears to be the difficulty of building trust in disaster relief. Hastily formed networks and the lack as well as high turnover of adequately trained staff cause big challenges for developing relationships (Kovács et al., 2009, 2012; Pettit and Beresford, 2009; Tatham and Kovács, 2010). This is specifically true for relationships between aid agencies and commercial actors, which are even more challenging because of differences in culture and working styles (Nurmala et al., 2017). One exemplary consequence is humanitarian practitioners fearing that commercial LSPs might abuse the context of disaster relief for making excessive profits (see Section 4.11) while the financial resources of aid agencies are scarce (Kovács et al., 2009). It appears that aid agencies first need to address the foundations for building trust before they can more comfortably substitute formal contracts by relational ones. For example, they would have to increase their level of communication with partners (Cottam et al., 2004; Tatham and Spens, 2011), create internal awareness for cultural differences (Dowty and Wallace, 2010) and adopt more decentralized decision-making (Baharmand et al., 2017).

It is noteworthy that some of the panelists’ recommendations are, at least to a certain extent, conflicting or controversial. For example, experts conform with the literature (Cottam et al., 2004) regarding the fact that close relationships can ease coordination and improve mutual understanding. They also highlight, however, that such relationships can endanger an aid agency’s reputation by causing a perception of favoritism. Similarly, experts recognize that long-term contracts can be beneficial for building partnerships (Maon et al., 2009), but counter that they increase an organization’s dependency and limit its flexibility. Also with respect to performance-based service fees the panel did not reach a consensus. While some argue that it is important to implement them (Balcik et al., 2010), other consider them counterproductive. As mentioned in Section 3.3, the usefulness of selected activities is certainly influenced by contextual factors, such as the value of the service purchase, size and funding structure of an aid agency, the geographic context of the service (before or after point-of-entry) or the phase of disaster relief. This study’s aim was to provide a comprehensive picture on promising activities for organizations engaged in outsourcing. It was an unfortunate, but inherent consequence that we were not able to go into the details of all identified controversies and had to leave some of them unresolved. We suggest that future research provides more clarity regarding the respective matters.

6. Summary and outlook
This study investigated best practices of aid agencies for ensuring the success of outsourcing logistics to commercial LSPs in disaster relief. It is based on a Delphi study with a panel of 31 experienced practitioners and a complementary focus group with 12 experts. As it is one of the first studies in the field to apply the Delphi method, it also examined the application of the technique to the field of humanitarian logistics.

Our research revealed 12 best practices and a compilation of more than 100 activities for putting these practices into action. Experts consider a proper balance between efficiency and compliance, a detailed contract and a detailed service request the most important practices. The practice of balancing efficiency and compliance is a unique addition of our study to literature from the commercial context and results from the influential role of donors in disaster relief. In contrast to existing literature, building trust and establishing win–win situations have a lower importance for practitioners than most of the other best practices. This apparent contradiction is potentially a consequence of the great challenges for building trust in disaster relief. Apart from providing guidance to aid agencies, the developed ranking of best practices can help to prioritize future academic research, since it reflects the priorities of practitioners.
The findings have certain limitations and can be extended in several directions. Even though we involved LSPs in the focus group, our results clearly represent the one-sided perspective of aid agencies. While this was our intended focus, future studies in this context could aim to determine best practices for LSPs as well (Heaslip, 2013; Vega and Roussat, 2015). Moreover, our research design did not allow to investigate potential interdependencies between individual practices, which are likely to exist. Future research could deepen the insights in this regard, for example, by applying interpretive structural modeling as illustrated by Qureshi et al. (2007). In general, future studies could further examine specific aspects of the 12 practices. For instance, they could determine criteria for selecting service providers and indicators for evaluating their performance (Baharmand et al., 2017). It would also be important to better understand the role of donors in the context of outsourcing and to identify approaches for further harmonizing their requirements with the operational environment of aid agencies (Burkart et al., 2016). Likewise, future research could provide more clarity with respect to some of the unresolved controversies in our results, for example, how aid agencies should deal with close relationships or performance-based fees.

Finally, we would like to encourage other researchers to explore the use of the Delphi method for their work. We found it to be a promising approach for assessing the perspectives of humanitarian experts in a structured and confirmable way. While specific limitations exist, we strongly believe that these can be addressed by an adequate research design.

Notes

1. Seven participants preferred a phone interview to the online survey. In these cases, we used the online questionnaire as an interview guideline. All interviews took between 45 and 90 min and were transcribed in verbatim form for further analysis.

2. E19 refers to Expert 19 (see Table A1). Direct quotes from experts are provided without modifications. Any adjustments are highlighted using squared brackets.

References


Outsourcing logistics in disaster relief


## Appendix 1. Participants of Delphi panel

<table>
<thead>
<tr>
<th>ID</th>
<th>Current job title</th>
<th>Exp. in hum. log. (years)</th>
<th>Focus of experience (headquarters/field)</th>
<th>Participation (e-Delphi/focus group (FG))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert 1 (E1)</td>
<td>Deputy Head of Procurement and Logistics</td>
<td>14</td>
<td>HQ and field</td>
<td>e-Delphi</td>
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<tr>
<td>Expert 2 (E2)</td>
<td>Global Logistics Advisor</td>
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<td>HQ and field</td>
<td>e-Delphi</td>
</tr>
<tr>
<td>Expert 3 (E3)</td>
<td>Administrator Department Of Operations</td>
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<td>HQ and field</td>
<td>e-Delphi and focus group</td>
</tr>
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<td>HQ and field</td>
<td>e-Delphi</td>
</tr>
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<td>10</td>
<td>HQ and field</td>
<td>Focus group</td>
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<td>HQ and field</td>
<td>e-Delphi and focus group</td>
</tr>
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<td>15</td>
<td>Field</td>
<td>e-Delphi</td>
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<td>Expert 8 (E8)</td>
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<td>10</td>
<td>HQ and field</td>
<td>Focus group</td>
</tr>
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<td>n/a</td>
<td>e-Delphi</td>
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<td>e-Delphi</td>
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<td>e-Delphi and focus group</td>
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<td>HQ</td>
<td>Focus group</td>
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<td>4</td>
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<td>Focus group</td>
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<td>Focus group</td>
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<td>Expert 16 (E16)</td>
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<td>e-Delphi and focus group</td>
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<td>Expert 17 (E17)</td>
<td>Project Manager</td>
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<td>HQ and field</td>
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<td>Expert 19 (E19)</td>
<td>Procurement Officer</td>
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<tr>
<td>Expert 20 (E20)</td>
<td>Head of Aid and Relief for IMEA</td>
<td>8</td>
<td>n/a</td>
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<tr>
<td>Expert 21 (E21)</td>
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<tr>
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<tr>
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<tr>
<td>Expert 25 (E25)</td>
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<td>Focus group</td>
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<tr>
<td>Expert 26 (E26)</td>
<td>Chief Vendor Management and Supply</td>
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<tr>
<td>Expert 27 (E27)</td>
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<tr>
<td>Expert 28 (E28)</td>
<td>Global Lead for Emergency Logistics</td>
<td>20</td>
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Table AI. Participants of Delphi study and focus group (continued)
<table>
<thead>
<tr>
<th>Name of organization</th>
<th>No. of participants in e-Delphi</th>
<th>No. of participants in focus group</th>
<th>Country of residency of participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caritas International</td>
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<td>–</td>
<td>Austria</td>
</tr>
<tr>
<td>Danish Refugee Council</td>
<td>4</td>
<td>1</td>
<td>Denmark, South Sudan</td>
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<tr>
<td>Diakonie Disaster Relief</td>
<td>1</td>
<td>–</td>
<td>Germany</td>
</tr>
<tr>
<td>Bill and Melinda Gates Foundation</td>
<td>1</td>
<td>–</td>
<td>USA</td>
</tr>
<tr>
<td>Globale Verantwortung</td>
<td>–</td>
<td>1</td>
<td>Austria</td>
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<td>Handicap International</td>
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<td>–</td>
<td>France</td>
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<td>ICRC</td>
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<td>–</td>
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<td>–</td>
<td>Switzerland</td>
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<tr>
<td>International Medical Corps</td>
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<td>USA, Croatia</td>
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<td>Lutheran World Relief</td>
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<td>–</td>
<td>USA</td>
</tr>
<tr>
<td>Medicines Sans Frontières</td>
<td>4</td>
<td>1</td>
<td>France, Switzerland</td>
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<tr>
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<td>People in Need (PIN)</td>
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<td>Red Cross Austria</td>
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<td>Samaritan Austria</td>
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<td>UN Mission in South Sudan</td>
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<td>UNHCR</td>
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<td>Welthungerhilfe</td>
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<td>–</td>
<td>Germany</td>
</tr>
<tr>
<td>WFP/Logistics Cluster</td>
<td>1</td>
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<td>Italy, Denmark</td>
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<tr>
<td>World Vision Australia</td>
<td>1</td>
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</tr>
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<td>World Vision Germany</td>
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<tr>
<td>Damco</td>
<td>–</td>
<td>1</td>
<td>UK</td>
</tr>
<tr>
<td>Kuehne + Nagel</td>
<td>–</td>
<td>1</td>
<td>UAE</td>
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Table AII.

Organizations of participants
### Appendix 2. List and rating of activities

<table>
<thead>
<tr>
<th>Practice ID</th>
<th>Activity name</th>
<th>Mean rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 1.02</td>
<td>Develop tools and templates (e.g. contract templates, supplier database, performance evaluation checklist)</td>
<td>3.67</td>
</tr>
<tr>
<td>P1 1.10</td>
<td>Set up framework agreements (non-binding contracts for longer duration which are ready-to-use in case of need)</td>
<td>3.63</td>
</tr>
<tr>
<td>P1 1.08</td>
<td>Perform regular assessments of service provider market (e.g. searching for new providers, market prices, cost structure of providers)</td>
<td>3.56</td>
</tr>
<tr>
<td>P1 1.09</td>
<td>Run pre-qualification and pre-selection procedures (e.g. request for information, to have reference list of ready-to-use providers)</td>
<td>3.56</td>
</tr>
<tr>
<td>P1 1.03</td>
<td>Train employees on outsourcing (e.g. on tender processes, contracting, vendor management)</td>
<td>3.52</td>
</tr>
<tr>
<td>P1 1.06</td>
<td>Exchange best practices and templates with other humanitarian organizations</td>
<td>3.52</td>
</tr>
<tr>
<td>P1 1.01</td>
<td>Develop guidelines and standard operating procedures for outsourcing (e.g. process descriptions, approval workflows)</td>
<td>3.50</td>
</tr>
<tr>
<td>P1 1.05</td>
<td>Perform regular lessons learnt sessions within team to enable organizational learning</td>
<td>3.46</td>
</tr>
<tr>
<td>P1 1.04</td>
<td>Establish internal group of experts for outsourcing of logistics (e.g. in central procurement offices)</td>
<td>3.08</td>
</tr>
<tr>
<td>P1 1.07</td>
<td>Engage professional (external) support for outsourcing (e.g. experts for tender process or contract design)</td>
<td>2.76</td>
</tr>
<tr>
<td>P2 2.02</td>
<td>Develop exact understanding of service needs and requirements</td>
<td>3.65</td>
</tr>
<tr>
<td>P2 2.03</td>
<td>Source multiple alternative providers for same service (e.g. to reduce risks)</td>
<td>3.56</td>
</tr>
<tr>
<td>P2 2.07</td>
<td>Perform regular risk analysis and develop contingency plans (e.g. availability of alternative providers)</td>
<td>3.56</td>
</tr>
<tr>
<td>P2 2.08</td>
<td>Discuss and plan fallback options (= plan B) with providers (e.g. alternative routes for transportation)</td>
<td>3.48</td>
</tr>
<tr>
<td>P2 2.04</td>
<td>Negotiate with providers based on consolidated demands (e.g. across areas or countries)</td>
<td>3.42</td>
</tr>
<tr>
<td>P2 2.01</td>
<td>Align plan for engagement of logistics providers with overall logistics strategy</td>
<td>3.35</td>
</tr>
<tr>
<td>P2 2.05</td>
<td>Coordinate service purchases with other aid agencies (e.g. alignment of plans to avoid competition or joint tendering of services to increase bargaining power)</td>
<td>3.22</td>
</tr>
<tr>
<td>P2 2.06</td>
<td>Plan budget for handling of challenges during engagements (306)</td>
<td>3.06</td>
</tr>
<tr>
<td>P2 2.09</td>
<td>Negotiate prices for potential future service requirements with provider (even if these services are not required right away)</td>
<td>3.00</td>
</tr>
<tr>
<td>P3 3.08</td>
<td>Carefully document every purchase (from request to decision)</td>
<td>3.78</td>
</tr>
<tr>
<td>P3 3.02</td>
<td>Allow exceptions from general process for urgent or emergency procurements (with adequate approval workflow)</td>
<td>3.67</td>
</tr>
<tr>
<td>P3 3.05</td>
<td>In case of emergencies, send request for proposal only to limited number of providers (minimum three)</td>
<td>3.52</td>
</tr>
<tr>
<td>P3 3.07</td>
<td>Involve tender committee to steer procurement for long-term and framework agreements</td>
<td>3.48</td>
</tr>
<tr>
<td>P3 3.03</td>
<td>Use open tenders for long-term and framework agreements (i.e. publication of request for tender)</td>
<td>3.46</td>
</tr>
<tr>
<td>P3 3.04</td>
<td>In case of one-time services (e.g. single transport order), send request for proposal only to limited number of providers (minimum three)</td>
<td>3.44</td>
</tr>
<tr>
<td>P3 3.06</td>
<td>Use direct negotiations with providers (without competitive bidding process) only in cases of very high urgency</td>
<td>3.23</td>
</tr>
<tr>
<td>P3 3.01</td>
<td>Align service procurement process with public procurement regulations and donor requirements</td>
<td>3.11</td>
</tr>
<tr>
<td>P4 4.02</td>
<td>Specify detailed service expectations and requirements when sending request for proposal (e.g. deadlines, technical specifications, documentation requirements)</td>
<td>3.81</td>
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</table>

Table III. List and rating of activities

(continued)
<table>
<thead>
<tr>
<th>Practice ID</th>
<th>Activity name</th>
<th>Mean rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>P4 4.03</td>
<td>Describe details of bidding process when sending request for proposal (e.g. administrative requirements, timeline)</td>
<td>3.74</td>
</tr>
<tr>
<td>P4 4.04</td>
<td>Describe selection and decision process when sending request for proposal (e.g. relevant selection criteria)</td>
<td>3.56</td>
</tr>
<tr>
<td>P4 4.01</td>
<td>Highlight context of operation and specifics of humanitarian operation when sending request for proposal (urgency, criticality, etc.)</td>
<td>3.52</td>
</tr>
<tr>
<td>P4 4.06</td>
<td>Attach questionnaire to gather further information on provider when sending request for proposal (e.g. company information, experience, customer references)</td>
<td>3.44</td>
</tr>
<tr>
<td>P4 4.05</td>
<td>Attach standardized bid template when sending request for proposal (which can be used by providers for making their bid)</td>
<td>3.33</td>
</tr>
<tr>
<td>P4 4.07</td>
<td>Attach draft contract when sending request for proposal</td>
<td>3.70</td>
</tr>
<tr>
<td>P5 5.08</td>
<td>Perform background checks on provider (e.g. regarding independence, legal compliance, working conditions, financial health)</td>
<td>3.44</td>
</tr>
<tr>
<td>P5 5.06</td>
<td>Ask providers for track records (credentials) and customer references</td>
<td>3.44</td>
</tr>
<tr>
<td>P5 5.09</td>
<td>Perform site visits, physical checks (e.g. of trucks) and field assessments</td>
<td>3.37</td>
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<tr>
<td>P5 5.05</td>
<td>Ask for recommendations within own network (other aid agencies, suppliers, service providers, local authorities)</td>
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</tr>
<tr>
<td>P5 5.02</td>
<td>Approach as many potential providers with a request for proposal (or quotation) as possible (minimum three)</td>
<td>3.30</td>
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<tr>
<td>P5 5.03</td>
<td>Leave enough time for service providers to respond to request for proposal (or quotation)</td>
<td>3.26</td>
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<tr>
<td>P5 5.01</td>
<td>Ensure good media support for publication of open tenders</td>
<td>3.15</td>
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<tr>
<td>P5 5.07</td>
<td>Perform bid presentations and questioning of representatives</td>
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</tr>
<tr>
<td>P5 5.04</td>
<td>Develop understanding of preferred type of logistics service provider (e.g. rather small or big, international or local, asset-based or non-asset-based providers)</td>
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<tr>
<td>P5 5.10</td>
<td>Test new providers before full engagement (e.g. in less important operations or with short contract durations)</td>
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</tr>
<tr>
<td>P6 6.04</td>
<td>Include service-level agreements and performance indicators into the contract (e.g. deadlines, response times)</td>
<td>3.67</td>
</tr>
<tr>
<td>P6 6.08</td>
<td>Describe detailed provider responsibilities in contract (e.g. documentation, reporting)</td>
<td>3.67</td>
</tr>
<tr>
<td>P6 6.03</td>
<td>Describe scope of services in detail in contract (e.g. in-scope vs out-of-scope)</td>
<td>3.63</td>
</tr>
<tr>
<td>P6 6.09</td>
<td>Describe indemnities, liquidated damages or penalties in contract (e.g. for product damages or theft)</td>
<td>3.59</td>
</tr>
<tr>
<td>P6 6.05</td>
<td>Describe structure of service fees and payment terms in contract</td>
<td>3.52</td>
</tr>
<tr>
<td>P6 6.06</td>
<td>Include duration of contract and rules for contract extension in contract</td>
<td>3.52</td>
</tr>
<tr>
<td>P6 6.11</td>
<td>Include provisions for adjustments and termination of contract</td>
<td>3.44</td>
</tr>
<tr>
<td>P6 6.14</td>
<td>Include code-of-conduct and data protection clauses (e.g. non-disclosure agreement) into the contract</td>
<td>3.41</td>
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<tr>
<td>P6 6.12</td>
<td>Clarify process for arbitration of disputes in contract</td>
<td>3.38</td>
</tr>
<tr>
<td>P6 6.10</td>
<td>Regulate insurance coverage in contract</td>
<td>3.37</td>
</tr>
<tr>
<td>P6 6.13</td>
<td>Clarify legal framework (e.g. court of jurisdiction, governing law) in contract</td>
<td>3.33</td>
</tr>
<tr>
<td>P6 6.07</td>
<td>Describe mode of cooperation in contract (e.g. ordering process, planning process)</td>
<td>3.15</td>
</tr>
<tr>
<td>P6 6.02</td>
<td>Describe context of operation and specifics of humanitarian mission in contract (e.g. urgency, criticality)</td>
<td>2.85</td>
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<tr>
<td>P6 6.01</td>
<td>For one-time services (e.g. single transport orders), limit contract to most important elements (e.g. by e-mail confirmation)</td>
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<tr>
<td>P7 7.03</td>
<td>Define adequate documentation as precondition for payments (e.g. provision of waybills)</td>
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<tr>
<td>P7 7.01</td>
<td>Avoid payments in advance</td>
<td>3.08</td>
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</table>

(continued)
<table>
<thead>
<tr>
<th>Practice ID</th>
<th>Activity name</th>
<th>Mean rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>P7 7.05</td>
<td>Design contracts as open-book (i.e. providing full transparency on true cost of provider)</td>
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<tr>
<td>P7 7.02</td>
<td>Design service fee as performance based (i.e. decrease of service fee for performance below target)</td>
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<tr>
<td>P7 7.04</td>
<td>Offer (automatic) contract extensions for satisfactory performance</td>
<td>2.50</td>
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<tr>
<td>P8 8.10</td>
<td>Avoid communicating sensitive data to provider (e.g. beneficiary lists, budget)</td>
<td>3.62</td>
</tr>
<tr>
<td>P8 8.04</td>
<td>In longer-term contracts, include sufficient provisions for termination of contract (e.g. because of funding issues, end of mission)</td>
<td>3.56</td>
</tr>
<tr>
<td>P8 8.06</td>
<td>Obtain written commitment of provider to adhere to agreed service fees (e.g. by using fixed price contracts)</td>
<td>3.56</td>
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<tr>
<td>P8 8.03</td>
<td>In longer-term contracts, avoid exclusivity clauses (i.e. restriction to single service providers)</td>
<td>3.54</td>
</tr>
<tr>
<td>P8 8.05</td>
<td>In longer-term contracts, include future price adjustments according to market valuation (e.g. alignment with best published price)</td>
<td>3.38</td>
</tr>
<tr>
<td>P8 8.08</td>
<td>Avoid (impression of) too close personal relationships with provider</td>
<td>3.37</td>
</tr>
<tr>
<td>P8 8.07</td>
<td>Have all contracts reviewed by legal expert</td>
<td>3.35</td>
</tr>
<tr>
<td>P8 8.09</td>
<td>Follow-up in written on all oral communication to have proof of conversation</td>
<td>3.30</td>
</tr>
<tr>
<td>P8 8.02</td>
<td>In longer-term contracts, avoid volume commitments (e.g. minimum service volume)</td>
<td>3.22</td>
</tr>
<tr>
<td>P8 8.01</td>
<td>Set short contract duration (e.g. one-time services) in case of high uncertainty (e.g. economic volatility, chaotic situations, at the beginning of an operation)</td>
<td>2.85</td>
</tr>
<tr>
<td>P9 9.01</td>
<td>Monitor execution of activities by service provider (e.g. status tracking)</td>
<td>3.56</td>
</tr>
<tr>
<td>P9 9.02</td>
<td>Perform inspections and audits (e.g. product quality, documentation compliance)</td>
<td>3.56</td>
</tr>
<tr>
<td>P9 9.09</td>
<td>Maintain record of performance for each provider</td>
<td>3.50</td>
</tr>
<tr>
<td>P9 9.04</td>
<td>Use a limited number of qualitative and quantitative performance indicators</td>
<td>3.35</td>
</tr>
<tr>
<td>P9 9.03</td>
<td>Run performance review in regular intervals (e.g. in fixed time intervals or at milestones)</td>
<td>3.30</td>
</tr>
<tr>
<td>P9 9.07</td>
<td>Measure provider against benchmarks (e.g. best-performing service provider)</td>
<td>3.23</td>
</tr>
<tr>
<td>P9 9.06</td>
<td>Involve provider in definition of performance metrics</td>
<td>3.15</td>
</tr>
<tr>
<td>P9 9.08</td>
<td>Involve multiple people into evaluation of service (e.g. recipient of deliveries)</td>
<td>3.11</td>
</tr>
<tr>
<td>P9 9.05</td>
<td>Set up performance metrics which measure “humanitarian performance” (no business-as-usual KPIs)</td>
<td>3.04</td>
</tr>
<tr>
<td>P10 10.10</td>
<td>Always keep own commitments (e.g. compliance of promised payments)</td>
<td>3.78</td>
</tr>
<tr>
<td>P10 10.09</td>
<td>Be flexible if changes to agreed terms are required</td>
<td>3.28</td>
</tr>
<tr>
<td>P10 10.11</td>
<td>Share projections (e.g. future service demands) with provider</td>
<td>3.28</td>
</tr>
<tr>
<td>P10 10.03</td>
<td>Give feedback to loosing tenderers on rejection decision (e.g. reason of rejection)</td>
<td>3.27</td>
</tr>
<tr>
<td>P10 10.05</td>
<td>Review the contract in detail together with the service provider</td>
<td>3.27</td>
</tr>
<tr>
<td>P10 10.07</td>
<td>Define relationship manager on both sides (management level)</td>
<td>3.26</td>
</tr>
<tr>
<td>P10 10.01</td>
<td>In case of open publication of service request, additionally send direct invite to important providers</td>
<td>3.04</td>
</tr>
<tr>
<td>P10 10.04</td>
<td>Set up contracts with “longer duration” (e.g. multiple months)</td>
<td>3.04</td>
</tr>
<tr>
<td>P10 10.06</td>
<td>Explain specifics of humanitarian context to managerial and operational staff of provider in person</td>
<td>3.04</td>
</tr>
<tr>
<td>P10 10.02</td>
<td>Preferentially select providers with which you have experience in working together</td>
<td>2.96</td>
</tr>
<tr>
<td>P10 10.08</td>
<td>Have selected staff of provider working in your organization for some time</td>
<td>2.58</td>
</tr>
<tr>
<td>P11 11.01</td>
<td>Negotiate and fix fair service fees (which allow adequate profits for provider)</td>
<td>3.20</td>
</tr>
<tr>
<td>P11 11.02</td>
<td>In longer-term contracts, include future price adjustments based on official cost index (e.g. fuel price index)</td>
<td>3.15</td>
</tr>
<tr>
<td>P11 11.08</td>
<td>Acknowledge good performances of provider (e.g. in letter of reference or letter of acknowledgment)</td>
<td>3.15</td>
</tr>
</tbody>
</table>

(continued)
Appendix 3. Questionnaire 1 (shortened)

The first page of the questionnaire introduced the goal of the study, explained the usage of the results, outlined the procedure of the study and described the structure of the questionnaire. The questions were then presented in three consecutive sections:

- **Section I: personal experience**
  - Please shortly describe a humanitarian operation in which you engaged commercial logistics service provider(s) (country, aim, reason, year, etc.).
  - What were your role and responsibilities with respect to the engagement of the logistics service provider(s) in this humanitarian operation?
  - Please describe the logistics service providers which you engaged in this humanitarian operation (e.g. “small local organization with limited capacity” or “major international enterprise”)
  - What kind of relationship did your organization have with the service provider(s) before the start of the operation?
  - For how long did you engage the service provider(s) in this humanitarian operation?
  - For which logistics activities did you engage service provider(s) in this humanitarian operation?
  - Why did you engage logistics service provider(s) for these activities in this humanitarian operation?
  - To which extent would you consider the described engagement of logistics service providers successful? Why?

### Table AIII.

<table>
<thead>
<tr>
<th>Practice ID</th>
<th>Activity name</th>
<th>Mean rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>P11.05</td>
<td>Link service fees to actual costs of service provider (e.g. cost-plus contract)</td>
<td>2.57</td>
</tr>
<tr>
<td>P11.03</td>
<td>Design service fee as performance based (i.e. increase of service fee for performance above target)</td>
<td>2.44</td>
</tr>
<tr>
<td>P11.07</td>
<td>Let provider benefit from publicity (“humanitarian image”)</td>
<td>2.49</td>
</tr>
<tr>
<td>P11.10</td>
<td>Make faster payments in case of good performance</td>
<td>2.23</td>
</tr>
<tr>
<td>P11.04</td>
<td>Offer (automated) contract extensions for satisfactory performance</td>
<td>2.08</td>
</tr>
<tr>
<td>P11.06</td>
<td>Guarantee fixed minimum payment to provider (independent of transaction volume)</td>
<td>2.04</td>
</tr>
<tr>
<td>P11.09</td>
<td>Reward service provider team with gifts (e.g. family trips)</td>
<td>1.08</td>
</tr>
<tr>
<td>P12.03</td>
<td>Communicate frequently, honestly and transparently</td>
<td>3.67</td>
</tr>
<tr>
<td>P12.01</td>
<td>Define and document contact persons and numbers with 24/7 availability on both sides (incl. backups)</td>
<td>3.50</td>
</tr>
<tr>
<td>P12.08</td>
<td>Work together to find joint solutions for issues and challenges and support provider on his tasks</td>
<td>3.37</td>
</tr>
<tr>
<td>P12.05</td>
<td>Proactively share all relevant information with provider</td>
<td>3.33</td>
</tr>
<tr>
<td>P12.09</td>
<td>Provide continuous performance feedback to provider and conduct regular lessons learnt sessions with provider</td>
<td>3.30</td>
</tr>
<tr>
<td>P12.10</td>
<td>Involve provider in internal training (e.g. standard operating procedures, best practices)</td>
<td>3.06</td>
</tr>
<tr>
<td>P12.02</td>
<td>Involve provider in logistics planning of operation</td>
<td>2.95</td>
</tr>
<tr>
<td>P12.04</td>
<td>Work face to face whenever possible</td>
<td>2.95</td>
</tr>
<tr>
<td>P12.06</td>
<td>Exchange information with provider through electronic data interchange (EDI)</td>
<td>2.76</td>
</tr>
<tr>
<td>P12.07</td>
<td>Allow provider access to parts of own IT system (e.g. for warehouse services)</td>
<td>2.21</td>
</tr>
</tbody>
</table>

**Notes:** Scale: 1 – not useful; 2 – somewhat useful; 3 – useful; 4 – very useful. *No consensus among panelists (IQR > 1.0 and/or r_wg ≤ 0.3)*
- What should your colleague do in the same way as you did it during the described operation?
- Why should your colleague do the above activities in the same way?
- What could your colleague do differently than you did it during the described operation?
- What would be the advantages of doing the above activities differently?

- Section II: humanitarian operations in general
  Looking beyond your past experience and speaking in general: What do you consider most important for successfully engaging logistics service providers in humanitarian operations?

- Section III: specific recommendations
  Please assume that a colleague of yours wants to engage a logistics service provider under similar conditions as during the operation which you have just described. What advice would you give your colleague based on your experience in the mentioned operation?
  - What should your colleague pay attention to when running the tender process?
  - Which criteria should your colleague apply when choosing between different service providers?
  - For how long should your colleague engage the chosen service provider(s)?
  - How should your colleague design the compensation and payment of the service provider(s)?
  - Which content should your colleague include into the contract with the service provider(s)?
  - What else should your colleague pay attention to when negotiating the compensation and setting up the contract?
  - In which way and how frequently should your colleague coordinate and align with the service provider(s)?
  - Which authorizations and responsibilities should your colleague assign to the service provider?
  - What data and information should your colleague share with the service provider(s) and how should your colleague organize the exchange of data and information?
  - Which criteria should your colleague use to evaluate the performance of the service provider(s)?
  - In which way and how often should your colleague measure the performance of the service provider(s)?
  - Which kind of performance incentives (e.g. rewards and penalties) should your colleague set up for the service provider(s)?
  - How should your colleague handle challenges and difficulties in the collaboration with the logistics service provider(s)?

Appendix 4. Questionnaire 2 (extract)
The questionnaire contained one page for each of 12 practices. Each of the 12 pages was designed in the same way. For illustration we provide the extract from the first page.

Practice 1: Prepare for the engagement of logistics service providers
Practitioners recommend to take actions which prepare the humanitarian organization for the engagement of logistics service providers. The preparation should take place internally (e.g. training)
and externally (e.g. framework agreements with preferred providers). Having the right structures in place allows to be more efficient when the need for such services occurs:

1. How useful do you consider the following activities, which were recommended by practitioners in the context of this practice? (not useful, somewhat useful, useful, very useful):
   - Develop guidelines and standard operating procedures for outsourcing (e.g. process descriptions, approval workflows).
   - Develop tools and templates (e.g. contract templates, supplier database, performance evaluation checklist), etc.

2. How important do you consider this practice (Prepare for the engagement of logistics service providers) in general? (not important, somewhat important, important, very important).

3. Do you have any comment with respect to your judgment?

**Corresponding author**
Timo Gossler can be contacted at: timo.gossler@wu.ac.at
An automated quantitative content analysis process for humanitarian logistics research

Nathan Kunz
Coggin College of Business, University of North Florida, Jacksonville, Florida, USA

Abstract
Purpose – Access to high-quality data is a challenge for humanitarian logistics researchers. However, humanitarian organizations publish large quantities of documents for various stakeholders. Researchers can use these as secondary data, but interpreting big volumes of text is time consuming. The purpose of this paper is to present an automated quantitative content analysis (AQCA) approach that allows researchers to analyze such documents quickly and reliably.

Design/methodology/approach – Content analysis is a method to facilitate a systematic description of documents. This paper builds on an existing content analysis method, to which it adds automated steps for processing large quantities of documents. It also presents different measures for quantifying the content of documents.

Findings – The AQCA approach has been applied successfully in four papers. For example, it can identify the main theme in a document, categorize documents along different dimensions, or compare the use of a theme in different documents. This paper also identifies several limitations of content analysis in the field of humanitarian logistics research and suggests ways to mitigate them.

Research limitations/implications – The AQCA approach does not provide an exhaustive qualitative analysis of documents. Instead, it aims to analyze documents quickly and reliably to extract the contents’ quantifiable aspects.

Originality/value – Although content analysis has been used in humanitarian logistics research before, no paper has yet proposed an automated, step-by-step approach that researchers can use. It also is the first study to discuss specific limitations of content analysis in the context of humanitarian logistics.

Keywords Methodology, Literature review, Content analysis, Text mining

Paper type Research paper

1. Introduction
Any good research project requires high-quality data. However, such data are difficult to get, especially in the area of humanitarian logistics, because humanitarian organizations do not prioritize data collection when responding to disasters. Even when they collect data, it is often incomplete and of insufficient quality (Kunz et al., 2017). Therefore, researchers must collect their own primary data, which is difficult if they do not have established contacts among humanitarian organizations. As a result, researchers often use hypothetical data to test their findings, which questions the validity and accuracy of the models they develop (Gupta et al., 2016; Kovacs and Moshtari, 2019).

An alternative to using hypothetical data or collecting primary data is to use secondary data from humanitarian organizations, such as reports, websites, or social media. Humanitarian organizations publish large amounts of reports for their donors. These reports must be transparent and publicly available, and some governments even regulate their structure and content. For example, the US Internal Revenue Service has specific annual-reporting requirements for nonprofit and charity organizations (IRS, 2018). Public repositories of rich secondary data about humanitarian crises also exist. For example, the UN Office for the Coordination of Humanitarian Affairs runs the website ReliefWeb.int (ReliefWeb, 2018), on which it publishes maps, reports and press releases about specific disasters. Most of these resources come from humanitarian organizations. The UN World Food Program operates a similar website focusing specifically on humanitarian logistics operations (Logistics Cluster, 2018). Content on
social media (Facebook, Twitter, LinkedIn, etc.) is another source of rich data that organizations and their followers generate.

These few examples show that large amounts of secondary data are available, and most are potential sources of data for research in humanitarian logistics. However, the challenge is that these data are unstructured and most often in text form. Analyzing such data requires a method called content analysis, which is a “research technique for the objective, systematic, and quantitative description of the manifest content of communication” (Berelson, 1952, p. 18). Shapiro and Markoff (1997) further define it as a methodological measurement applied to text that makes it a rigorous and reproducible way of analyzing written documents. While content analysis has been used since the beginning of the 20th century, it has evolved significantly over the past few decades as digitalization of communication has increased and computer-assisted tools for text analysis have been developed (Krippendorff, 2004).

Content analysis has been used for a variety of research approaches in different disciplines. In operations management, multiple studies have used it for conducting literature reviews (see e.g. Demeter et al., 2019; Seuring and Gold, 2012; Seuring and Müller, 2008; Spens and Kovacs, 2012; Spens and Kovác, 2006). Other studies have used content analysis to analyze social media feeds related to operations management (see e.g. Chae, 2015).

Over the years, content analysis has evolved into two different approaches, qualitative and quantitative. The present paper focuses on the latter and proposes an automated quantitative content analysis (AQCA) approach using the four steps suggested by Seuring and Gold (2012). In the first step, the researcher selects the documents to be analyzed, then assesses their descriptive characteristics in the second step (e.g. year of publication, length, authors). In the third step, the researcher identifies the dimensions of interest for the study and their related categories, resulting in the creation of several codes (i.e. labels for specific concepts). Finally, the researcher assigns these codes to words or sentences in the text (“coding”), constituting the basis for identifying patterns in the documents.

Several of these steps are time consuming and rely on the researcher’s subjective judgment. For example, deriving codes from the data may require reading the documents multiple times. This paper proposes an approach to automate the development of codes. The coding process is another time-consuming task because the researcher must read the documents carefully and label words or sentences of interest with the corresponding codes. While this is feasible with a small set of documents, e.g., interview notes, it becomes a monumental task when analyzing thousands of pages of documents, e.g., academic papers or annual reports. This task also is mentally challenging because the researcher must remember all codes and their definitions, as well as decide on the appropriate code to use for each sentence of interest. This results in a process that is not only slow, but also quite subjective. This paper proposes an approach to automate the coding process through software, and it provides several recommendations for mitigating the risks inherent in this approach.

After coding the documents, the codes can be analyzed qualitatively or quantitatively (Hsieh and Shannon, 2005). In the qualitative approach, the researcher analyzes the document’s latent content by interpreting the text’s underlying meaning (Seuring and Gold, 2012). In the quantitative approach, which is this paper’s focus, the researcher analyzes the frequency of codes in the different documents to identify patterns (Berelson, 1952). However, code frequency may not be sufficient for extracting information of interest. This paper proposes a set of measures to address this limitation for different types of analyses.

This paper’s objective is to present the AQCA approach and provide researchers with a tool that they can use to analyze large amounts of text quickly and reliably. Although the method is generic and can be used in different fields, this paper contributes to humanitarian logistics
research by providing application examples from this discipline and discussing specific opportunities and limitations. Specifically, the following research questions are investigated:

**RQ1.** How can one use an automated approach to derive codes from a set of documents?

**RQ2.** How can large quantities of documents be coded automatically?

**RQ3.** How can the relative frequency of codes help identify themes in a document reliably?

The next section presents a short literature review on content analysis and its application to humanitarian logistics research. Section 3 describes the four studies that use the content analysis method introduced in this paper, and Section 4 presents the AQCA approach. Section 5 discusses the approach’s limitations and how they can be mitigated, and Section 6 concludes the paper.

## 2. Literature review

Content analysis has been used in research since the beginning of the 20th century (Hsieh and Shannon, 2005) and was formally recognized as a research method in 1941 (Schreier, 2012). Ten years later, Berelson (1952) published the first leading textbook on this method, which set the basis for content analysis as a scientific research methodology (Schreier, 2012). Berelson (1952) defined content analysis as a method for the systematic, objective and quantitative description of the manifest content of communication. Shortly after that, Kracauer (1952) criticized the quantitative approach suggested by Berelson, arguing that it fails to consider the complex meaning of text and the context in which it is used. He proposed a qualitative approach to content analysis. The benefits and limitations of both approaches have been the subject of a continuous debate, but both are now recognized as acceptable methods to conduct content analysis (Duriau et al., 2007; Hsieh and Shannon, 2005; Schreier, 2012; Seuring and Gold, 2012). The next subsections describe both approaches in more detail.

### 2.1 Quantitative content analysis

Quantitative content analysis is the original approach suggested by Berelson (1952), and it focuses on counting words’ usage frequencies in documents. The words are coded into categories, and their relative frequency is analyzed to create a numerical summary of the message (Neuendorf, 2016). The basic assumption is that a word’s usage frequency indicates the importance of the subject (Guthrie et al., 2004; Krippendorff, 2004). Kracauer (1952) questioned this assumption and argued that a word that occurs only once in a text can convey a strong message about the content of the text. Another limitation is the quantitative content analysis’ inability to take into account the context in which the words are used (Kracauer, 1952). Despite some criticism, the quantitative approach has been recognized widely (Neuendorf, 2016; Patton, 2002; Tashakkori, 2006) and used extensively because of its ability to evaluate the content of documents systematically and objectively (see e.g. Barringer et al., 2005; Doucet and Jehn, 1997; Kabanoff et al., 1995; Riff et al., 2014).

The widespread digitalization of written communication and the development of information technology have enabled the use of computers to support the quantitative content analysis process (Krippendorff, 2004). Stone et al. (1966) undertook the first attempts in this direction in 1966, yielding a tool that still is in use today (Harvard General Inquirer, 2018). Computer-assisted content analysis has increased the scalability of the method, thereby allowing for use with large volumes of data by automating tasks such as coding and data storage (Duriau et al., 2007).

The emergence of big data and data-analytics tools further reinforced the role of computers in quantitative content analysis on large data sets, where it is often referred to as “text mining”
or “text analytics.” Whereas quantitative content analysis and text mining use similar tools, they differ at the analysis level. While content analysis concentrates on analyzing word frequencies, text mining uses Natural Language Processing tools to interpret communication and identify patterns that human readers might overlook (Neuendorf, 2016). Text mining also has a predictive ability that is not pursued in quantitative content analysis (Yu et al., 2011), rendering it suitable for analyzing social media (e.g., using posts to predict future patterns without a preconceived theoretical basis). Therefore, while text mining and quantitative content analysis have some overlap, they are not intended for the same purposes, or as Neuendorf (2016) puts it, text mining is “almost (but not quite) content analysis” (Neuendorf, 2016, p. 235).

2.2 Qualitative content analysis

Qualitative content analysis emerged in reaction to Berelson’s (1952) method of quantifying the content of documents. Kracauer (1952) criticized the loss of accuracy in this approach, as rich qualitative content is lost when transforming it into numbers. He also noticed that communication often contains “latent meanings” that require some form of interpretation, which only can be done through a qualitative analysis. In light of these criticisms, qualitative content analysis has been developed as a method for analyzing not only the manifest content of documents, but also the latent meaning of “what is written between the lines” (Carney, 1972, p. 25). With this approach, the researcher identifies thematic patterns that emerge from a close reading of the text (Neuendorf, 2016), while also considering the context (Schreier, 2012). This human interpretation, which requires multiple readings of the text (Hsieh and Shannon, 2005), is slow and inevitably subjective (Kracauer, 1952), making it more difficult to achieve high reliability (Schreier, 2012).

Qualitative content analysis has been applied in several studies (see e.g. Altheide and Schneider, 2013; Elo and Kyngäs, 2008; Forman and Damschroder, 2007; Mayring, 2000; Schreier, 2012). Hsieh and Shannon (2005) categorize qualitative content analysis in three categories, depending on how the codes are developed (inductively, deductively, or summatively). Mayring (2000) proposes a similar classification and differentiates between inductive category development (categories derived from the content) and deductive category application (categories derived from existing theory).

Both Berelson (1952) and Krippendorff (2004) question the distinction between quantitative and qualitative content analysis. They argue that any text is qualitative in nature, even when some characteristics are later converted into numbers. Berelson (1952) has criticized the generally small samples analyzed in qualitative approaches and the high degree of subjective interpretation required of the coder.

2.3 Content analysis in humanitarian logistics research

This subsection presents a number of applications of content analysis in the field of humanitarian logistics research. So far, this method has been used mainly for conducting literature reviews and analyzing social media content. Caunhye et al. (2012) used qualitative content analysis to identify the type of optimization models used in emergency logistics literature. Kunz and Reiner (2012), Leiras et al. (2014) and Seifert et al. (2018) used qualitative and quantitative content analysis to categorize papers along different dimensions. Content analysis also has been used to analyze social media content in the context of humanitarian operations. Ashktorab et al. (2014) used content analysis to extract information related to disaster response from Twitter posts. Chew and Eysenbach (2010) analyzed the content of Twitter posts to monitor the outbreak of the swine flu pandemic in 2009. Mejia et al. (2019) used content analysis to examine how updates posted on a crowdfunding platform affected the amount of donations collected. Yoo et al. (2016) used content analysis to study the diffusion speed of information on Twitter in 2012 during hurricane Sandy. Content analysis can also be...
used to analyze reports and news, which Kovacs and Moshtari (2019) suggest as a relevant way for researchers to better understand real problems of humanitarian organizations.

Several risks exist when using content analysis in the context of humanitarian logistics research. Trustworthiness of the data source is sometimes questionable, particularly when using big data generated on social media platforms (Kovacs and Moshtari, 2019; Wells and McMillan, 2017).

Another risk when using social media content is the potential bias due to the “echo chamber” effect, in which users are “are exposed only to information from like-minded individual” (Bakshy et al., 2015, p. 1130). Such situations ultimately reinforce individuals’ pre-established opinions and perspectives (Colleoni et al., 2014) and lead to a viral propagation of some posts. As a result, the number of posts on social media is not necessarily a representative assessment of the population’s opinion, especially when users express opinions on issues such as donations, humanitarian aid policy, or government actions in the aftermath of a disaster.

Another limitation of using content analysis of social media data comes from the “digital divide” (Norris, 2001), which excludes the population without internet access from having a social media presence. Although this divide is shrinking worldwide as internet access becomes more widely available, a large share of the population in developing countries still does not have web access and, thus, no presence on social media. Therefore, any study using social media, especially in the context of a developing country, will be biased toward the population that has an online presence, and non-connected people will be missed (Crawford, 2013). This may lead researchers to wrong conclusions (Lazer et al., 2014). This limitation is reinforced in the event of a disaster because the most affected population probably would not have access to social media (due to power or communication outages), or would not be spending time on social media because they would be focusing on disaster survival and/or recovery (Madianou, 2015). Thus, any results from a content analysis using social media are only representative of the least-affected people who post on social media.

Trustworthiness of data is also an issue when analyzing other forms of written communication. While academic papers and reports from reputable international organizations can generally be considered trustworthy, this assumption is questionable with other forms of materials. In today’s world of increasing politicization of humanitarian crises and information warfare, there is a serious risk that published documents or even newspapers contain false information. Host governments have a strong influence on humanitarian operations in some countries (Dube et al., 2016; Kunz and Reiner, 2016), and may force humanitarian organizations to omit information in their reports.

2.4 Gap

This literature review provides a limited overview of content analysis history and its application to humanitarian logistics research. Several books present this methodology and its use in multiple disciplines (see e.g. Berelson, 1952; Carney, 1972; Krippendorff, 2004; Neuendorf, 2016; Schreier, 2012), and several papers describe how to conduct content analysis in logistics and supply chain management research, (see e.g. Seuring and Gold, 2012; Spens and Kovacs, 2006). This paper does not intend to replicate these studies, but rather to extend them to the field of humanitarian logistics research. In particular, it proposes an Automated Quantitative Content Analysis (AQCA) approach to guide researchers in humanitarian logistics through the content analysis process.

3. Application cases

This section briefly presents four papers that applied the AQCA approach, and specifically describes the content analysis process.
3.1 Paper 1: literature review on humanitarian logistics research
Kunz and Reiner (2012) used the AQCA approach to conduct a literature review of 174 papers on humanitarian logistics. This study categorized the papers along six dimensions. The first five dimensions came from existing theory and previous reviews (e.g. type of disaster, research methodology). The sixth dimension categorized the most prevalent situational factors described in each paper (socio-economic, environmental, infrastructure and government). The study’s objective was to identify situational factors underrepresented in extant research and suggest areas in need of more research.

We used an inductive approach to identify 120 codes related to situational factors (Mayring, 2000). Three researchers then independently assigned these codes to the four categories of situational factors to ensure validity and reliability (Duriau et al., 2007). We used the software Atlas.ti to auto-code the papers with the 120 codes (9,233 words coded), then analyzed the occurrence of codes from each category. The relative frequency of codes allowed us to identify the most represented situational factors in each paper.

3.2 Paper 2: literature review on humanitarian supply chain management research applied to refugee assistance
Seifert et al. (2018) was another literature review using the AQCA approach. This study identified and analyzed all papers at the nexus of humanitarian supply chain management and refugee assistance. It used the AQCA approach to categorize papers according to three dimensions: the paper’s main focus (supply chain management vs refugee assistance), research approach (quantitative vs qualitative) and the type of operation described in the paper (disaster relief vs development aid). Because only two categories existed in each dimension, the objective was to determine whether the paper has more codes in one or the other category.

3.3 Paper 3: analysis of agrifood companies’ activity reports
Gold et al. (2017) is not directly related to humanitarian logistics, but employs the AQCA approach in a way that could be used for humanitarian logistics research. Our hypothesis was that agrifood companies focus most of their communication on the sustainability of their actions, although this does not always translate into real action at the operational level. We selected the four largest agrifood companies and analyzed their activity and sustainability reports using the AQCA approach. We inductively derived the codes from the documents and assigned them to four performance objectives: sustainability, quality, cost and responsiveness. The reports’ auto-coding with 52 codes yielded 5,143 words coded.

3.4 Paper 4: insecurity in humanitarian operations
In this working paper (Dube et al., n.d.), we use the AQCA approach to analyze annual reports of four humanitarian organizations over five years (representing over 4,600 pages of content) to find how insecurity affects them over time. We inductively derived 35 codes from the documents, and auto-coding yielded 6,873 words coded. The frequency of insecurity-related codes in each report shows an increase in insecurity in humanitarian operations from 2010 to 2015. However, comparing different organizations showed that insecurity does not affect all organizations equally.

4. Automated quantitative content analysis (AQCA) approach
The approach presented in this section builds on the experience gained from the four papers described in the previous section. This paper does not claim to develop a new method of content analysis. Instead, its contribution is to present an approach that has proven itself valuable in four papers, then share some best practices on how to apply it. The approach
follows the four steps proposed by Seuring and Gold (2012), which are inspired by Mayring (2000) and Krippendorff (2004). Although the AQCA approach uses the software package Atlas.ti, other tools for text analysis exist and could be equally used (e.g. NVivo, RapidMiner).

Figure 1 shows the terminology used throughout this paper. At the first level is the dimension to be analyzed. For example, in the case of a literature review, this could be the “method of the paper.” Each dimension then has two or more categories, e.g., “Quantitative” and “Qualitative.” Each category has one or more corresponding codes (which are developed inductively from the documents or deductively from theory). Such codes could be “Interview,” “Case study,” “Delphi,” etc. The codes are the basis for the auto-coding process, in which the software tool assigns the codes to the actual words in the document. For example, the software would assign the code “Interview” to all words with the same root, such as “interviewer,” “interviewee,” “interview” and “interviews.”

4.1 Material collection

Before starting the material collection, one must define the study’s purpose based on the research questions to be investigated. The study either could aim to categorize documents along different dimensions (e.g. a literature review, as in Papers 1 and 2), or to identify specific constructs within documents to find patterns (e.g. analysis of reports, as in Papers 3 and 4). The study’s purpose then allows for defining the unit of analysis, which could be academic papers or reports, news articles, or social media content.

The next step is to identify the source for collecting the documents and define the search criteria and any filters applied for excluding particular documents. It is extremely important to define and delimit the material carefully (Seuring and Gold, 2012) because adding documents later in the process is particularly challenging. Indeed, the inductive development of codes must be done based on all documents in the selection, or on a carefully selected sample of documents. Adding documents once the codes have been developed is a potential source of bias.

The last step in the material collection is reporting the sources of documents (e.g. databases, websites) and describing the search criteria and filters used to include or exclude documents in the selection. This ensures transparency and allows researchers to replicate the study in the future.

4.2 Descriptive analysis

The objective of this step is to present the documents’ characteristics to be analyzed (Seuring and Gold, 2012). In the case of a literature review, one typically would present the
number of papers published per year, number of papers per journal, number of papers per author, etc. The descriptive analysis can show interesting trends concerning the evolution of the body of literature. For an analysis of reports, a descriptive analysis shows the number of documents analyzed, publication years, number of pages in each document, etc.

4.3 Selection of dimensions, categories and codes

4.3.1 Dimensions and categories. In this step, the researcher defines the dimensions to be analyzed, as well as their related categories. When the purpose of the study is to categorize papers, or categorize documents’ content, at least two mutually exclusive categories should be made for each dimension (Krippendorff, 2004), so that each document (or content source) can be assigned to one of the categories. It is important that these dimensions and categories are clearly defined (Guthrie et al., 2004) and connected to theory to ensure the findings’ internal validity (Spens and Kovács, 2006). Common dimensions and their related categories in the field of humanitarian logistics are:

- context of operations (disaster relief or development aid) (Kovács and Spens, 2007);
- cause of disaster (natural or man-made) (Van Wassenhove, 2006);
- speed of disaster’s onset (slow or sudden) (Van Wassenhove, 2006);
- phase of disaster (mitigation, preparation, response, or recovery) (Kovács and Spens, 2007); and
- type of research methodology (various categories, see e.g. Altay and Green, 2006, Caunhye et al., 2012).

A literature review usually also adds one or more specific dimensions in line with the review’s purpose. In such a case, the dimension and its categories might not exist in extant literature, but nevertheless should be grounded in theory. When analyzing secondary documents, e.g., activity reports, dimensions also should be based on existing theory and aligned with the research questions.

4.3.2 Codes. Once the researcher defines the dimensions and related categories, the next step is to identify the codes for each category. This can be done in two ways: deductively (based on theory) or inductively (based on the documents’ content). In the deductive approach, the researcher derives codes from existing theory (Mayring, 2000), or from a content analysis dictionary, e.g., the Harvard General Inquirer (HGI) (Stone et al., 1966). Such dictionaries provide exhaustive lists of words related to specific concepts, but only a limited number of dimensions are available in these dictionaries (HGI currently covers only 26 dimensions, and none of them is specific to humanitarian logistics research, obviously). This deductive approach is particularly suitable when the study aims to extend existing theory, and codes can be extracted from literature (Hsieh and Shannon, 2005). It has the benefit of increasing construct validity because it relies on codes that have been used before and validated.

When existing theory is limited, and no predefined codes are available from extant research – as often is the case in humanitarian logistics research – one must take an inductive approach and derive the codes from the documents to be analyzed (Mayring, 2000). All four papers presented in Section 3 followed this approach. The benefit of the inductive approach is that one gets the information directly from the documents, without being influenced by preconceived codes or theoretical perspectives (Hsieh and Shannon, 2005). However, deriving codes from documents is a long process that requires reading the material repeatedly. The AQCA approach automates the inductive development of codes with a software tool, as described in Figure 2.
In Step 1, the software tool creates a count of all words in all documents, which results in a (very long) table of words with their frequency counts. In Paper 1, this list contained 40,000 words. In Step 2, all words occurring less than \( x \) times are eliminated to focus only on the most relevant words. \( x \) is a threshold defined by the researcher, depending on the level of detail required and the number of documents in the selection. For example, Paper 1 used a threshold of five (resulting in 12,000 words used five times or more), and Paper 4 used a threshold of 10 (resulting in 8,300 words used ten times or more). In Step 3, the researcher “scans” through the list of remaining words to identify the ones related to the dimension to be analyzed. This process is daunting at first, but after a while, it becomes manageable and surprisingly fast (200 words per minute is easily feasible). Sorting the words into alphabetical order helps in this process because it allows for identifying and grouping words with the same roots together (unless they have different prefixes). To increase reliability and ensure that no word is missed, one or two other researchers can do the same process independently. Alternatively, the same researcher can repeat the process multiple times to increase the likelihood of identifying all words of interest.

In Step 4, the researcher combines the selected words that have the same roots. For example, say the word “politics” and all its variations (“political,” “politically,” “geopolitical,” “politician,” etc.) are combined into a word, “politic.” It is important to document these word combinations because they will be needed for the auto-coding process. In Step 5, the researcher assigns the words to codes. Depending on the desired level of granularity in the analysis, each word is assigned to one code (e.g. the word “politic” and its variations are assigned to code “POLITIC”), or multiple words are assigned to one code (e.g. the words “school,” “schooling,” “educator,” “education,” “teach,” “teacher” and “teaching” are assigned to code “EDUCATION”).

In Step 6, the researcher assigns the codes to the different categories. It is recommended to have one or two other researchers do this same task independently to ensure the coding’s reliability, then to verify inter-coder reliability with a measure such as Cohen’s \( \kappa \), Fleiss’ \( \kappa \) (Landis and Koch, 1977), or Krippendorff’s \( \alpha \) (Krippendorff, 2004). Such measures work in most cases, but they have limitations in terms of number of coders or number of categories that they can cover. An alternative measure is the percentage agreement between coders (Kovács et al., 2012), which measures what percentage of codes were assigned to the same categories.

Once the researchers assign the codes to categories and settle any discrepancies, one can produce the final list of codes for each category. The paper always should provide this list to increase transparency and allow other researchers to replicate the study or use the identified codes for future research.

4.4 Material evaluation

4.4.1 Coding. Once the codes have been defined, it is time to start the coding work, i.e., to label the words or sentences in the documents with the relevant codes. This can be done
manually with software such as Atlas.ti or NVivo, but this task is cumbersome because the researcher must remember all codes and their related words while reading through the material. Therefore, manual coding is limited to relatively small selections of short documents. Also, the manual coding of text is subject to errors (e.g., overlooking a word that needs to be coded, or coding a word with the wrong code). The AQCA approach addresses these limitations by using the software’s auto-coding function.

Before starting the auto-coding function, the researcher enters all codes in the software using a specific syntax. In Atlas.ti, the researcher defines a list of all words to be coded with a particular code. In doing so, it is important to include all words with the same root, as identified in Step 4 of the inductive development of codes. In Atlas.ti, the sign “*” is the operator for including all variations of a word, and the sign “|” is the Boolean OR operator. The following example shows how to define the code “POLITIC” for all instances of the words “politics,” “political,” “politically,” “geopolitical” and “politicalian.” Note that the “*” at the beginning of the word “politic” ensures that the word “geopolitical” is included:

\[
\text{POLITIC} := *\text{politic}\* \\
\]

The next example shows how to define the code “EDUCATION” for coding all instances of the words “school,” “schooling,” “educator,” “education,” “teach,” “teacher” and “teaching”:

\[
\text{EDUCATION} := \text{school*|educat*|teach*} \\
\]

After entering all codes into the software, the researcher selects the documents to be coded and starts the process. At the end of this process, Atlas.ti shows the documents with the coded words highlighted in the text, and the assigned code indicated in the margin.

4.4.2 Post-coding verification. Post-coding verification is an important follow-up step to ensure reliability in the coding process. It is a manual verification of the coding work, which intends to confirm that the coded words have the intended meaning. The researcher manually removes the coding from the words that have a different meaning because of context. For example, in Paper 3, the code “QUALITY” was used for identifying words related to food quality. The post-coding verification showed that the word “quality” had been coded in the term “high-quality debt,” which obviously is a financial term that is unrelated to food quality. Thus, all codes assigned to this term were removed.

Post-coding verification also shows words coded in sections of the document that should not be analyzed. For example, the researcher might find a word coded in the running titles of reports, which falsely influences subsequent analysis (because the word appears on each page of the report). One also might need to remove all codes assigned in the reference section of academic papers because they could bias the analysis. In extreme cases, the researcher might even need to delete a code entirely if it has an ambiguous meaning that could be assigned to two different categories. For example, in Paper 3, the code “NATURE” had to be deleted because it was sometimes used to describe food quality, while other times, it was used in the context of the company’s sustainability practices.

Post-coding verification is a time-consuming task, but it is nevertheless important to ensure the study’s reliability. In any case, this verification step still is much faster than reading all the content of all documents and assigning codes manually.

4.4.3 Analysis. The coding output is a code-document matrix that indicates how many times each code appears in each document (absolute frequency). Summing up the occurrence of all codes in a category makes it possible to find the frequency of words from each category in a document. While this absolute measure provides some useful insights, it is
difficult to compare the frequency of words across different categories, or between documents of different lengths. The AQCA approach uses different measures of relative frequency that address these limitations and allow for normalizing absolute frequency, thereby comparing frequencies across categories and across documents.

Normalize to code in other documents. This measure is particularly useful when allocating documents to different categories, e.g., for a literature review. The challenge is that codes from one category might be used more often than others in all documents, and it would not make sense to allocate all documents to this category. For example, in Paper 1, words from the category “socio-economic” situational factors were the most frequent in all documents. However, some documents obviously focused more on this situational factor than others. The measure presented in Equation (1) allows for identifying the category that is over-represented in a document by comparing category frequency in that document with the average frequency of that category in all documents:

$$F_{i,j} = \frac{x_{i,j}}{X_i}$$ (1)

in which $X_i = \frac{\sum_{j=1}^{N} x_{i,j}}{N}$ (2)

Equation (1) defines the relative frequency of codes from category $i$ in document $j$ ($F_{i,j}$) as the absolute number of code occurrences from category $i$ in document $j$ ($x_{i,j}$), divided by the average occurrence of codes from category $i$ in all documents ($X_i$). Equation (2) shows the calculation of $X_i$, in which $N$ is the number of documents in the selection. If a category appears more often in a document than in the average of all documents, its relative frequency is larger than 1, meaning that this category is over-represented in that document. Once the relative frequency of codes from all categories in a document is known, one can assign the document to the category with the highest relative frequency, as shown in the following equation:

$$\text{Category}_j = \max(F_{1,j}; F_{2,j}; F_{3,j}; F_{4,j})$$ (3)

When using the method in Paper 1, the papers with no over-represented category were removed from the analysis (i.e. the maximal $F_{i,j} < 1$) because no category is mentioned more in that paper than the average of all papers. Papers in which the difference between the two highest relative frequencies was smaller than 0.1 also were removed because the distinction between the two highest frequencies is unclear. Doing so ensured that the categorization included only papers with a clearly over-represented category. We used this measure in Paper 1 to identify the situational factor most represented in each reviewed paper. Based on this measure, we found that socio-economic and governmental situational factors were understudied.

Normalize to other codes in document. This measure is useful when allocating documents to two categories used similarly often, i.e., there is no one category that always is used more often, like in the previous measure. Paper 2 uses this measure to categorize papers based on their main focus, either “supply chain management” or “refugee assistance.” The following equations show the measure for calculating the relative frequency of codes from both categories:

$$F_{1,j} = \frac{x_{1,j}}{x_{1,j} + x_{2,j}}$$ (4)

$$F_{2,j} = \frac{x_{2,j}}{x_{1,j} + x_{2,j}}$$ (5)
Equation 4 defines the relative frequency of codes from category 1 in document $j$ ($F_{1,j}$) as the absolute number of occurrences of codes from category 1 in document $j$ ($x_{1,j}$), divided by the sum of the absolute number of occurrences of codes 1 and 2 in document $j$. Equation (5) presents the same formula for $F_{2,j}$. Because only two categories exist, the sum of both relative frequencies is equal to 1. Once the relative frequency of both categories in a document is known, one can assign the document to the category with the highest relative frequency, as shown in the following equation:

$$\text{Category}_j = \max(F_{1,j}; F_{2,j})$$  \hspace{1cm} (6)$$

Running this analysis in Paper 2 showed that some papers have a similar relative frequency of codes from both categories. This indicates an unclear distinction between both categories, and the method cannot make a reliable judgment. One option would be to remove these documents from the selection; another option is to create a middle category, called “Balanced,” which contains all documents with an unclear distinction (Equation 7). For example, Paper 2 used limits of 0.33 and 0.66 for the middle category of the dimension “main focus of the paper,” but the researcher must decide what limits to use, depending on the number of documents in this category and the study’s purpose:

$$\text{Category}_j = \begin{cases} 
0 \leq F_{1,j} \leq 0.33; \text{Category 2} \\
0.33 < F_{1,j} \leq 0.66; \text{Balanced} \\
0.66 < F_{1,j} \leq 1; \text{Category 1}
\end{cases}$$  \hspace{1cm} (7)$$

In Paper 2, only 6 percent of the papers were assigned to the category “Balanced.” This was a surprising finding and indicated that the body of literature is focused heavily either on supply chain management or refugee assistance, with only few papers combining both disciplines.

Normalize to document length. This measure is useful when comparing the frequency of codes from a category across documents with various lengths. Paper 4 uses this measure to compare the frequency of insecurity-related words in activity reports over time and across different organizations. One organization, the International Committee of the Red Cross publishes activity reports that can be over 600 pages in length, whereas the activity reports from another organization, World Vision International, are only 70 pages long. Therefore, comparing the absolute frequency of codes would not be useful. The measure in Equation (8) solves this by normalizing the frequency to the number of words in the document:

$$F_{i,j} = \frac{x_{i,j}}{W_j} \times 1,000,000.$$  \hspace{1cm} (8)$$

Equation (8) defines the relative frequency of codes from category $i$ in document $j$ ($F_{i,j}$) as the absolute number of occurrences of codes from category $i$ in document $j$ ($x_{i,j}$), divided by the number of words in paper $j$ ($W_j$). Because the result of this division is a small number that is difficult to comprehend, it is multiplied by 1 million to express the frequency as the number of codes per million words. In Paper 4, we used this measure to monitor the evolution of insecurity-related issues over the years, and found that humanitarian organizations have been increasingly affected by insecurity. Comparing this measure across organizations also shows that insecurity affects the organizations in their operations differently.
5. Discussion and limitations

This section discusses the limitations of using the AQCA approach and how to mitigate them. The method, like any quantitative content analysis approach, is a simplification of written communication. It tries to transform rich content into numbers, which has the benefit of enabling faster and more reliable coding, but comes at the expense of losing valuable qualitative content from the text. This limitation can be addressed by clearly specifying the objective of the method (analyzing quantifiable aspects of content) and acknowledging the limits of the approach.

Another limitation is the method’s inability to consider the context in which a word is used, which is particularly important when doing research in humanitarian logistics. This limitation can be addressed by conducting a thorough post-coding verification to identify instances where a word is not used in its intended meaning and remove them. The risk of missing important contextual information can also be addressed by combining the ACQA approach with a qualitative content analysis approach, as we did in Papers 1 and 2 (but which is not the focus of the present paper). In Paper 4, we combined the ACQA approach with a case study method to capture the rich contextual knowledge of practitioners.

There is a risk of selection bias when identifying words related to the dimension of interest from documents (inductively deriving the codes from the documents). This can be mitigated by having multiple researchers do the same task individually, then comparing their selections of words and assessing the degree of inter-coder reliability. Another risk of selection bias occurs when assigning codes to categories. This must be addressed by having multiple researchers assigning codes separately, then assessing the degree of inter-coder reliability.

There is also a risk of bias caused by coded words appearing in specific sections of a document. If a word appears in the running title (i.e. on each page of a document), it will be over-represented in that document and probably should be removed from the occurrence count. Systematically removing the coding from these sections is not always required, but the researcher must assess this risk and decide accordingly whether to make such changes.

If the selected documents are intended for different target audiences and fulfill different purposes, they might be difficult to compare because they use different wording, and an auto-coding approach might not work well. For example, comparing meeting minutes across different humanitarian organizations would be acceptable, but it is not advisable to compare newsletters, meeting minutes and activity reports in the same content analysis (unless one can ensure that the same wording is used for the studied dimension). This must be carefully considered during the material collection process.

In addition to these limitations in the AQCA approach, several risks exist when using content analysis in the context of humanitarian logistics research, as presented in Section 2. Researchers need to be extremely cautious when analyzing content of news media, and should discuss potential political affiliation of the sources of content and describe how to mitigate resulting biases. Content of humanitarian organization reports must be used with great caution when the government of the host country imposes severe restrictions on humanitarian organizations, such as limitations on public communications.

Using content analysis to study social media content also raises the issue of trustworthiness of data. While the researcher can never guarantee a total veracity of the content, it is nevertheless important to discuss possible biases caused by false information and describe measures taken to mitigate this risk. The digital divide is another limitation when doing content analysis of social media data. The content posted online is only representative of the population with access to the internet, not necessarily the most affected population. Humanitarian logistics researchers using content analysis on social media data should be extremely cautious when interpreting their results, and clearly discuss how the digital divide impacts their results.
The echo chamber effect, in which social media users follow only posts of like-minded individuals, may lead to certain posts propagating virally and skewing the result of the quantitative analysis. Researchers using the AQCA approach have to be aware of this risk and discuss how to mitigate it.

6. Conclusion
This paper presents an AQCA approach that has been applied successfully in four papers. This approach is particularly suitable for humanitarian logistics research because good data are very limited and difficult to collect (Kovacs and Moshtari, 2019; Kunz et al., 2017). However, it is possible to overcome this challenge by using documents published by humanitarian organizations, which must communicate transparently with their donors; thus, plenty of documents are available. Public repositories of such documents are a reliable source of information about particular disasters (see e.g. Logistics Cluster, 2018; ReliefWeb, 2018). However, analyzing large quantities of documents reliably is challenging because it is extremely time consuming and involves subjective judgments.

This paper demonstrates how to analyze such documents using an automated approach, which saves significant amounts of time and provides a more objective content assessment. In particular, the paper’s first contribution is a process for identifying words of interest from documents, then assigning them to different categories. This inductive development of codes ensures that the content analysis captures all concepts of interest mentioned in the documents. The paper’s second contribution is a process for automatically coding documents with a software tool, allowing for coding of large documents quickly and reliably (one paper analyzed 4,600 pages of content with the AQCA approach). The third contribution is a description of three measures of relative code frequency, which researchers can use to categorize documents, identify common themes in documents, or track the use of certain themes over time. Finally, the paper discusses several limitations and risks that researchers must address when applying content analysis in the context of humanitarian logistics research.

The AQCA approach presented in this paper will help researchers analyze the content of large sets of documents and use them as a convenient data source. Considering the recommendations and limitations presented in this paper will enable them to conduct rigorous and reliable research on secondary documents in humanitarian logistics.

Acknowledgment
This paper presents the automated quantitative content analysis (AQCA) approach that the author has developed and applied in three published papers (Kunz and Reiner, 2012; Gold et al., 2017; Seifert et al., 2018) and in a working paper. Although the author was responsible for developing the AQCA approach and implementing it in these papers, the author has benefited greatly from suggestions and input from co-authors, and the author is grateful for their contributions (Nonhlanhla Dube, Stefan Gold, Gerald Reiner, Lysann Seifert, Taco van der Vaart and Luk Van Wassenhove).

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**Corresponding author**
Nathan Kunz can be contacted at: nathan.kunz@unf.edu
Social network analysis in humanitarian logistics research

Zhasmina Tacheva and Natalie Simpson
State University of New York, Buffalo, New York, USA

Abstract

Purpose – The purpose of this paper is to promote social network analysis (SNA) methodology within the humanitarian research community, surveying its current state of the art and demonstrating its utility in analyzing humanitarian operations.

Design/methodology/approach – A comprehensive survey of the related literature motivates a proposed agenda for interested researchers. Analysis of two humanitarian networks in Afghanistan demonstrates the use and utility of SNA, based on secondary data. In the second case study, the use of random graphs to detect network motifs is demonstrated using Monte Carlo simulation to create the benchmark null sets.

Findings – SNA is an adaptable and highly useful methodology in humanitarian research, quantifying patterns of community structure and collaboration among humanitarian organizations. Network motifs suggesting distinct affinity between particular agencies within humanitarian clusters are observed.

Research limitations/implications – The authors summarize common challenges of using SNA in humanitarian research and discuss ways to alleviate them.

Practical implications – Practitioners can use SNA as readily as researchers, to visualize existing networks, identify areas of concern and better communicate observations.

Social implications – By making SNA more accessible to a humanitarian research audience, the authors hope its ability to capture complex, dynamic relationships will advance understanding of effective humanitarian relief systems.

Originality/value – To the best of knowledge, it is the first study to conduct a systematic analysis of the application of SNA in empirical humanitarian research and outline a concrete SNA-based research agenda. This is also a currently rare instance of a humanitarian study using random graphs to assess observed SNA measures.

Keywords Humanitarian logistics, Research methodology, Social network analysis

Paper type Research paper

1. Introduction

Social network analysis (SNA) is a methodology well adapted to hyper-dynamic environments, with a capacity to assess, model and predict the behavior of complex adaptive systems (Choi et al., 2001). Humanitarian logistics is a domain challenged with the provision of urgent services in the face of dynamic demand, dependent on complex collaborations between multiple entities. While the potential of SNA to assist in research under such conditions is undeniable, such research is relatively scarce at the time of this writing. Related fields such as supply chain management (SCM) already recognize the value of SNA, evidenced by the growing number of studies using a network lens while advancing theory on supply chain complexity and archetypes (Bellamy and Basole, 2013). The purpose of this paper is to promote interest in the SNA methodology within the humanitarian research community, by demonstrating its ability to illuminate intangible connections in large-scale humanitarian endeavors. We begin with a briefing on SNA and its extension into the supply chain literature, followed by detailed review and synthesis of SNA-related humanitarian research to date. We follow with two case studies set in Afghanistan, using data from the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). Throughout decades of conflict impacting all aspects of life, one of the driving forces behind Afghanistan’s painstaking reconstruction has been the diverse body of non-state humanitarian actors among which OCHA is one of the most influential (West, 2017). The first and briefer case study demonstrates popular SNA metrics, while the second explores new ways to measure relationships between humanitarian agencies. These cases,
combined with our literature survey, motivate a proposed SNA-based humanitarian research agenda, to benefit anyone interested in applying this methodology to the study of humanitarian operations.

The remainder of this paper is as follows: in the next section, we outline the development of SNA research and its growth in SCM. This provides the theoretical foundation for Section 3, in which we discuss the state of extant SNA applications in humanitarian operations, including limitations encountered. To demonstrate both SNA’s current state-of-the-art and its promising opportunities for future research, the two case studies follow in Sections 4 and 5. In conclusion, we provide a summary of research gaps and potential directions to aid interested researchers and practitioners in their work with this exciting methodology.

2. Related literature

2.1 A brief history of social network analysis (SNA)

SNA emerged as an offshoot of graph theory, a branch of mathematics initiated by Swiss Scientist Leonhard Euler in the eighteenth century. This mathematical foundation was blended with a strong sociological element, originating in the work of Georg Simmel (Simmel, 1950), who first theorized social dynamics between individuals. The methodology was soon extended to the study of larger groups, organizational structures (Moreno, 1934) and entire societies (Travers and Milgram, 1967; Merton, 1957). The initial interest in patterns of affiliation led to what could be called the “second wave of SNA,” as configuration of social connections became formally defined as network embeddedness (Granovetter, 1985). At this juncture, sociologist Granovetter proposed the influential theory of weak ties: strong bonds of high frequency contact and/or close proximity tend to connect similar individuals, while weaker ties often denote bridges between otherwise disconnected communities, useful in diverse contexts (Granovetter, 1973). Another influential theory from this period is that of social capital (Coleman, 1987), the advantage of affiliation with a high density social network. Sociologist and Strategist Burt followed with an argument that the greatest benefit accrues to those who connect otherwise disconnected social entities, i.e. those who span structural holes, as opposed to those embedded in closed, highly connected networks (Burt, 1992).

One could argue that current SNA research has reached a third phase, an evolution into the broader domain of network science. Here focus shifts to whole networks, with increasing interest in areas such as network evolution, complexity, synchronicity and diffusion. While the theoretical foundations of these ideas date back many years, novelty arises from the statistical rigor now used to analyze them, made possible by recent advances in technology. As an example of SNA’s broadening applicability to real-life contexts, Barabási and Albert (1999) discuss the scale-free network, characterized by a few nodes whose connections greatly exceed the network’s average, observed in entities as diverse as the World Wide Web and biological networks. This new view of network structure has given rise to one of the central problems in SNA today, the identification of key influencers or smaller set of actors instrumental in propagating useful or harmful effects throughout a much larger network (Delre et al., 2010). Recent research suggests that weakly connected entities, traditionally thought insignificant, can in fact emerge as influencers of great consequence, superseding the best-connected actors by serving as more efficient conduits (Morone and Makse, 2015). With the rise of network science, several SNA software platforms have aided growth in related research (Otte and Rousseau, 2002). Among the most widely used in social science is UCINET (Borgatti et al., 2002), which combines an extensive variety of network concepts with empirical tests. Alternatives include Igraph for complex networks (Csardi and Nepusz, 2006), Cytoscape for biomolecular interactions (Shannon et al., 2003), Gephi for network visualization and dynamics (Bastian et al., 2009), and SNAP for very large networks (Leskovec and Sosič, 2016). Further fueling growth in the third phase of SNA
research is the emergence of social media platforms such as Twitter, Facebook and Instagram, which both exemplify many of the original theories of SNA, and provide massive data sets for empirical study (Lewis et al., 2008).

2.2 Social network analysis and supply chain management
A significant feature of the rise of network science was SNA's assimilation into numerous academic fields outside of sociology, some employing a macro-organizational perspective (Brass et al., 2004), and others repurposing social measures to study natural phenomena. Of those investigations still focused on human society, SNA research can now be categorized as interpersonal, intra-organizational or inter-organizational (Wittek, 2014). Perhaps no other application reflects the complex dynamics of inter-organizational networks better than SCM, a domain that emerged concurrent with the second phase of SNA research (Simchi-Levi and Kaminsky, 2008). Bellamy and Basole (2013) consider De Toni and Nassimbeni (1995) among the earliest SCM studies to adopt SNA's network analytic view, in a comparison of two manufacturing sectors. The clear distinction in SCM between actors and flows creates a context prime for SNA along several dimensions, including network structure, diffusion and evolution. Supply chain structure studies focus primarily on node-level metrics, to characterize the dynamics between organizations inside networks. Kim et al. (2011) emphasize the importance of social capital within organizations, while Gulati (1998) extends that concept to broader organizational alliances. Further SNA applications include investigations of technology adoption patterns (Greve, 2009), variations in productive efficiency (Kao et al., 2017), volume of innovation (Bellamy et al., 2014), innovation diffusion (Johnsen et al., 2006) and disruption and resilience in complex supply networks (Zhao et al., 2011; Kim et al., 2015). Despite this activity, there exists a distinct paucity of empirical studies that robustly demonstrate causal relationships between SNA metrics and SCM outcomes, which may be explained by the difficulty of studying these complex multi-echelon connections in their otherwise uncontrolled environments (Pérez Mesa and Galdeano-Gómez, 2015). Others argue that extrapolation of micro-theories of human behavior to the macro-organizational level is problematic, due to the idiosyncratic qualities of organizations (Galaskiewicz, 2011). While SCM is not exempt from these considerations, one particular branch of SCM is poised between human and supply networks, perhaps capable of leading the way in a reconciliation of their theoretical and practical differences. This branch is the emerging domain of humanitarian logistics.

3. Social network analysis in humanitarian logistics: the state of the art
The potential of humanitarian logistics with respect to SNA (and vice versa) lies in its powerful blend of community well-being with the constructs of commercial SCM, connecting two network-based worlds. SNA can provide valuable insight in both cases, and thus it is not surprising to find an extant body of recent humanitarian research employing this methodology (Table I). Most of this emerging research focuses on how network features relate to communication and coordination during an incident. In general, higher node-level centrality metrics are shown advantageous for both the procurement and diffusion of resources following a crisis, and the embeddedness of humanitarian organizations in the core of a network shown beneficial over its periphery. The metrics commonly cited in the second column of Table I are likewise popular in the study of non-humanitarian supply chains, and we will demonstrate several in our first case study.

On aggregate, Table I represents the vanguard in SNA applications to humanitarian contexts. As such, their combined observations on the methodology’s limitations provide insight for further work. Most challenges cited fall into one of three categories: obtaining an adequate sample, establishing the right amount and intensity of connections and finding accurate outcome data. Collectively, Table I research uses two primary means of gathering data – directly, through surveys and face-to-face interviews (Moore et al., 2003; Lai et al., 2017;
<table>
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<td>Curtis (2016)</td>
<td>Degree centrality</td>
<td>Organizations that could have been helpful to the relief effort were found to be isolated or peripheral to the response, suggesting that Hurricane Katrina was not just a natural disaster but also a communication crisis</td>
<td>Hurricane Katrina</td>
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<td>Degree centrality</td>
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<tr>
<td>Kim et al. (2018)</td>
<td>In-degree, out-degree, eigenvector and betweenness centrality</td>
<td>News agencies exhibited the highest in- and out-degree centrality among high eigenvector centrality actors during the disaster.</td>
<td>Storm Cindy</td>
</tr>
</tbody>
</table>
Sengooba et al., 2017) and indirectly, by analyzing secondary sources such as public media outlets, social media announcements, government documents and agency reports (Curtis, 2016; Kim et al., 2018; Kim and Hastak, 2018). Even when an exhaustive list of actors is available, reconstructing network ties among actors presents challenges. For direct data collection, cognitive biases, unreliable memories, subjective opinions or biases endogenous to survey research threaten the data’s validity (Fowler, 2013). Indirect collection methods can harbor pitfalls such as incomplete or inconsistent data and variations in the visibility of different humanitarian activities.

Even when an accurate network is constructed, data for operationalization of non-network variables may prove hard to get. In Table I, most studies use network measures such as centrality or density as independent variables, and one or more non-network factors such as cost efficiency (Urrea et al., 2016), beneficiary outcome (Moore et al., 2003), foreign aid allocation (Swiss, 2017) or relief communication (Álvarez and Serrato, 2013) as dependent variables. Such data are prone to missing values and often restrict statistical analyses to non-parametric methods, which do not allow for establishing causal relationships (Moore et al., 2003). Humanitarian researchers interested in SNA causal analysis with non-normally distributed data are advised to consider non-parametric causality testing techniques such as the non-parametric Granger causality test (Diks and Panchenko, 2006). Authentic network data also violate the assumption of random sampling; hence, ordinary statistical tests arguably produce biased results (Borgatti et al., 2002). Bootstrapping and permutation tests are strongly recommended, and are available through many SNA software platforms, including the quadratic assignment procedure as an option for both correlation and regression analysis in UCINET (Borgatti et al., 2002).

Reviewing the most popular SNA concepts evident in Table I confirms that extant SNA-related research in humanitarian settings is consistent with “second wave” SNA’s focus on node-level social capital (Borgatti and Foster, 2003), as opposed to the study of whole networks. This focus is also consistent with most SCM network-related research,

<table>
<thead>
<tr>
<th>Name</th>
<th>SNA concepts</th>
<th>Major findings</th>
<th>Humanitarian context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Han et al. (2018)</td>
<td>In-degree, out-degree, eigenvector and betweenness centrality</td>
<td>Top 10 in-degree, out-degree, and eigenvector centralities were individuals rather than organizations; organizations, however, had the highest betweenness centrality</td>
<td>2016 Louisiana flood</td>
</tr>
<tr>
<td>Lai et al. (2017)</td>
<td>Network evolution, density and configuration</td>
<td>Demonstrates the evolutionary process of an emergent disaster response community</td>
<td>2014 gas explosions in Kaohsiung, Taiwan</td>
</tr>
<tr>
<td>Swiss (2017)</td>
<td>In-degree centrality and global ties</td>
<td>Countries with higher adherence to world society norms are the beneficiaries of more aid relationships with donor countries</td>
<td>Official bilateral country aid relationships, 1975–2006</td>
</tr>
<tr>
<td>Ssengooba et al. (2017)</td>
<td>Core-periphery analysis and density</td>
<td>More connected organizations can be leveraged for faster communication and resource flow to boost the delivery of health services</td>
<td>Post-conflict northern Uganda</td>
</tr>
<tr>
<td>Vachette et al. (2017)</td>
<td>Bonding, bridging, and linking networks</td>
<td>Continuous relationship-building is essential for fostering inter-organizational connections during a crisis</td>
<td>Cyclone Pam</td>
</tr>
</tbody>
</table>

Table I.
where emphasis on actor-level measures persists, despite pointed calls for better understanding of whole supply networks (Singhal and Singhal, 2012). Limiting focus to this level has arguably stunted the development of supply network typology, and hindered better understanding of risk propagation, resilience, subgraph formation and network life cycles (Bellamy and Basole, 2013). This concern is also voiced elsewhere in network science, as recognition of self-organized networks should not preclude researchers from seeking underlying principles of controllability that could make self-organizing architecture better serve the network's purpose (Barabasi, 2019). In other words, just because many real-world networks emerge spontaneously and follow unique trajectories, does not mean they exclude common principles that could assist in maintaining the normal functioning of those networks. Ironically, these concepts are even more critical in humanitarian settings, where uncovering patterns such as the governing principles of humanitarian collaboration are critical to the success of these activities (Waugh Jr and Streib, 2006). This will be the particular focus of our second case study, exploring the measurement of affinity between organizations within an instance of the UN's Cluster Approach model to humanitarian operations.

4. Case study 1: examining population displacement in Afghanistan
We continue with a short case study to demonstrate network visualization and the application of those metrics most popular in the current literature. In that sense, this tutorial continues the discussion in the previous section, since it demonstrates the actor-level social capital orientation of the "second wave" of SNA research, the current lens of much of the extant humanitarian SNA-related research to date. The subject of analysis is conflict-induced population displacement between provinces in Afghanistan, from January 1 to August 20 of 2018. This provides the reader with an example of a directed network, one that embodies tangible movement. Throughout this briefing, we emphasize key terms from the parlance of network analysis in italics.

4.1 Data and methodology
For the tutorial, we collect network data directly from spreadsheets downloaded from the Humanitarian Data Exchange (HDX), an open data repository site at humdata.org (OCHA, 2018).

These reports provide all instances of conflict displaced persons in Afghanistan between January 1 and August 20 of 2018. The raw data are consolidated by province and converted to VNA format, a common input configuration for network software. UCINET and Netdraw are then used to analyze those files. As one of the most widely used SNA packages, UCINET is credited with facilitating and standardizing network analysis across many different research domains (Kok and Labadin, 2019; Freeman, 2004).

4.2 Results
4.2.1 Network visualization. Figure 1 provides a visualization of population displacement in Afghanistan during the first eight months of 2018. It embodies the SNA framework of systems as graphs (better known as networks), consisting of vertices and arcs (Johnson et al., 2001) and their meanings change with the application (Galaskiewicz, 2011). In Figure 1, the vertices (sometimes known as actors but better known as nodes) represent Afghan provinces, arranged according to their physical proximity on a map. The arcs (also known as links, edges or ties) represent the movement of displaced persons between those provinces. Links are visually weighted by the relative volume of migration, ranging from 50 people in the case of some links to over 9,000 people forced from the province of Faryab into neighboring Balkh. Node size reflects internal displacement within the province, known more generally as reflexive ties, those whose
origin and target nodes coincide (Wasserman and Faust, 1994). Figure 1 demonstrates how network visualization can render complex interactions in an easy-to-understand way, particularly the representation of multiple characteristics at once. Studies in domains as diverse as sociology, biology and information science have pointed to the potential of network visualization, provided it conforms to the principle of graphical excellence and contains meaningful information (Brandes et al., 2006; Royer et al., 2008; Moody et al., 2005).

Although accurate, Figure 1 does not take advantage of abstraction, in that geography dictates the placement of its nodes. In contrast, Figure 2 shows the same network, where the nodes have been “unpinned” from their map locations and rearranged by a force directed placement (FDP) algorithm, which treats nodes as analogous to physical bodies attached by spring-like bonds (Di Battista et al., 1994). This process is usually applied to an otherwise random arrangement, disentangling arcs to create a more intuitive network. In Figure 1, geographic location naturally provides some network esthetic, as provinces locate nearest those provinces with which they share links, because the links themselves represent the crossing of provincial borders. Both Figures 1 and 2 visually emphasize the provinces of Faryab, Kunduz and Ghazni through node size and multiple outgoing links, an emphasis that triangulates with media reports of ongoing Taliban attacks on the local population in these provinces during this period (Usmani, 2018a, b). However, the FDP algorithm provides further insight into this pattern of population displacement, relative to the map in Figure 1. Its simulated physics moves Kabul into the center of the graphic, clarifying its role in the convergence of multiple evacuations, while suggesting branching subsystems of evacuation in those areas farthest from the Kabul-based center. While nodes Hilmand and Nimroz are visually associated with Figure 1, they are widely separated in Figure 2, as FDP highlights the stark logistical separation created by the Hindu Kush mountain range, which effectively divides Afghanistan along most of its southwest/northeast diagonal axis. Readily generated
and intuitive, visualizations such as these can aid the processes of assessment and allocation, as well as assist in communication of humanitarian issues.

4.2.2 SNA metrics. SNA provides well-known metrics to express the nature of each node’s connectedness, such as the high in-degree centrality of the Kabul province in Figure 2. Table II provides a sample of node-level metrics for a selection of provinces.

<table>
<thead>
<tr>
<th>Province</th>
<th>Out-degree centrality</th>
<th>In-degree centrality</th>
<th>Degree centrality</th>
<th>Eigenvector centrality</th>
<th>Directed betweenness</th>
<th>Symmetric betweenness</th>
<th>2-step reach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Badghis</td>
<td>3</td>
<td>1</td>
<td>4</td>
<td>0.019</td>
<td>1</td>
<td>44</td>
<td>5</td>
</tr>
<tr>
<td>Baghlan</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>0.332</td>
<td>0</td>
<td>121.667</td>
<td>16</td>
</tr>
<tr>
<td>Balkh</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>0.212</td>
<td>0</td>
<td>118.833</td>
<td>9</td>
</tr>
<tr>
<td>Ghazni</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td>0.309</td>
<td>3</td>
<td>146.333</td>
<td>16</td>
</tr>
<tr>
<td>Hirat</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>0.017</td>
<td>0</td>
<td>14.5</td>
<td>5</td>
</tr>
<tr>
<td>Kabul</td>
<td>0</td>
<td>10</td>
<td>10</td>
<td>0.547</td>
<td>0</td>
<td>342.667</td>
<td>23</td>
</tr>
<tr>
<td>Parwan</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>0.116</td>
<td>0</td>
<td>12.833</td>
<td>7</td>
</tr>
<tr>
<td>Takhar</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0.04</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Zabul</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>0.118</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>

Table II. Node-level metrics corresponding to selected provinces in Figures 1 and 2

Notes: Network initially configured by the “graph theoretic” option, which employs an FDP algorithm to determine arrangement. Arcs are weighted by population movement between provinces; nodes are scaled by total displaced population in province.

Figure 2. Example output of SNA software Ucinet/NetDraw, illustrating movement of population displaced by conflict in Afghanistan, during the period 1 January to 20 August 2018.
Node-level metrics quantify various aspects of network structure around a node, such as the foundational concept of degree, the number of direct connections between the node and any other part of the network. Kabul’s centrality in the Figure 2 is due in large part to the fact that it has the highest degree of all the nodes, ten connections. As noted previously, all these connections represent inward flow, so Kabul’s in-degree centrality is also 10, while its out-degree centrality is 0. The value of any SNA metric to a researcher is driven by its ability to detect some useful “ground truth” specific to its application. Kabul’s combination of non-zero in-degree with zero out-degree is an earmark property of a region that serves exclusively as shelter from adversity in other provinces, and Table II indicates that provinces such as Balkh, Hirat and Parwan serve in that same role, although to a lesser magnitude. Having positive in-degree and out-degree centrality (movement of refugees both in and out of a province) is a relatively rare condition in this example, occurring in only 6 of the 34 provinces. In Table II, Badghis and Ghazni are two examples, and here we see that this condition is reflected in positive directed betweenness, meaning the nodes are intermediaries on a number of directed paths between other pairs of nodes, in a purely graphical sense. While Kabul has no such score, serving strictly as a destination, it possesses the highest scores on the popular undirected measures of eigenvector and symmetric betweenness centralities, as well as the greatest 2-step reach. Each expresses some dimension of a node’s embeddedness within the overall network structure, from the dramatic centrality of Kabul to the peripheral nature of a network pendant such as Takhar. Of the span of measures demonstrated in Table II, degree centrality and 2-step reach will play an important role in our exploratory study of affinity discussed next.

5. Case study 2: exploring affinity within two clusters of the humanitarian response in Afghanistan
In this section, we explore affinity between humanitarian agencies operating in Afghanistan, and demonstrate a new metric for its assessment. Originally framed as a tendency of people to affiliate with certain others, affinity has outgrown its sociological origins, boasting numerous applications to complex networks including biological and language processing (Ivarsson and Jemth, 2019; Pomeroy et al., 2018). Seeking its ability to uncover sub-community structures not readily apparent otherwise, we examine affinity by first analyzing the proximity of agencies operating on behalf of two UN-coordinated humanitarian clusters in Afghanistan. We then assess affinity through contrast of observed proximities with random “null models,” an important step in validation rarely witnessed in extant humanitarian research. This case study represents the third and most recent phase of SNA research, as it demonstrates network dynamics over time and evaluates whole networks as opposed to individual actors. Affinity is also an undirected relationship, illustrating a fundamental distinction in network theory (Wasserman and Faust, 1994) when compared with the first case study. Before we begin our analysis of proximity and affinity, it is helpful to review certain details concerning its context here.

5.1 The UN cluster approach model and the clusters under study
Coordinating separate organizations is central to successful humanitarian aid. In 2005, the UN undertook a major reform of this process, establishing the Cluster Approach model. The Cluster Approach divides a large-scale humanitarian effort into smaller communities of agencies, each focused on a particular sector such as health, food security or shelter. A lead agency provides coordination within each cluster, and any number of the 11 pre-defined
clusters may be active, according to the needs of the humanitarian crisis. The main function of the Cluster Approach is to provide a platform for communication between agencies for data collection, needs assessment and distribution of information (Stumpenhorst et al., 2011). Some reservations about its effectiveness have been expressed, such as the challenge faced by some practitioners to reconcile the multi-sectoral nature of their organizations with a single cluster (Clarke and Campbell, 2018). Overall assessment of the Cluster Approach has been positive, however, recognizing better coverage of humanitarian needs, reduced duplication of effort and stronger partnerships among local actors (Steets et al., 2010). Arguably, the model can operate in two different modes, a command-and-control-like structure or a more organic approach, the distinction being the difference between cluster members “being coordinated” vs “coordinating” in the provision of services (Clarke and Campbell, 2018; Saavedra and Knox-Clarke, 2015). Surveys indicate that in practice, cluster members are more likely to follow the latter strategy, an approach largely consistent with adaptive practices common to emergency management (Clarke and Campbell, 2018). In the context of system dynamics, such emergent processes entail dynamic complexity, a characteristic of humanitarian logistics which requires rigorous study to improve understanding of how to design and manage such operations in the future (Gonçalves, 2008).

Of the six clusters currently operating in Afghanistan, we select two for detailed analysis: the Health cluster and the Water, Sanitation and Hygiene (WASH) cluster. We collect data on all agencies within each cluster with some degree of operating presence across the 399 districts of Afghanistan, as reported quarterly from the start of 2015 through the third-quarter of 2018. We first calculate geographic proximity between cluster agencies, and use this data to demonstrate dynamic network analysis. We then propose a new metric for detecting affinity between agencies from proximity data, which we use to contrast the Health and WASH clusters.

5.2 Data and methodology
Raw data are provided by quarterly reports of Who-Does-What-Where (3W), downloaded from HDX at humdata.org. We collect 3W reports from the first quarter of 2015 through the third-quarter of 2018, to serve as input files for a program written in VBA. This program extracts information on a target cluster and calculates proximity, which we define as instances in which agencies are working on behalf of the same cluster in the same district. Such operations may not necessarily be located in the same community, but average district size in Afghanistan suggests most co-located operations are within 30 km of one another. As outputs, the program reports pairwise instances of co-location between all combinations of cluster members, writes VNA format files for generating proximity networks in Netdraw, and provides basic node-level metric reporting. Detecting affinity in proximity data requires random replications of authentic proximity networks, discussed in detail in Section 5.3.2. Monte Carlo simulations provide the random results, in spreadsheets that mimic the structure of the original 3W reports, to enable analysis in the same manner as the original data. A second VBA program reads proximity reports of both authentic and random instances and creates numerical matrices visible as heat maps in Section 5.3.2.

5.3 Results
5.3.1 Early results: proximity and network churn. Figure 3 provides a visualization of proximity within the Health cluster in Afghanistan in the third-quarter of 2018. Each node represents an agency, scaled in size to reflect the number of districts in which that agency maintained an operating presence. The links between nodes represent proximity, the condition of agencies operating in the same districts. Interestingly, the data used in the generation of Figure 3 indicate that 38 per cent of all operations in the Health cluster were
alone in their respective districts. In light of this, Figure 3 underscores the value of visualization, by revealing only one true isolate in this network, or agency that operated alone in all its districts. In other words, while members of the Health cluster operated alone in many instances, those that did operate alone almost invariably operated in close proximity to other cluster members in some other part of their service areas.

The value of network science does not stop at describing the present state of the network, but can assist in prediction of its future development, including the changing of participants commonly known as network churn (Sasovova et al., 2010). Predicting future changes begins with study of historical data, such as the four “snapshots” of the Health cluster proximity network in Figure 4, and the same networks as they relate to the WASH cluster in Figure 5.

Visual inspection of Figures 4 and 5 suggests some differences in the evolution of these two clusters over a three-year period. Figure 4 suggests that the Health cluster has declined somewhat in the number of actors, and dramatically in terms of these agencies’ proximity to one another, apparent from the lower density of connections in the most recent proximity graph. In contrast, WASH cluster networks in Figure 5 are somewhat smaller and more homogenous, with no drastic changes in size or density apparent in comparison of 2015–2018. Table III provides underlying data on network size and churn across this time line.

In Table III, the mean values across the full time series reveal another interesting feature: while both clusters experience surges in agency entrances and exits, these numbers nearly balance when averaged across the three-year interval. This indicates both clusters cycle in size, centered on a less dramatic trend toward contraction over three years. At this point, a natural next step in network analysis would be to search for potential drivers of this cyclic churn. Figure 6 begins that exploration, plotting the proportion of cluster size change against data introduced in our first case study, the number of people displaced by conflict in Afghanistan each quarter. Here the cycles in
magnitude of operating presence are apparent, and they do appear to respond to surges in displacement in the last quarters of 2016 and 2017. This pattern evokes the ground truth of greater need for cluster services in the wake of such events, although it is likely that multiple factors drive cluster churn. For example, the precipitous drop in Health cluster size in the last quarter of 2017 was likely exacerbated by October 2017 attacks against humanitarian workers that closed Red Cross field offices in the Faryab and Kunduz provinces, and/or December 2017 clashes with the Taliban that also threatened the security of humanitarian staff in northern Afghanistan. While Figure 6 suggests resurgence of cluster size in early 2018 may be response to the needs of those displaced by the 2017 conflicts, the rapid expansion of the Health cluster in particular is likely
at least partially related to a wave of poliovirus cases that emerged that previous December (USAID, 2017).

5.3.2 Evaluating affinity between agencies through random graphs. While visualization in the previous section offers interesting observations of network churn, it does not confirm that the proximity observed reflects genuine affinity between co-located agencies. If present, affinity between cluster members would be the driver of one or more network motifs within Figures 4 and 5, or significant patterns of interconnection specific to the networks under investigation (Milo et al., 2002). Apart from social networks, affinity-oriented motifs have been demonstrated in a variety of non-human networks ranging from protein interaction

![Graph showing percentage changes in Health and WASH cluster sizes in Afghanistan, compared with the total number of people displaced by conflict in the same period](image)

Table III. Network churn in the Health and WASH clusters

<table>
<thead>
<tr>
<th></th>
<th>Health cluster</th>
<th>WASH cluster</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of agencies at start of quarter</td>
<td>Entrances/ exits during quarter</td>
<td>% change in no. of agencies (%)</td>
</tr>
<tr>
<td>Q1 2015</td>
<td>53</td>
<td>4/2</td>
</tr>
<tr>
<td>Q2 2015</td>
<td>55</td>
<td>9/7</td>
</tr>
<tr>
<td>Q3 2015</td>
<td>57</td>
<td>2/7</td>
</tr>
<tr>
<td>Q4 2015</td>
<td>52</td>
<td>4/5</td>
</tr>
<tr>
<td>Q1 2016</td>
<td>51</td>
<td>1/4</td>
</tr>
<tr>
<td>Q2 2016</td>
<td>48</td>
<td>2/3</td>
</tr>
<tr>
<td>Q3 2016</td>
<td>47</td>
<td>0/0</td>
</tr>
<tr>
<td>Q4 2016</td>
<td>47</td>
<td>1/3</td>
</tr>
<tr>
<td>Q1 2017</td>
<td>45</td>
<td>7/1</td>
</tr>
<tr>
<td>Q2 2017</td>
<td>51</td>
<td>10/2</td>
</tr>
<tr>
<td>Q3 2017</td>
<td>59</td>
<td>2/19</td>
</tr>
<tr>
<td>Q4 2017</td>
<td>42</td>
<td>2/1</td>
</tr>
<tr>
<td>Q1 2018</td>
<td>43</td>
<td>1/1</td>
</tr>
<tr>
<td>Q2 2018</td>
<td>43</td>
<td>2/0</td>
</tr>
<tr>
<td>Mean quarterly value</td>
<td>49.5</td>
<td>3.4/3.9</td>
</tr>
</tbody>
</table>
networks to webpages on the internet (Voevodski et al., 2009; Li and Horvath, 2009). In general, the process of motif discovery involves comparison of an existing network with a series of randomized graphs, where the motif is detected as a pattern occurring more frequently in reality than in the random instances (Milo et al., 2002). We now propose to apply this process of motif discovery to evaluate affinity among the Health and WASH cluster members.

Random graphs were first introduced in the 1950s as a mathematically tractable means of analyzing complex networks (Barabási and Albert, 1999), and have since become the preferred benchmark for in-silico validation of network topology and structure observed in existing systems (Schaffter et al., 2011). Their value depends on their ability to hold salient characteristics of the original network constant, creating a “null model” of the original system (Silva et al., 2017). In the case of the Health and WASH clusters, we create null models that preserve each node’s identity, the relative magnitude of its collective operations and the observed needs of each district in Afghanistan. When compared to actual data, a null model allows us to recognize what portion of proximity could be the natural result of the size of the agencies in question. In this study, each null model consists of ten random replications of a particular proximity network at a particular time. To generate a random replication, the following values are required for every agency \( j \) and every district \( i \):

- \( s(j) \) is the total number of operations provided by agency \( j \) across all districts.
- \( d(i) \) is the total number of operations in district \( i \) across all agencies.

Each random replication is the result of a Monte Carlo simulation in which \( d(i) \) is fixed for each district, derived from original cluster data in that time period. To determine who is operating where, agencies are chosen randomly with a probability that reflects their overall contribution to the existing network, or \( s(j)/\sum_i d(i) \) for a given agency \( j \). The simulation enforces the condition that an agency is not assigned to a district two or more times, by replacing any redundant random draw with another random draw that meets that condition. Figure 7 illustrates the most recent WASH cluster network in our data set, contrasted with three of its random replications.

Figure 7. Third-quarter 2018 WASH cluster proximity network with three random replications of same
Examination of Figure 7 suggests that the random replications possess greater density of connections, as mean degree centrality appears to be higher. This is an early suggestion of affinity in the actual cluster, in that distribution of the same operating instances across the same districts at random is creating greater diversity of co-located operations, a heterogeneity of proximity that highlights the presence of at least some habitual co-location partners in the upper-left network. Degree centrality is a well-known node-level metric introduced in our first case study, and it returns here to express the number of different agencies that a fellow cluster member would likely be familiar with, due to co-located operations in one or more districts. Table IV reports several whole network measures including mean degree centrality, for both clusters and their corresponding null models, in the earliest and the most recent quarters of this data set. In each of the four cases, the mean degree centrality of the actual proximity network is less than the mean value of the null model, confirming our visual impression of Figure 7. To explore one potential consequence of that distinction, Table IV also reports the mean 2-step reach within each of the eight cases. 2-step reach centrality is another node-level metric introduced in the first case study, stated here as the proportion of the network a target node can “reach” through paths of up to two links. Restated, this measure tallies direct connections and “friends of friends,” an expression of the weak ties first discussed to Section 2.1 as potential bridges between groups. Reach centrality can represent the potential for information diffusion, particularly in terms of referrals, as in “[...] I can’t assist you with that, but I know someone who probably can[…]” Indeed, SNA research has demonstrated that in certain contexts, “friends of friends” ties constitute an important relational resource which may prove more useful to focal nodes than their immediate

<table>
<thead>
<tr>
<th></th>
<th>Q1 2015</th>
<th>Q3 2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health cluster</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolates</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>% of operations alone in district</td>
<td>44.5%</td>
<td>37.6%</td>
</tr>
<tr>
<td>% of districts where cluster is present</td>
<td>93.7%</td>
<td>54.9%</td>
</tr>
<tr>
<td>Mean degree centrality</td>
<td>9.5</td>
<td>5.9</td>
</tr>
<tr>
<td>Mean 2-step reach (% of network)</td>
<td>75.4%</td>
<td>44.3%</td>
</tr>
<tr>
<td>Random Health clusters*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Isolates</td>
<td>5.5</td>
<td>2.8</td>
</tr>
<tr>
<td>% of operations alone in district</td>
<td>44.5%</td>
<td>37.6%</td>
</tr>
<tr>
<td>% of districts where cluster is present</td>
<td>93.7%</td>
<td>54.9%</td>
</tr>
<tr>
<td>Mean degree centrality</td>
<td>10.2</td>
<td>8.4</td>
</tr>
<tr>
<td>Mean 2-step reach (% of network)</td>
<td>67.5%</td>
<td>69.3%</td>
</tr>
</tbody>
</table>

|                  |         |         |
| WASH cluster     |         |         |
| Isolates         | 7       | 1       |
| % of operations alone in district | 41.3% | 26.6% |
| % of districts where cluster is present | 39.6% | 38.1% |
| Mean degree centrality | 3.5 | 6.1 |
| Mean 2-step reach (% of network) | 36.4% | 64.3% |

| Random WASH clusters* |         |         |
| Isolates             | 4.2     | 1.1     |
| % of operations alone in district | 41.3% | 26.6% |
| % of districts where cluster is present | 39.6% | 38.1% |
| Mean degree centrality | 4.9  | 8.2    |
| Mean 2-step reach (% of network) | 59.5% | 82.6% |

Table IV. Network properties of the real vs random proximity networks

Note: *All values are the means of ten random replications of agency assignment to district requirements.
All locations of all existing operations were determined at random. In this study, we estimate pairwise comparisons between nodes. For clarity, these maps include only the figures. 8 and 9 display these differences as heat maps, a useful format for surveying jk connections (Bian, 1997). One compelling feature of the affinity suggested by restricted degree centrality in the actual networks is the distinct drop in 2-step reach in three of the four scenarios. As an example, if district assignments were determined at random within the Health cluster in 2018, any given agency would be, on average, within one referral of 54.9 per cent of the entire cluster membership, whereas the actual arrangement of operations provides that accessibility at mean of 44.3 per cent. Only the Health cluster at the start of 2015 provides a scenario in which random mean 2-step reach is narrowly higher than the actual network.

Table IV supports the notion of some affinity present in at least three of the four scenarios. To gain further insight into its source, to understand why Q1 2015 for the Health cluster may be an exception, we return to the node-level. Within a target cluster at a given period in time, let us define two further parameters:

- \( \alpha_{jk} \) is the count of co-located operations between agency j and k.
- \( \tilde{z}_{jk} \) is the count of co-located operations that occur naturally, given \( s(j), s(k), \) and \( d(i) \) for all districts i.

Parameter \( \tilde{z}_{jk} \) reflects the degree to which we would expect agencies j and k to overlap given all locations of all existing operations were determined at random. In this study, we estimate \( \tilde{z}_{jk} \) using the mean \( \alpha_{jk} \) observed in the appropriate null model. Affinity between agencies j and k is expressed in the strict difference between the actual and random proximity instances, or:

\[
\alpha_{jk} - \tilde{z}_{jk}.
\]  

Figures 8 and 9 display these differences as heat maps, a useful format for surveying pairwise comparisons between nodes. For clarity, these maps include only the “major players,” or the 15 largest agencies in terms of number of operations.

At first glance, comparison of Figures 8 and 9 would suggest that the Health cluster is host to a significant network motif consisting of both positive affinity among some agencies and its opposite, a notable lack of affinity between some pairs. In contrast, the WASH cluster would appear to have fewer features. However, it is difficult to judge the significance of these particular values without further context, which motivates our proposed Affinity Index, normalizing expression (1) by the overall size of the smaller agency. Restated, for any agency j and k, let:

\[
A_{jk} = \frac{\alpha_{jk} - \tilde{z}_{jk}}{\min(s(j), s(k))}
\]  

Figure 8. The difference between actual instance of co-location and the mean of random occurrences of same, between the 15 largest agencies in terms of Health cluster operations.
Figure 10 provides Affinity Index heat maps corresponding to the Health cluster scenarios in Figure 8. Here we see the dramatic departures from random originally visible in Figure 8 reduce when taking variation in agency size into account. Distinct affinities within the Health cluster persist, however, as indicated by the remaining heat map cells with darker backgrounds. Indeed, two pairs of agencies clearly visible in Figure 10 (OCCD and BDN and CAF and BARAN) are the likely cause of most of the observed paucity of overall 2-step reach in the Q3 2018 proximity network. Here each participant within a pair invests most instances of co-location with the other participant, to the exclusion of the remaining actors in the network. Although seemingly dramatic instances of non-affinity in Q1 2015 appear to fall away upon normalization, one motif that emerges is the widespread occurrence of a moderately negative affinity score between most of 15 largest agencies. This indicates that each of these larger agencies frequently has one or two less than expected instances of co-location with other large agencies, a collective deficit apparently invested in smaller agencies or in opportunities to operate alone. In this context, both investments enhance the internal connectedness of the network, at which point we return to the observation that this was the only scenario in Table IV in which the actual proximity network had a greater 2-step reach than its random counterparts.

Figure 11 provides the equivalent Affinity Index values for the WASH cluster, corresponding to the absolute differences in Figure 9. The WASH cluster is somewhat smaller than the Health cluster and contains a greater concentration of operations in its two largest agencies, apparent earlier in the scaling of node size in Figures 5 and 7.
When affinity is normed in this context, most of the significant features of Figure 9 persist, in contrast to the same comparison on behalf of the Health cluster. We note at this point that the ground truth of significant affinity could be genuinely “social,” as a pair of agencies may have a distinct preference for operating in each other’s vicinity. Factors that could motivate such a preference include previous experience, cooperative agreements and/or a propensity for collaboration. However, a significantly positive Affinity Index score does not necessarily mean two agencies prefer proximity to one another, but may also detect preference for a third factor. One example would be a shared preference for operating across adjacent districts, so co-location in one district implies higher likelihood of co-location in the neighboring districts. Another factor might be preference for a specific type of project, consistently drawing two agencies into the same districts where that particular need arises.

6. Conclusions and future research directions

Interactions among humanitarian actors are crucial to humanitarian response and research. However, their structure has received limited attention in quantitatively rigorous empirical research. Although SNA is not a new methodology, its use in humanitarian research is still sporadic. Extant empirical studies have treated humanitarian systems primarily as static snapshots, despite their distinctly dynamic nature. SNA can frame important humanitarian issues, by adapting existing SNA concepts to humanitarian contexts, as demonstrated in our first case study; or by introducing humanitarian-specific metrics, such as the Affinity Index proposed in our second case study. Among its many benefits, this methodology can detect salient network motifs in humanitarian data, which may then be used to quantify collaboration and assess its outcomes.

However, challenges remain for SNA research in humanitarian research. Following a framework adapted from Jones and Faas (2016), we organize observations from our literature review along four dimensions in Table V, to present both research gaps and potential future directions.

The highly dynamic character of humanitarian operations is driven by its myriads of different actors, the temporality of its supply structures, and the immense scope of potential disaster (Jahre et al., 2009; Kovács and Spens, 2009). As such, both humanitarian operations and supporting research should be open to influence, but cannot be scripted. SNA is a methodology that welcomes complexity and offers easy-to-implement ways to analyze and quantify it. This paper provides a subset of the possible paths humanitarian researchers might explore with SNA; the rest remains ready for discovery.

![Figure 11. Affinity index ($A_{ij}$) values as measured between the 15 largest agencies in terms of WASH cluster operations](image)
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**Table V. Research gaps and directions**

**References**


Corresponding author
Zhasmina Tacheva can be contacted at: zhasmina@buffalo.edu