Assessing humanitarian supply chain operations in the aftermath of the Kermanshah earthquake

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Abstract

Purpose – The main objective of this study is to consider how to benefit efficiently from the significant potential of humanitarian operations by individuals. For this purpose, this study aims to assess failure factors in humanitarian supply chain operations after the Kermanshah earthquake considering the role of all parties, focusing on individuals who did not wish to work with formal organisations on the whole. In the aftermath of the Kermanshah earthquake, which occurred on 12 November 2017, improvised groups of Iranian civilians from all over the country played an important role in humanitarian supply chain operations as individuals. Although most of these groups sincerely intended to help the affected society, victims could not benefit properly from these significant potential humanitarian actions. On the contrary, these potential actions caused some issues during humanitarian operations, such as blocking roads, inappropriate last-mile distribution, wasting resources and so on.

Design/methodology/approach – This research study considers mixed methods, including an on-site survey, semi-structured interviewing and a questionnaire designed for statistical analyses. The analysis included 140 responses to the questionnaire, semi-structured interviews with 32 affected families, interviews with 5 emergency managers from the Housing Foundation of the Islamic Republic of Iran and on-site survey reports.

Findings – This study presents a framework for humanitarian supply chain management to deal with future disasters in the same area or areas with similar characteristics to the case study. In general, the results of this study demonstrate that the nature of humanitarian supply chain operations makes it impossible to consider that these operations are free of challenges. However, several influential factors, such as training humanitarian actors and integrated management, might considerably increase the efficiency of humanitarian operations by individuals.

Originality/value – This study highlights the influential factors of inappropriate humanitarian operations by individuals, derived from an analysis of the Kermanshah case and literature review. The authors suggest a framework to benefit from the significant potential of individuals with wide-ranging experiences and proficiency, for future cases similar to the case study.

Keywords Humanitarian supply chain management, Humanitarian logistics, Humanitarian operations by individuals, Kermanshah earthquake

Paper type Research paper

Introduction

On average, each year, natural disasters affected 218 million people between 1994 and 2013, causing approximately 68,000 deaths (UNISDR, 2015). The considerable number of victims caused by combinations of natural hazards and human errors demonstrates the need to look specifically at post-disaster actions. Najafi *et al.* (2013) declared that the essential activity in the aftermath of disasters is logistics, including the affected people and commodity logistics. Furthermore, logistical

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activities may be the most expensive of all relief operations (Van Wassenhove, 2006). Indeed, it should be highlighted that almost all emergency response sections, such as initial needs, medical aid, accommodation provision and debris removal, depend on logistics activities. Additionally, humanitarian logistics may be the most important factor in the speed of humanitarian operations (Kovács and Spens, 2007).

Humanitarian logistics can be a highly critical issue because of many factors arising from post-disaster situations. For instance, there is no true demand in humanitarian logistics, as the affected population has no choice (Kovács and Spens, 2007). Furthermore, many actors with different responsibilities, missions and expertise are involved in humanitarian logistics (Balcik *et al.*, 2010), which might be problematic. This problem might escalate when several donors, such as non-governmental organisations (NGOs), private organisations and sectors, and individuals act independently, with little coordination (Heaslip *et al.*, 2019).

According to Van Wassenhove (2006), donors put pressure on humanitarians to pledge sufficient distribution of aid and goods, which have been provided for the victims, as well as monitoring all activities transparently. In this regard, if the humanitarian and distributor organisations cannot satisfy donors, regardless of the reason why, then donors might get involved individually and directly in all sections of humanitarian supply chain operations without working together. Furthermore, this disaster-aftermath situation may lead to corruption (Maxwell *et al.*, 2012). To overcome this issue, Balcik *et al.* (2010) and Scheidlinger (1991) suggest an umbrella organisation concept, which could help organisations coordinate properly. However, in some cases, aid agents, especially individuals, prefer to work independently, even when an umbrella organisation exists.

On the one hand, individuals participating in humanitarian operations independently might lead to chaos. On the other hand, participation from individual actors in humanitarian operations could bring many advantages. In this regard, it should be mentioned that large-scale humanitarian and governmental organisations usually struggle with issues that individuals do not (McLachlin and Larson, 2011). For instance, large-scale actors are bound to high transparency, media, limiting regulations, etc., which might prolong activities and incur more bureaucratic processes (Lynch, 2010). Furthermore, it might be impossible for governments to act alone to rise above problems in the wake of disasters, and consequently, NGOs and individuals are required to help (Benson *et al.*, 2001; Kumar *et al.*, 2009; Scanlon *et al.*, 2014; Sheu and Pan, 2014). Therefore, a suitable infrastructure should be prepared to make use of the considerable potential of any type of humanitarian aid. Although not enough research has studied the emergency logistics issue (Sheu and Pan, 2014; van der Laan *et al.*, 2016; Van Wassenhove and Pedraza Martinez, 2012), the number of research projects in this area is growing (Caunhye *et al.*, 2012; Kovács and Spens, 2007; Kovács *et al.*, 2019).

According to Maghsoudi and Moshtari (2021) and Safarpour *et al.* (2020), the aforementioned problems related to unsuitable humanitarian supply chain operations, especially because of insufficient actions by individuals, arose in the aftermath of the Kermanshah earthquake, which hit on 12 November 2017, with a magnitude of 7.3 and depth of 18.1 km (Mahani and Kazemian, 2018). Many Iranian civilians, as individuals, were independently involved in humanitarian logistics in the affected areas. However, according to Fernandez *et al.* (2006), "convergence" is a normal phenomenon and nothing new; lack of coordination between humanitarian actors (formal organisations and individuals) was one of the main problems in the wake of the Kermanshah earthquake (Peyravi *et al.*, 2019). This situation led to several issues, such as road blockages, inappropriate and unfair supply distribution, lack of coordination between supply and demand, wasting resources, garbage and so on (Maghsoudi and Moshtari, 2021). Meanwhile, huge donations, both monetary and in-kind, could have helped the affected society further. In general, increasing the efficiency of humanitarian logistics could save more lives and reduce suffering (Tatham *et al.*, 2017; Yadav and Barve, 2015).

In this regard, the main objective of this research study is to explore how affected people might benefit efficiently from the potential power of humanitarian aid, especially from individuals, regarding the Kermanshah humanitarian operations, including strengths, weaknesses and outcomes. In other words, as humanitarian supply chain operations by individuals were run based on minimum collaboration, mainly because of a lack of trust (Maghsoudi and Moshtari, 2021), this current research study intends to suggest a relatively urgent solution to overcome the problem. Although fundamental long-term solutions to this problem must be devised by experts from different fields (e.g. humanitarian supply chain management, social science and politics), this paper suggests a medium-term solution. It follows this strategy for two main reasons:

1 lack of expectation that public trust will be restored in a short time; and
2 many potential individuals are considered indispensable for upcoming events unless public trust can be restored.

In this regard, this research study intends to reveal the capacity, challenges and influential factors of humanitarian operations by individuals, considering the specific conditions of the case study. Finally, this study suggests a new framework, based on a combination of literature review and data analysed in the case study, to make the most of the maximum potential of individuals. It should be emphasised that *individual* is a term used in this paper referring to all helpers (individuals and private organisations), who were not affiliated to any formal organisations or agencies involved in the Kermanshah case. *Individual* as a term in this research study takes on the total or partial meaning of several terms used by other experts, such as spontaneous volunteers, informal volunteers, unaffiliated volunteers, private donors or ordinary citizens. Additionally, this research study considers operations by individuals during the response and recovery phases, considering all individuals' roles (cash, time and in-kind) categorised by Urrea and Pedraza-Martinez (2019). Furthermore, although there is a difference between the terms *logistic* and *supply chain* (Overstreet *et al.*, 2011), these terms are used interchangeably in this research study. Moreover, *respondent* refers to all individuals who answered the questionnaire. It should be highlighted that *displaced people* (*DP*) refers to those who lost

their homes because of the disaster; and *affected people* refers to anyone affected by the disaster somehow.

The remainder of this paper is divided into five parts:

1 methodology;
2 definition of humanitarian supply chain operations, focusing on humanitarian operations by individuals (literature review);
3 a case study considering the humanitarian operations in the aftermath of an earthquake in Kermanshah, a city in western Iran, in 2017, based on the on-site survey and interviews;
4 review and questionnaire results; and
5 findings, proposed approach and conclusions.

Methodology

This study intends to achieve the main objective by considering challenges, factors and solutions for suitable humanitarian operations by individuals based on comparing international experience against the local case study, as shown in Figure 1. In general terms, this research study collected and analysed data from three different channels (emergency managers, DP and individuals), which is called *local experience*, and then matched the findings against results from previous related studies, otherwise known as *international experience*, to follow quality criteria introduced by Halldórsson and Aastrup (2003).

An extensive literature review was run to obtain international experience regarding humanitarian operations by individuals. Furthermore, the initial analysis was based on the strengths, weaknesses, opportunities and threats (SWOT) technique (Ghazinoory *et al.*, 2011; Helms and Nixon, 2010), implemented on specifying features of humanitarian operations by individuals. In this technique, strengths and weaknesses are often based on internal factors, while opportunities and threats usually consider external aspects.

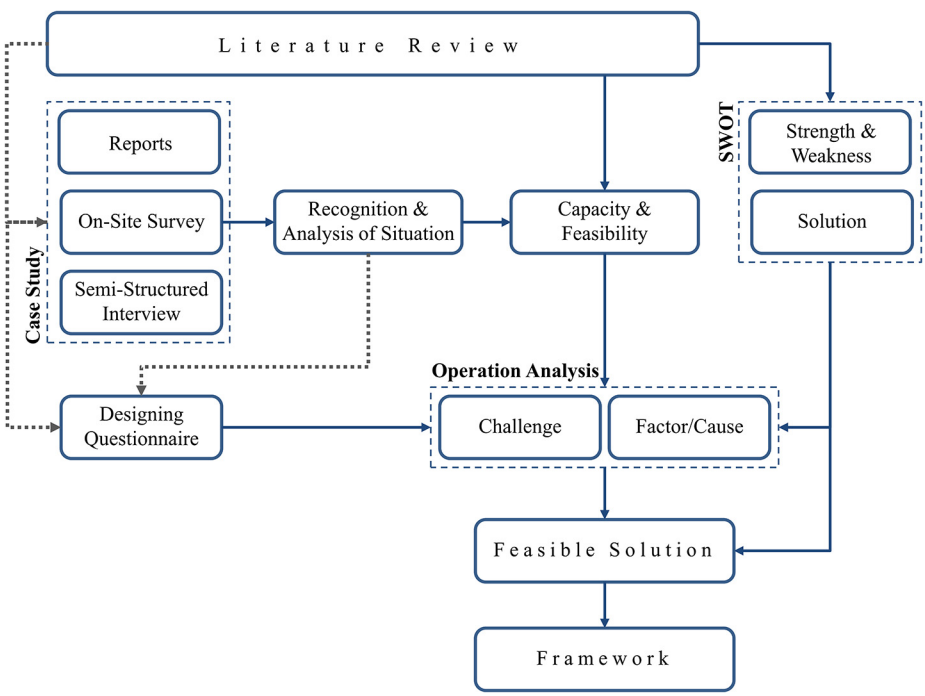
The local experiences and conditions are derived from exploring a case study assessment based on mixed methods, including information from technical reports, surveys and interviews, as shown in Figure 1. The authors of this research study had followed emergency responses and recovery processes through on-site observations starting five days after the event up until when this paper was written.

The local experience part could be divided into two sections, which introduce the humanitarian supply chain operations aftermath of the Kermanshah earthquake based on different perspectives depending on who was involved. *Section I* depicts the humanitarian supply chain operations, including challenges, local requirements and possible potentials; interviewing DP and emergency managers (see information of *Section I* in Appendix 1). *Section II* mainly focuses on humanitarian operations by individuals, considering their actions and capabilities (see information of *Section II* in Appendix 2).

In *Section I*, a total of 32 families accommodated in post-disaster temporary sheltering and housing since the aftermath of the earthquake were interviewed to consider humanitarian operation challenges from DP's point of view. These families were asked about wide-ranging issues related to disaster management, including humanitarian operations, based on two funds from the Centre for Development Cooperation of Polytechnic University of Catalonia. Additionally, five interviews were held with managers from the Housing Foundation of the Islamic Republic of Iran (HFIR), which was introduced as a lead organisation by the Iranian Government in the Kermanshah case.

Chain or snowball criterion concepts were used to select the interviewees, where the first interviewee is usually chosen in a

Figure 1 Methodology for considering humanitarian operations in the aftermath of the Kermanshah earthquake



straightforward way (Biernacki and Waldorf, 1981). Subsequently, according to Eisenhardt (1989) and Yin (2009), in the qualitative research by interview, the interviewees are asked to suggest other candidates help the research process. Selection should be guided by the diversity and the potential of the cases to contribute to the research objectives rather than being taken at random. After 37 interviews (5 managers and 32 displaced families), theoretical saturation (Eisenhardt, 1989; Yin, 2009) was obtained, which means that a pattern had been identified and each new case makes a proportionally smaller contribution to the investigation.

In *Section II*, a questionnaire and semi-structured interviews were designed based on the literature reviews and case study assessment. The questionnaire was designed to collect information about humanitarian supply operations by individuals and to assess the roles of these actors in the outcomes achieved in the Kermanshah case. The questionnaire includes three sections:

1 the respondents' familiarity with humanitarian operations;
2 respondents' humanitarian activities in the aftermath of the Kermanshah earthquake; and
3 respondents' ideas and knowledge on improving humanitarian aid operations (Appendix 2).

The questionnaire was sent to 220 individuals involved in humanitarian operations. Overall, more than 170 individuals sent back responses to the questionnaires. In this part (Sections I and II), the grounded theory, which was already used in the field of disaster management (Hosseini *et al.*, 2020), is applied to derive hypotheses from the primary and secondary data (Glaser, 2017). The grounded theory was applied as a systematic methodology to build ideas and connect the collected data to the existing results of other cases derived from the literature review. These ideas were taken into account to achieve adequate coordination and, consequently, efficiently make the most of individuals' potential in situations of mistrust.

In the last part of this study, based on matching findings from both main parts (local and international experiences), an approach is proposed to increase the efficiency of humanitarian operations by individuals for future cases with similar characteristics to Kermanshah.

Humanitarian supply chain operation

Van Wassenhove (2006) defined the term *logistics* from a humanitarian point of view as processes related to mobilising people, resources, skills and knowledge to assist the affected population. Humanitarian logistics take into consideration of delivering humanitarian goods and services to meet basic human needs most efficiently and responsively (Beamon and Balcik, 2008; Nurmala *et al.*, 2017). According to Caunhye *et al.* (2012), Leiras *et al.* (2014), Negi and Negi (2020), Özdamar and Ertem (2015), Sigala and Wakolbinger (2019), Thomas and Mizushima (2005), van der Laan *et al.* (2016) and Van Wassenhove and Pedraza Martinez (2012), humanitarian logistics embrace all managerial and operational activities related to supply and delivery of goods and materials to affected areas, debris collection and transportation of casualties and affected population. Humanitarian logistics, from disaster relief to the regional development process, aim to reduce suffering and death among the affected population (Balcik *et al.*, 2008; Kovács and Spens, 2007).

However, humanitarian logistics face more challenges than their commercial equivalent (Sheu and Pan, 2014). According to Balcik *et al.* (2010), Charles *et al.* (2016), Dube *et al.* (2016), Fernandes *et al.* (2016), Holguín-Veras *et al.* (2012), Kovács and Spens (2009), Van Wassenhove and Pedraza Martinez (2012) and Van Wassenhove (2006), challenges for the humanitarian supply chain could be categorised as follows:

- number of stakeholders;
- uncertainties (e.g. information, unknown and dynamic demand and supply, volunteers' knowledge and infrastructure);
- physical or geographic environments damage because of disasters;
- transportation problems (e.g. vehicle availability and available network);
- poor security;
- unsuitable coordination and collaboration;
- expenses; and
- high pressure (e.g. time pressure, politician, donors and media).

In this regard, some researchers, such as Battini *et al.* (2014), assessed the impacts of humanitarian logistic characteristics on last-mile distribution.

Some of these challenges might escalate when individuals are involved in humanitarian supply chain operations (Fernandez *et al.*, 2006; Korff *et al.*, 2015). Additionally, this could lead to other challenges, such as:

- an increase of unsolicited donations (mainly non-priority donations);
- road blockages;
- health and safety issues;
- inappropriate last-mile distribution;
- cultural issues;
- disrupting disaster planning;
- reducing resources; and
- competitive behaviour (Balcik *et al.*, 2010; Fernandez *et al.*, 2006; Helsloot and Ruitenberg, 2004; Holguín-Veras *et al.*, 2014; Lassiter *et al.*, 2015; Whittaker *et al.*, 2015).

Nevertheless, most researchers noted the significance of several humanitarian operations by individuals that could not be ignored because of the success of their disaster management. For instance, Tomasini and Van Wassenhove (2009) discussed the role of new actors like the individual in a situation where disasters are on the rise, more complex and donor support is increasingly unpredictable. In this regard, Lassiter *et al.* (2014) presented a model to improve volunteer productivity.

To benefit efficiently from these potentials and capacities, the weaknesses and threats of individual operations must be minimised, with a focus on their strengths and opportunities. Thus, to find out more about the characteristics of individual humanitarian supply chain operations, an extensive literature review was conducted, and the results were categorised based on the SWOT technique, as shown in Table 1.

Table 1 shows preliminary SWOT analysis on individual operations in humanitarian logistics.

Table 1 Preliminary SWOT analysis on individual operations in humanitarian logistics

	Strengths, Weaknesses, Opportunities, Threats	Reference
S	S1. Innovation and improvisation	Bealt and Mansouri (2018), Benson *et al.* (2001), Fernandez, Barbera and Dorp (2006), Helsloot and Ruitenberg (2004), Hilhorst *et al.* (2019), Moore *et al.* (2003), Pedraza-Martinezet al. (2013), Tomasini and Van Wassenhove (2009), Urrea and Pedraza-Martinez (2019), Van Wassenhove and Pedraza Martinez (2012), Whittaker, McLennan and Handmer (2015) and Xu and Beamon (2006)
	S2. Rapid action	
	S3. Altruism motivation	
	S4. Not bureaucracy	
	S5. Emergent behaviour	
W	W1. Poor connection	
	W2. Not sharing information/Poor communications	
	W3. Weak monitoring	
	W4. Nonmature discipline	
	W5. Insufficient knowledge, skill and experience	
O	O1. Long-term commitment	
	O2. Social engagement	
	O3. Learning and business development	
	O4. Disaster preparedness	
	O5. Network (e.g. local, religious and followers)	
T	T1. Acceptance from local governments and people	
	T2. Health and safety issues (e.g. unsafe behaviour)	
	T3. Variable skill and experience	
	T4. Ethnic (e.g. culture and religion)	
	T5. Limited access (e.g. data)	

To overcome the individual weaknesses mentioned in Table 1 and to increase the efficiency of individuals' actions, the following aspects could be listed:

- providing pre-disaster networks;
- training;
- robust organisation (defining tasks and overarching management);
- providing formal responders and pre-trained volunteers (intermediate group);
- increasing individual satisfaction (e.g. social interaction and recognition);
- increasing awareness concerning negative outcomes of individuals' actions; and
- engaging the media proactively (Fernandez *et al.*, 2006; Holguín-Veras *et al.*, 2014; Urrea and Pedraza-Martinez, 2019).

However, the aforementioned aspects could be established, provided that the individuals coordinate and cooperate with official organisations (Kapucu, 2005; Urrea and Pedraza-Martinez, 2019). In this case, individuals could act independently of official organisations, as an isolated system without any connection to the comprehensive disaster-relief system. Although this could happen because of several reasons, such as competition, unpredictability, inappropriate management system, coordination costs and cultural differences (Balcik *et al.*, 2010; Bealt and Mansouri, 2018; Kapucu, 2005; Pedraza-Martinez *et al.*, 2013; Schulz and Blecken, 2010), the key factor in this troublesome situation is lack of trust (Stephenson and Schnitzer, 2006), which was evident between individuals and formal organisations in the Kermanshah case (Maghsoudi and Moshtari, 2021).

Regarding situations of mistrust, different approaches for coordination (command, consensus and default) were mentioned by Van Wassenhove (2006) referring to Donini (1996). In general, several studies consider interorganisational coordination and trust issues, such as Kapucu (2005), Schiffling *et al.* (2020), Schulz and Blecken (2010) and Tatham *et al.* (2017). Various models have been introduced to deal with coordination in humanitarian operations by several scholars, such as Dubey and Altay (2018). Sopha *et al.* (2019) introduced a model to improve coordination during last-mile distribution. Some research studies, such as those of Akhtar *et al.* (2012), Balcik *et al.* (2010) and Scheidlinger (1991), declared that an umbrella organisation concept is required to achieve suitable coordination. Umbrella organisations, which act as the central core to ensure efficient coordination, help to improve the following items:

- information flow;
- receiving and delivering of donations;
- service quality; and
- operation cost (Akhtar *et al.*, 2012; Balcik *et al.*, 2010; Scheidlinger, 1991).

The umbrella organisation concept could be categorised as centralised coordination, which a single organisation is responsible for leading the relief effort coordination (Dolinskaya *et al.*, 2011). However, this mainly depends on the features and acts of the umbrella (main coordinator) organisation.

Nonetheless, no or few studies consider these aforementioned aspects for individuals in particular. Additionally, coordination approaches might sometimes not be applicable for some cases, like Kermanshah, where gaps between individuals and formal organisations do not seem likely to be filled in the near future. Thus, a strategy is required to make the most of the individuals' potential in the short and medium term. However, future studies by multidisciplinary experts must be run fundamentally to solve this problem.

Case study

Kermanshah earthquake case

On 12 November 2017, at 18:18:16 UTC (21:48:16 local time), an earthquake, with a magnitude of 7.3 and a depth of

18.1 km, took place in Kermanshah province, Iran (Mahani and Kazemian, 2018). Covering an area of 24,640 km^2, Kermanshah province is located in the west of Iran, close to the Iran–Iraq border. Chen *et al.* (2018) declared this earthquake to be one of the largest events in the northwest of the Zagros fold-and-thrust belt. The two cities in this province, Ezgeleh (in Salas-e Babajani county) and Sarpol-e Zahab, close to the epicentre, were strongly affected as well as several villages close by. Some characteristics of the affected areas are shown in Table 2. More than 600 people lost their lives, and almost 10,000 people were injured. Approximately 37,000 residential units were destroyed, and almost 63,000 units were damaged [Iranian Students News Agency (ISNA), 2018]. The last high-magnitude earthquakes happened in 958 and 1150 AD (with magnitudes of 6.4 and 5.9, respectively) close to Sarpol-e Zahab [International Institute of Earthquake Engineering and Seismology (IIEES), 2017].

Table 2 shows the characteristics of affected areas (main cities).

Humanitarian and relief operations in the aftermath of the Kermanshah earthquake

Unaffected local people started search operations immediately after the event and tried to rescue people who were injured and trapped under the rubble of buildings. From a few hours after the event, members of Iranian Red Crescent Society (IRCS) and military provided relief operations for the affected people (IIEES, 2017). The main hospital in Sarpol-e Zahab was damaged. A few days after the event, there was no medical activity inside this hospital. A merely temporary hospital was erected in tents and container units in front of the hospital (IIEES, 2017). However, a few days after the event, several temporary hospitals were sent to the affected areas. Additionally, some casualties were moved to hospitals in Kermanshah city, in the centre of the province, from the early hours. Practically none of the main roads were seriously damaged that made it possible to access to almost all areas by vehicle. Nevertheless, road blockages were reported for a variety of reasons, such as landslides and rockfalls, road traffic and traffic accidents. HFIR was responsible for debris removal, provision of post-disaster temporary housing and permanent housing reconstruction.

The Kermanshah humanitarian logistic operations cover the three key typologies, which were defined by Holguín-Veras *et al.* (2012). The last-mile material distributions in the Kermanshah case could be broken down into two main approaches. The first made use of official organisations, such as the IRCS and military, which were assigned by the government. The second involved individuals and other organisations, both private and public. The goods were delivered to DP following three different methods, to the affected persons (APs), the head of the family and trusted persons by neighbours, such as the reeve, alderman and school managers. Most trusted persons were elected or assigned before the event. However, some of them were accepted for this role after the event, especially in newly erected campsites. Most individuals delivered goods to APs, as it was almost impossible to identify trusted persons. However, this situation changed several days after the event.

It should be noted that the following two sections have been based on information collected from the reports, on-site observations and interviews with emergency managers from HFIR and 32 displaced families, 3 of which were trusted persons. As previously mentioned, the interviews embrace vast issues, from emergency responses to reconstruction work lasting more than three years (Tables A1 and A2). Nonetheless, some parts of the information related to this research study have been applied and analysed.

Issues for the humanitarian operations in Kermanshah

Most interviewed displaced families, including trusted persons and the others, complained about delivering aid (last-mile distribution). Trusted persons were displeased mainly because of two factors:

1 a massive amount of work and responsibility; and
2 misgivings and negative feelings among neighbours concerning the accuracy of trusted persons' activities.

Meanwhile, other affected families (not trusted persons) were dissatisfied because of the unfair distribution of goods by trusted persons.

In general, based on observations from the authors, assessing reports and interviewing emergency managers and displaced families, humanitarian logistics in the Kermanshah case experienced several problems:

- Delivery time could lead to the DP receiving required goods after they were needed. For instance, DP collected their undamaged home appliances from their previous houses, as well as received donated items. DP had to stack their belongings outside the shelters because of a lack of space inside. As this earthquake happened in autumn, the DP had to waterproof their collected goods and shelters with rolls of plastic sheeting on rainy days. The DP used different communication channels, such as social media, mobile phones and social networks, to request rolls of plastic sheeting for the affected areas. However, by the time it was delivered, it was too late to solve this problem.

Table 2 Characteristics of affected areas (main cities)

	Population (Total)	Population Urban	Population Rural	No. of households	Working population	Ownership (Household) Owner	Ownership (Household) Tenant	Structure of residential unit Concrete	Structure of residential unit Steel	Structure of residential unit Other
Kermanshah	1,083,833	952,285	129,719	323,291	254,300	166,493	128,942	53,592	86,743	164,605
Sarpol-e Zahab	85,342	45,481	39,726	23,696	20,657	14,200	7,599	4,117	5,663	12,191
Salas-e Babajani	32,219	16,203	18,869	9,270	7,995	6,546	2,175	157	2,168	6,499
Kermanshah Province	1,952,434	1,468,615	478,444	576,861	463,242	324,605	199,796	84,407	147,343	306,671

Source: Iran Statistical Yearbook 2017–2018 (2020)

In this regard, the DP used any items (such as trash bags) to cover their property.

- Second is wasting a considerable amount of aid.
- Less attention is paid to supplying the needs of DP and affected populations who were from areas far from the main city, such as remote villages. While some affected populations from areas close to the centre received a considerable amount of aid merely hours after the event, some areas only received initial aid after a few days, especially from individual donors.
- Next is inappropriate last-mile distribution of goods. In this case, it should be noted that some non-local or non-affected local people abused the system to collect aid from donors. All interviewees (displaced families) declared that donors could not distinguish between local and non-local people because of similarities in their language, accent and dress. Nonetheless, it is very easy for locals to identify non-locals.
- Next is road blockages because of large numbers of humanitarian actors, who went to the affected areas individually to deliver aid directly, especially in the early days after the event until a few weeks later. Additionally, the number of actors with private vehicles, plus the fact that some petrol stations stopped working for a few days after the event, led to long queues for fuel.
- The costs of goods and transportation was increased in the affected area.
- Imposition, in some cases, of humanitarian actors, especially individuals with less experience, caused extra difficulties for relief forces.

For instance, some individuals occupied hospital beds because of diseases caused by conditions in the affected areas, or they needed to be accommodated.

Although most of the interviewees (displaced families) appreciated individuals, these interviewees believed that individual actions, which could have been used more appropriately, were the main reason for the aforementioned problems.

Questionnaire results and analysis

In this section, the questionnaire results are considered and analysed to specify characteristics of the humanitarian operations by individuals in the Kermanshah case. Overall, more than 170 questionnaires were collected, of which 140 responses were considered acceptable. It should be emphasised that the results of the questionnaire, as well as Figures A1–A8, found in Appendix 2 of this paper, provide the detailed questionnaire results. For instance, Figure A1 shows the percentage of different types of donations provided by respondents.

The questionnaire results confirm that the respondents, who acted in the aftermath of the Kermanshah earthquake, were involved in most sections of the humanitarian supply chain operation by themselves. These respondents had different levels of experience and different approaches in humanitarian operations, as shown in Table A3. Although 85% of all respondents were individuals (informal volunteers) and 15% were private organisations, all respondents were categorised as individuals in this research study because the humanitarian actions of both groups (informal volunteers and private organisations) were almost the same. Additionally, as already mentioned, the term *respondent* refers to who answered the questionnaire.

Most respondents were individually involved in the Kermanshah case humanitarian supply chain activities (such as supply and last-mile distribution), mostly because of a lack of trust in organisations responsible for relief operations. Analysis of responses demonstrates that most respondents took unplanned approaches for almost all steps in humanitarian supply chains. For instance, to identify DP, personal experience and information collected from relatives were high-ranked channels (Table A4 and Figure A2), instead of other more reliable channels. Furthermore, using this channel might confirm that respondents trusted themselves and their relatives, instead of official organisations, such as HFIR and IRCS. This led to individual operations and a consequent lack of coordination in Kermanshah.

Moreover, based on responses to questionnaires as well as interviews with emergency managers of HFIR and on-site observations, most individuals applied the easiest and safest approaches for their last-mile distribution strategies. For instance, individuals did not deliver their aid to remote areas, even several days after the event. In this regard, as shown in Figure A3, most individuals chose delivery zones based on their experience and information, which came from social media or relatives. Meanwhile, social media usually focuses on larger cases, not small remote cases. This approach led to unfair donation distribution, especially to affected people who were far from the centre. Another factor, which provoked unfair donation distribution, was the lack of sufficient flow of information and management among all actors. However, social networks were used considerably by the humanitarian actors for sharing information in the aftermath of the Kermanshah earthquake (Ahmadi and Bazargan-Hejazi, 2018).

Most respondents focused on more than one affected region to deliver aid, while more experienced respondents concentrated on just one region. The latter approach (focusing on one region) usually lets helpers form more robust emotional relationships with the affected areas. Additionally, this approach leads to a customised response to the needs of each region's DP. However, the latter approach might lead to unfair situations where the abilities of helpers differ. Furthermore, conflict might arise between helpers who focus on one region, and at another level, conflict might arise between helpers and a comprehensive strategy designed by the authorities and decision-makers.

The questionnaire results show that respondents with more experience and knowledge concerning humanitarian operations wanted to collaborate and coordinate more with other organisations. Furthermore, these more experienced respondents tend to have more contacts than agents with no or less experience. This enabled experienced agents to collect and share data easily and accurately. Moreover, it was possible for these experienced actors to work with other actors in other sections of humanitarian supply chain operations, such as logistics operations.

In general, the results confirm that experienced respondents took part in more acceptable operations regarding

humanitarian supply chain management factors. Nonetheless, some experienced respondents acted inappropriately in some parts of humanitarian operations. Thus, all actors, with any level of experience, must be trained or coordinated with experts to obtain the most suitable outcomes. However, training might differ in terms of content and teaching approaches for different humanitarians with varying levels of experience. Regarding respondents' trust in social networks (Figures A2 and A3), it might be possible to facilitate and improve training by applying new technologies, such as online courses.

According to the questionnaire results, 45% of respondents did not prepare any type of report (documentation) on their activities. In this regard, failure to collect data on all activities led to increasing uncertainty. Moreover, this situation could be one of the main reasons for overlap regarding donation items and the consequent glut of unsolicited supplies and wasted resources. Furthermore, as shown in Figure A1, respondents mostly provided donations based on short-term requirements from DP, and long-term requirements were not considered. For instance, as shown in Figure A1, goods for children and adolescents were ranked lowest by respondents. In other words, these actors were not able to consider all the steps of the response and recovery programme.

Besides cash donations, most respondents provided clothing, food and health supplies as in-kind donations, as shown in Figure A1. According to on-site observation from the authors, beginning five days after the event and lasting until this research study was written and data collected, small numbers of individuals provided shelter and sanitation systems. This might be because of the individuals' economic and operational limitations.

A large amount of clothing, as shown in Figure A1, could be one of the main reasons that clothes were wasted. However, this problem also occurred because agents were unfamiliar with the culture of the affected people and unaware of their real needs. According to responses from most interviewees (displaced families), DP did not agree to receive clothes, especially second-hand, from others. In general, lack of information about the affected area, such as culture, geography, climate conditions and real DP needs, led to wasting considerable amounts of in-kind donations. In this regard, DP mentioned that exceeding the required amount of a specific item generated waste, while DP vitally needed other items.

Of all respondents, 80%, who considered clothing as a low-ranked need, provided clothing for the DP. This might be because of the respondents' inexperience. Indeed, when the actors answered the questionnaire, they had already provided aid and had seen the outcome of their activities. Thus, the humanitarian operations of the Kermanshah case could prove to be a valuable experience for all those involved. Additionally, this confirms that individuals could improve the efficiency of their operations if they were informed about the outcomes of their actions.

Lack of scientific methods was selected by 56% of all respondents as the second highest factor influencing the failure or success of humanitarian operations, as shown in Figure A4. Regarding the results, presented in Figures A4 and A5, further academic research is required to focus on this factor. These research studies might determine why a considerable percentage of agents selected this factor (lack of scientific methods). However, regardless of why this factor was selected, the result confirmed that scientific findings and methods could not be transferred appropriately to all levels of the community.

As already mentioned, 60% of all respondents preferred not to coordinate operationally with governmental organisations or NGOs. Furthermore, respondents considered governmental organisations as one of the main actors responsible for the failure of supply chain activities, as shown in Figures A6 and A7. This confirms that there was little or no coordination between most humanitarian operation actors and other organisations, especially governmental ones.

The respondents chose lack of coordination as one of the least important factors, as shown in Figure A5. No pre-planning, lack of scientific methods and poor information were ranked as the most important factors, respectively, as shown in Figure A5. However, it is clear that these three high-ranked factors, especially poor information, require suitable coordination among all actors in humanitarian operations. In this regard, respondents might be aware of the negative outcomes of a lack of coordination with organisations; nevertheless, the respondents did not agree to coordinate with the organisations. Furthermore, it should be highlighted that respondents with more experience coordinated more with non-governmental and governmental organisations. Nevertheless, this group also only accepted supervision and information-gathering from governmental organisations.

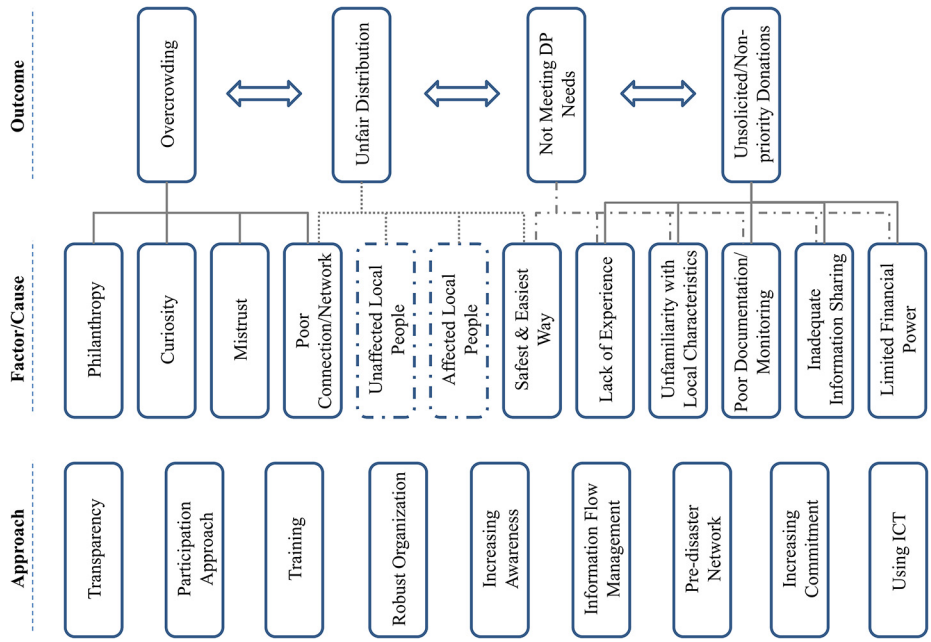
Discussion and findings

It might be mentioned that almost all humanitarian supply chain management problems in the Kermanshah case were derived from a lack of coordination, which was mostly because of damaged trust in governmental organisations. Regardless of actions required from governmental sectors to restore lost trust, coordination should be improved between formal organisations and individuals to benefit efficiently from the potential of individuals.

It should be noted that improper outcomes of humanitarian supply chain operations in the aftermath of the Kermanshah earthquake were not only because of humanitarian operations by individuals. As shown in Figure 2, local people (affected and non-affected) played their own roles in that chaos; however, this research study focuses on individuals. In this regard, Figure 2 shows negative outcomes of humanitarian operations, mainly considering the roles of individuals. Additionally, approaches required to minimise the negative impacts of humanitarian operations by individuals were obtained from the literature review, and some findings from the questionnaire results are shown in Figure 2. It should be emphasised that only the main negative outcomes are shown in Figure 2, not other outcomes, such as secondary problems. Indeed, Figure 2 presents a summary of findings from the previous sections of this paper, including the main negative outcomes that have arisen because of one or a set of factors, along with the approaches to solutions.

To avoid the negative outcomes of humanitarian operations by individuals in future cases similar to the case study, it is vital to follow all approaches derived from the literature review, as shown in Figure 2. Nonetheless, these approaches were not considered, especially for some cases where mistrust was the main constraint, as in the Kermanshah case.

Figure 2 A summary of findings, including adverse outcomes of the humanitarian operations in the aftermath of the Kermanshah earthquake, plus their causes and approaches to solutions



Thus, on the one hand, many individuals must be considered, who are not willing to entrust almost any sections of humanitarian logistics management to official organisations. On the other hand, it is necessary to have a system run by an umbrella organisation, which plays a key role in coordination (Akhtar *et al.*, 2012), to run a post-disaster master plan accurately. In this regard, Fernandez *et al.* (2006) declared that a lack of appropriate management systems could lead to ineffective efforts when individuals go their own way. Otherwise, it could be impossible or difficult to meet some approaches in Figure 2, for example, *Training*.

In this regard, a system must be considered where all components of this massive system are somehow linked to meet all approaches shown in Figure 2. However, each individual's positions, connections, tasks and commitments in this system should be determined accurately. Indeed, specifying the precise position of each member could ensure that the system works properly. This helps to achieve adequate coordination and, consequently, efficiently make the most of individuals' potential in situations of mistrust.

In this regard, two strategies could be applied: the *first strategy* involves direct coordination in possible sections of humanitarian supply chain operations. For instance, according to responses from respondents, considerable numbers of respondents agreed to only use information derived from umbrella organisations, not to collaborate operationally. Thus, umbrella organisations might benefit from using this channel to manage information flow accurately and prepare a robust database. The *second strategy* aims to increase coordination through indirect approaches. This strategy takes into account the arrangement of links (actors) based on the highest efficiency, using individuals' maximum abilities, as well as complete trust between the links (actors) in the system. To follow the second strategy, some intermediate groups, who are familiar with all actors and could encourage trust among all of them (Schiffling *et al.*, 2020), are considered to play a linking role. According to the questionnaire results (Questionnaire results and analysis), these groups could be individuals who have sufficient humanitarian operation experience.

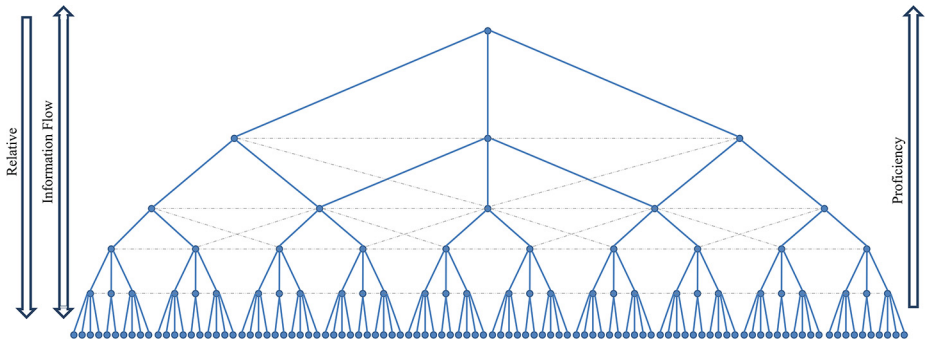
It is easier for professionals to work with intermediate levels because these intermediate groups, with some operational experience, act more professionally, unhindered by rumours and fake news or emotional decisions. On the other hand, ordinary individuals, who are not humanitarian operators and sometimes act after disasters, might trust this intermediate group more than others, mainly from governmental sectors. The middle levels are responsible for information flowing between all actors, collecting monetary or in-kind donations from the first level (ordinary individuals) and even working in the last-mile distribution. Moreover, these middle levels represent the lower level to monitor the accuracy of humanitarian operations. In general, middle levels, responsible for most humanitarian operational activities, are the link (intermediates) between lower levels, who provide donations, and top levels, who manage information to meet the master plan targets.

Finally, this research study takes into consideration the strategies mentioned above and findings from humanitarian operations in the Kermanshah case study, based on mixed methods and the literature review to suggest a conceptual framework to manage humanitarian operations by individuals.

Framework

This framework, as shown in Figure 3, only suggests a feasible arrangement to increase the participation and coordination of most actors as much as possible. This is based on the umbrella concept considering the minimum appearance of orders and maximum transparency. In other words, this framework

Figure 3 Schematic of framework suggested for the humanitarian supply chain management



benefits from the advantages of the umbrella concept. Nevertheless, this framework was mainly designed to increase the quantity and quality of individuals' collaboration with formal organisations (directly and indirectly) in situations of mistrust. The hierarchy system is like a pyramid, where actors with less knowledge and experience in humanitarian relief are on the base level and professional actors are closer to the apex. It should be highlighted that the hierarchy system (Figure 3) only presents a schematic link between all actors, considering experience, relationship and information flow, and is not arranged based on a command hierarchy. Moreover, this framework embraces horizontal and vertical coordination, as defined by Akhtar *et al.* (2012) and Balcik *et al.* (2010), through continuous and dashed lines, as shown in Figure 3.

Formal organisations (national or international) responsible for disaster management are assigned to the apex, considering their experience, potential and liability. For instance, in the Kermanshah case, the HFIR, which was introduced as a lead organisation by the Iranian Government, could be considered the apex. Nonetheless, instead of one organisation, some formal organisations, which collaborate together appropriately, could be the apex. Additionally, the apex could be an organisation that is an expert on humanitarian operations, such as the United Nations Office for the Coordination of Humanitarian Affairs, provided local authorities and individuals could accept this organisation's leading role. In this case, the country/region emergency managers work as strategic coordinators to lead and make major decisions.

Members of intermediate levels, who are humanitarian actors with more experience and knowledge of humanitarian operations compared to the base level, play a key role in linking actors from lower and higher levels of this system. These intermediate levels embrace both individuals and humanitarian organisations. In this regard, the formal responsible organisation(s), assigned to the apex, could recognise and manage members of intermediate levels before events and mobilise these members after disasters to follow a post-disaster master plan precisely. It should be noted that most of the intermediate levels with more experience and knowledge of humanitarian operations have already been known for the apex, as these levels acted individually or collaborated with formal organisations in previous cases. Nonetheless, these levels could be identified through volunteer recruitment and prepared before events.

This framework is presented for future disasters in the same area or areas with the same characteristics, such as the cultures of the aid agencies and recipients, infrastructure, humanitarian operation strategy and so on, like the case study. This framework tries to make direct and indirect connections and collaboration among all actors, including the base level, operators and decision-makers, when situations of mistrust do not seem to have an imminent solution. Furthermore, this framework aims to minimise humanitarian agencies and individuals present in the affected area without decreasing the amount of donations. In this regard, to achieve the aforementioned goals and to follow the approaches shown in Figure 2, several key factors of the framework are considered, as explained below.

Relationship and coordination

The relationships between members of the base of the pyramid and middle levels are based on mutual trust because of emotional ties, such as friendship, relatives and teammates. According to the results of the questionnaire analysis, most respondents, especially those with less experience, trusted their relatives more. In this regard, the actors and donors from the base levels might trust their relatives assigned to the middle levels of the pyramid. Meanwhile, relationships between members of the top levels of the pyramid are formed as professional mechanisms of the commercial supply chain/large-scale humanitarian relief organisations. Indeed, mutual trust between members of higher levels is based on knowledge and experience in humanitarian relief operations.

Participation of all actors

In this conceptual framework, an influential role is considered for each actor to use their potential and increase community participation in disaster management phases. However, the community-participation strategy to manage disasters suitably should be based on the specific characteristics of each community, and the type of contribution could vary (Jahangiri *et al.*, 2011). In this case, this framework encompasses different duties and responsibilities for all actors by considering their abilities, experience and knowledge of humanitarian operations.

Benefits from all actors' potential and abilities

The intermediate agents (individuals and organisations) might know each other. This could enable the middle agents' potential, which might lead to a more efficient humanitarian

operation, by reducing operation costs and delivery time. For instance, agents could use transportation potential or free space in the warehouse owned by other middle agents, based on the horizontal coordination concept. Just coordinating transportation could reduce operation costs considerably. Indeed, intermediate individuals could increase their horizontal and upstream networks to get more access to humanitarian logistics requirements.

Collecting and sharing information

Like commercial supply chains, information, such as inventory, point-of-use, clients, demands and so on, is the backbone of the humanitarian supply chain. Thus, it is vital for information to flow between all parties, aid agencies, recipients and decision-makers, to manage operations precisely. The information flow should be two way, from the top of the pyramid to the base and vice versa. However, the types of information could vary.

Because of a lack of manpower and time, individuals do not have a data tracking system and logistic process reports. Furthermore, it is impossible for individuals to coordinate with all other actors to share information. Meanwhile, large-scale organisations (top levels of the pyramid) with a broader picture of the humanitarian relief operation can control all operation processes appropriately. In this regard, apex organisations only collect data from the lower levels, analyse it and then return the analysis results regarding the master plan targets. For instance, information about donations (amount and types) from each middle-level actor is gathered to form an inventory list; then the information is shared with all intermediate-level agents. Consequently, this helps minimise unsolicited donations, which could have negative environmental, economic and social impacts. It should be noted that it is required to provide systems for information sharing by the apex. In this case, information and communications technologies, which are tools for improving coordination in humanitarian relief (Dolinskaya *et al.*, 2011; Vidolov, 2014), could be applied.

This procedure also helps protect against opportunistic costs when demand increases for specific goods at the same time. Indeed, there is an umbrella organisation, which only controls information flow, to improve the success rate of the humanitarian operation, without operational activities to avoid making unprofessional humanitarian actors seem unreliable. The pyramid shown in Figure 3 seems to be a single organisation based on the centralised coordination system through the top-down approach; however, this hierarchy system is mainly applied to manage information flow. In other words, this framework has not been designed to follow the centralised coordination system for all humanitarian operation actions.

Arrangement and disciplines

The military is extremely efficient in humanitarian logistics, because of its strong command and control system (Ekström *et al.*, 2020; Van Wassenhove and Pedraza Martinez, 2012). However, non-military organisations are not expected to follow such precise, strict disciplines. In this case, it is possible to arrange different levels of the pyramid regarding minimum to maximum disciplines, from bottom to top levels. This framework benefits from orders from the military system. Nonetheless, this approach does not pressure members of lower levels to follow strict rules that could lead base-level members of the pyramid to ignore and leave the system.

Training

This framework provides an opportunity to present different types of training based on agent levels in the pyramid with different commitments and tasks. As in the example given by Helsloot and Ruitenberg (2004) concerning the US "Community Response Teams", the individuals assigned to the middle level could be trained in basic concepts of humanitarian operations and improve the required skills. Thus, formal organisations are responsible for conducting these training programs for the middle levels before disasters. Additionally, these programs could help the formal organisation to know the potential of each individual (middle level) properly and consequently could assign the individual to an appropriate level of the pyramid. Furthermore, these training programs could assist middle levels in knowing each other and establishing relationships among all members. Nonetheless, the mass, at the base of the pyramid, could receive more general information through the media (directly or indirectly) before and after disasters, to be aware of the possible negative outcomes of their actions after disasters. As already mentioned by several researchers, this awareness concerning negative outcomes could increase the efficiency of humanitarian operations by individuals.

Conclusions

This research study assesses inappropriate humanitarian supply chain operations, focusing on humanitarian operations by individuals, in the aftermath of the Kermanshah earthquake. In this regard, this research study considers mixed methods, including a questionnaire (140 respondents), semi-structured interviews (32 affected families) and interviews (5 emergency managers from HFIR), as well as on-site survey reports. An extensive literature review is conducted to present the characteristics of humanitarian operations by individuals, using SWOT. Moreover, the essential factors to increase the efficiency of humanitarian operations by individuals are reviewed. Then, approaches derived from the literature review are compared against local conditions obtained from the mixed methods. Finally, a framework is suggested to benefit appropriately from the significant humanitarian potential of individuals for future cases similar to the case study.

In general, regarding the nature of the humanitarian operations by individuals, which is conducted in the context of disasters with many different actors, with varying experience and proficiency, this always raises several challenges. However, it is possible to lessen challenges by considering the specific characteristics of each case and factors influencing the success of humanitarian operations. In this regard, to benefit from extraordinarily human emotions (individuals) to assist affected societies, several factors must be considered:

- Lack of coordination between actors in different sections of humanitarian supply chain management is one of the key factors that might lead to chaos. This happened because of the independent actions of individuals in both operational and managerial sections. Lack of coordination could cause a chain of intertwined problems, such as inappropriate information management. Thus, coordination should be

established to achieve successful humanitarian operations, even if it is only possible to coordinate in some sections of the humanitarian supply chain management, such as information flow.

- Greater knowledge and experience among individuals in humanitarian operations could lead to more professional trust and coordination. Thus, it is vital to benefit from this potential of actors with greater experience for suitable coordination between all actors. Furthermore, different appropriate training is required for possible actors before events based on their responsibilities.
- It might be impossible to obtain suitable achievements in the absence of unit management (umbrella organisation concept). Even, in some cases, such as Kermanshah, where individuals (60% of all respondents) prefer not to work with the umbrella organisations, especially governmental ones, umbrella organisations must exist. However, the position, accountability and responsiveness of each individual in this system must be considered and determined efficiently.

As a limitation to this research study, it should be noted that this framework has been designed based on the results of the humanitarian supply chain in one case study. However, findings from the case study were assessed considering a broad literature review. Nonetheless, in future studies, findings from this research study could be considered with other cases, to generalise the findings considering both time and space (Halldórsson and Aastrup, 2003). Furthermore, it is necessary to study why some individuals could not trust governmental organisations, and as a line for future research, it seems necessary to conduct a comprehensive literature review study on the humanitarian supply chain, as well as social aspects to shed light on its various aspects.

Additionally, this research study presents an initial version of the framework to benefit suitably from the significant humanitarian potential of individuals regarding situations of mistrust. Although this initial version of the conceptual framework, as well as the findings of this research study, could be applied to deal with challenges of the humanitarian operations by individuals, some parts of this framework need to be considered deeply. Thus, factors that have strongly influenced the success of this framework should be studied further, as well as interconnections between its components in future studies, especially quantitative studies. A specific future study will be conducted by the authors to design an executable model based on this conceptual framework considering the main pillars of sustainability. This model could be applied by emergency decision-makers easily and quickly regarding the various conditions of each case.

References

Ahmadi, A. and Bazargan-Hejazi, S. (2018), "2017 Kermanshah earthquake; lessons learned", *Journal of Injury & Violence Research*, Vol. 10 No. 1, p. 1, doi: 10.5249/jivr.v10i1.1049.

Akhtar, P., Marr, N. and Garnevska, E. (2012), "Coordination in humanitarian relief chains: chain coordinators", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 2 No. 1, pp. 85-103, doi: 10.1108/20426741211226019.

Balcik, B., Beamon, B.M. and Smilowitz, K. (2008), "Last mile distribution in humanitarian relief", *Journal of Intelligent Transportation Systems*, Vol. 12 No. 2, pp. 51-63, doi: 10.1080/15472450802023329.

Balcik, B., Beamon, B.M., Krejci, C.C., Muramatsu, K.M. and Ramirez, M. (2010), "Coordination in humanitarian relief chains: practices, challenges and opportunities", *International Journal of Production Economics*, Vol. 126 No. 1, pp. 22-34, doi: 10.1016/j.ijpe.2009.09.008.

Battini, D., Peretti, U., Persona, A. and Sgarbossa, F. (2014), "Application of humanitarian last mile distribution model", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 4 No. 1, doi: 10.1108/JHLSCM-01-2013-0001.

Bealt, J. and Mansouri, S.A. (2018), "From disaster to development: a systematic review of community-driven humanitarian logistics", *Disasters*, Vol. 42 No. 1, pp. 124-148, doi: 10.1111/disa.12232.

Beamon, B.M. and Balcik, B. (2008), "Performance measurement in humanitarian relief chains", *International Journal of Public Sector Management*, Vol. 21 No. 1, pp. 4-25, doi: 10.1108/09513550810846087.

Benson, C., Twigg, J. and Myers, M. (2001), "NGO initiatives in risk reduction: an overview", *Disasters*, Vol. 25 No. 3, pp. 199-215, doi: 10.1111/1467-7717.00172.

Biernacki, P. and Waldorf, D. (1981), "Snowball sampling: problems and techniques of chain referral sampling", *Sociological Methods & Research*, Vol. 10 No. 2, pp. 141-163, doi: 10.1177/004912418101000205.

Caunhye, A.M., Nie, X. and Pokharel, S. (2012), "Optimization models in emergency logistics: a literature review", *Socio-Economic Planning Sciences*, Vol. 46 No. 1, pp. 4-13, doi: 10.1016/j.seps.2011.04.004.

Charles, A., Lauras, M., Wassenhove, L.N. and Dupont, L. (2016), "Designing an efficient humanitarian supply network", *Journal of Operations Management*, Vol. 47-48 No. 1, pp. 58-70, doi: 10.1016/j.jom.2016.05.012.

Chen, K., Xu, W., Mai, P.M., Gao, H., Zhang, L. and Ding, X. (2018), "The 2017 Mw 7.3 Sarpol Zahāb earthquake, Iran: a compact blind shallow-dipping thrust event in the Mountain front fault basement", *Tectonophysics*, Vols 747/748, pp. 108-114, doi: 10.1016/j.tecto.2018.09.015.

Dolinskaya, I.S., Shi, Z.E., Smilowitz, K.R. and Ross, M. (2011), "Decentralized approaches to logistics coordination in humanitarian relief", *IIE Annual Conference. Proceedings*, *Institute of Industrial and Systems Engineers (IISE)*, p. 1.

Donini, A. (1996), *The Policies of Mercy: UN Coordination in Afghanistan, Mozambique, and Rwanda*, Thomas J. Watson Jr. Institute for International Studies, Brown University.

Dube, N., Vaart, T.V., Teunter, R.H. and Wassenhove, L.N. (2016), "Host government impact on the logistics performance of international humanitarian organizations", *Journal of Operations Management*, Vol. 47/48 No. 1, pp. 44-57, doi: 10.1016/j.jom.2016.05.011.

Dubey, R. and Altay, N. (2018), "Drivers of coordination in humanitarian relief supply chains", *The Palgrave Handbook of Humanitarian Logistics and Supply Chain Management*, pp. 297-325, Palgrave Macmillan, London, doi: 10.1057/978-1-137-59099-2_10.

Eisenhardt, K.M. (1989), "Building theories from case study research", *The Academy of Management Review*, Vol. 14 No. 4, pp. 532-550, doi: 10.5465/amr.1989.4308385.

Ekström, T., Hilletofth, P. and Skoglund, P. (2020), "Differentiation strategies for defence supply chain design", *Journal of Defense Analytics and Logistics*, Vol. 4 No. 2, pp. 183-202, doi: 10.1108/JDAL-06-2020-0011.

Fernandes, C.W., Taglialenha, S.L. and Silva, V.M. (2016), "Performance measures to humanitarian logistics: the perspective of the humanitarian assistance chain", *Volume 4: Transdisciplinary Engineering: Crossing Boundaries*, IOS Press, pp. 1113-1120, doi: 10.3233/978-1-61499-703-0-1113.

Fernandez, L., Barbera, J. and Dorp, J.V. (2006), "Strategies for managing volunteers during incident response: a systems approach", *Homeland Security Affairs*, Vol. 2 No. 3.

Ghazinoory, S., Abdi, M. and Azadegan-Mehr, M. (2011), "SWOT methodology: a state-of-the-art review for the past, a framework for the future", *Journal of Business Economics and Management*, Vol. 12 No. 1, pp. 24-48, doi: 10.3846/16111699.2011.555358.

Glaser, G.B. (2017), *Discovery of Grounded Theory: Strategies for Qualitative Research*, Routledge.

Halldórsson, Á. and Aastrup, J. (2003), "Quality criteria for qualitative inquiries in logistics", *European Journal of Operational Research*, Vol. 144 No. 2, pp. 321-332, doi: 10.1016/S0377-2217(02)00397-1.

Heaslip, G., Vaillancourt, A., Tatham, P., Kovács, G., Blackman, D. and Henry, M.C. (2019), "Supply chain and logistics competencies in humanitarian aid", *Disasters*, Vol. 43 No. 3, pp. 686-708, doi: 10.1111/disa.12361.

Helms, M.M. and Nixon, J. (2010), "Exploring SWOT analysis – where are we now? A review of academic research from the last decade", *Journal of Strategy and Management*, Vol. 3 No. 3, pp. 215-251, doi: 10.1108/17554251011064837.

Helsloot, I. and Ruitenberg, A. (2004), "Citizen response to disasters: a survey of literature and some practical implications", *Journal of Contingencies and Crisis Management*, Vol. 12 No. 3, pp. 98-111, doi: 10.1111/j.0966-0879.2004.00440.x.

Hilhorst, D., Desportes, I. and Milliano, C.W. (2019), "Humanitarian governance and resilience building: Ethiopia in comparative perspective", *Disasters*, Vol. 43 No. S2, pp. S109-S131, doi: 10.1111/disa.12332.

Holguín-Veras, J., Jaller, M. and Wachtendorf, T. (2012), "Comparative performance of alternative humanitarian logistic structures after the Port-au-Prince earthquake: ACEs, PIEs, and CANs", *Transportation Research Part A: Policy and Practice*, Vol. 46 No. 10, pp. 1623-1640, doi: 10.1016/j.tra.2012.08.002.

Holguín-Veras, J., Jaller, M., Wassenhove, L.N., Pérez, N. and Wachtendorf, T. (2014), "Material convergence: important and understudied disaster phenomenon", *Natural Hazards Review*, Vol. 15 No. 1, pp. 1-12, doi: 10.1061/(ASCE)NH.1527-6996.0000113.

Hosseini, S.A., Fuente, A., Pons, O., Arroyo, D and Mendosa, C. (2020), "A decision methodology for determining suitable post-disaster accommodations: reconsidering effective indicators for decision-making processes", *Journal of Homeland Security and Emergency Management*, Vol. 17 No. 3, p. 20180058, doi: 10.1515/jhsem-2018-0058.

International Institute of Earthquake Engineering and Seismology (IIEES) (2017), *Earthquake Sarpol-e-Zahab volume3 Chapter 4*, International Institute of Earthquake Engineering and Seismology, available at: www.iiees.ac.ir/fa/eqreports/

Iran Statistical Yearbook 2017-2018 (2020), "Statistical center of Iran", available at: www.amar.org.ir (accessed 20 June 2020).

Iranian Students News Agency (ISNA) (2018), *Finishing 18,500 Destroyed Units of Kermanshah*, Iranian Students News Agency (ISNA), available at: www.isna.ir/news/97082009451/

Jahangiri, K., Izadkhah, Y. and Jamaledin Tabibi, S. (2011), "A comparative study on community-based disaster management in selected countries and designing a model for Iran", *Disaster Prevention and Management: An International Journal*, Vol. 20 No. 1, pp. 82-94, doi: 10.1108/09653561111111108.

Kapucu, N. (2005), "Interorganizational coordination in dynamic contexts: networks in emergency management", *Connections*, Vol. 26 No. 2, pp. 33-48.

Korff, V.P., Balbo, N., Mills, M., Heyse, L. and Wittek, R. (2015), "The impact of humanitarian context conditions and individual characteristics on aid worker retention", *Disasters*, Vol. 39 No. 3, pp. 522-545, doi: 10.1111/disa.12119.

Kovács, G. and Spens, K.M. (2007), "Humanitarian logistics in disaster relief operations", *International Journal of Physical Distribution & Logistics Management*, Vol. 37 No. 2, pp. 99-114, doi: 10.1108/09600030710734820.

Kovács, G. and Spens, K. (2009), "Identifying challenges in humanitarian logistics", *International Journal of Physical Distribution & Logistics Management*, Vol. 39 No. 6, pp. 506-528, doi: 10.1108/09600030910985848.

Kovács, G., Moshtari, M., Kachali, H. and Polsa, P. (2019), "Research methods in humanitarian logistics", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 9 No. 3, pp. 325-331, doi: 10.1108/JHLSCM-12-2019-082.

Kumar, S., Niedan-Olsen, K. and Peterson, L. (2009), "Educating the supply chain logistics for humanitarian efforts in Africa: a case study", *International Journal of Productivity and Performance Management*, Vol. 58 No. 5, pp. 480-500, doi: 10.1108/17410400910965733.

Lassiter, K., Alwahishie, A. and Taaffe, K. (2014), "Improving volunteer productivity and retention during humanitarian relief efforts", *International Journal of Supply Chain Management*, Vol. 3 No. 2, pp. 1-10.

Lassiter, K., Khademi, A. and Taaffe, K.M. (2015), "A robust optimization approach to volunteer management in humanitarian crises", *International Journal of Production Economics*, Vol. 163, pp. 97-111, doi: 10.1016/j.ijpe.2015.02.018.

Leiras, A., De brieto, Jr, I., Peres, E.Q., Bertazzo, T.R. and Yoshizaki, H.T. (2014), "Literature review of humanitarian logistics research: trends and challenges", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 4 No. 1, pp. 95-130, doi: 10.1108/JHLSCM-04-2012-0008.

Lynch, C. (2010), *Top UN Aid Official Critiques Haiti Aid Efforts in Confidential Email*, Foreign Policy.

McLachlin, R. and Larson, P.D. (2011), "Building humanitarian supply chain relationships: lessons from leading practitioners", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 1 No. 1, pp. 32-49, doi: 10.1108/20426741111122402.

Maghsoudi, A. and Moshtari, M. (2021), "Challenges in disaster relief operations: evidence from the 2017 Kermanshah earthquake", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 11 No. 1, pp. 107-134, doi: 10.1108/JHLSCM-08-2019-0054.

Mahani, A.B. and Kazemian, J. (2018), "Strong ground motion from the November 12, 2017, M 7.3 Kermanshah earthquake in Western Iran", *Journal of Seismology*, Vol. 22 No. 6, pp. 1339-1358, doi: 10.1007/s10950-018-9761-x.

Maxwell, D.S., Harvey, P., Walker, P., Sharbatke-Church, C. and Savage, K. (2012), "Preventing corruption in humanitarian assistance: perceptions, gaps and challenges", *Disasters*, Vol. 36 No. 1, pp. 140-160, doi: 10.1111/j.1467-7717.2011.01245.x.

Moore, S., Eng, E. and Daniel, M. (2003), "International NGOs and the role of network centrality in humanitarian aid operations: a case study of coordination during the 2000 Mozambique floods", *Disasters*, Vol. 27 No. 4, pp. 305-318, doi: 10.1111/j.0361-3666.2003.00235.x.

Najafi, M., Eshghi, K. and Dullaert, W. (2013), "A multi-objective robust optimization model for logistics planning in the earthquake response phase", *Transportation Research Part E: Logistics and Transportation Review*, Vol. 49 No. 1, pp. 217-249, doi: 10.1016/j.tre.2012.09.001.

Negi, S. and Negi, G. (2020), "Framework to manage humanitarian logistics in disaster relief supply chain management in India", *International Journal of Emergency Services*, Vol. 10 No. 1, pp. 40-76, doi: 10.1108/IJES-02-2020-0005.

Nurmala, N., de Leeuw, S. and Dullaert, W. (2017), "Humanitarian–business partnerships in managing humanitarian logistics", *Supply Chain Management: An International Journal*, Vol. 22 No. 1, pp. 82-94, doi: 10.1108/SCM-07-2016-0262.

Overstreet, R.E., Hall, D., Hanna, J.B. and Rainer, R.K. (2011), "Research in humanitarian logistics", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 1 No. 2, pp. 114-131, doi: 10.1108/20426741111158421.

Özdamar, L. and Ertem, M.A. (2015), "Models, solutions and enabling technologies in humanitarian logistics", *European Journal of Operational Research*, Vol. 244 No. 1, pp. 55-65, doi: 10.1016/j.ejor.2014.11.030.

Pedraza-Martinez, A.J., Stapleton, O. and Van Wassenhove, L.N. (2013), "On the use of evidence in humanitarian logistics research", *Disasters*, Vol. 37, pp. S51-S67, doi: 10.1111/disa.12012.

Peyravi, M., Marzaleh, M.A. and Khorram-Manesh, A. (2019), "An overview of the strengths and challenges related to health on the first 10 days after the large earthquake in the west of Iran, 2017", *Iranian Journal of Public Health*, Vol. 48 No. 5, pp. 963-970.

Safarpour, H., Fooladlou, S., Safi-Keykaleh, M., Mousavipour, S., Pirani, D., Sahebi, A., ... Dehghani, A. (2020), "Challenges and barriers of humanitarian aid management in 2017 Kermanshah earthquake: a qualitative study", *BMC Public Health*, Vol. 20 No. 1, doi: 10.1186/s12889-020-08722-5.

Scanlon, J., Helsloot, I. and Groenendaal, J. (2014), "Putting it all together: integrating ordinary people into emergency response", *International Journal of Mass Emergencies and Disasters*, Vol. 32 No. 1, pp. 43-63.

Scheidlinger, S. (1991), "Conceptual pluralism: AGPA's shift from orthodoxy to an "umbrella" organization", *International Journal of Group Psychotherapy*, Vol. 41 No. 2, pp. 217-226, doi: 10.1080/00207284.1991.11490645.

Schiffling, S., Hannibal, C., Fan, Y. and Tickle, M. (2020), "Coopetition in temporary contexts: examining swift trust and swift distrust in humanitarian operations", *International Journal of Operations & Production Management*, Vol. 40 No. 9, pp. 1449-1473, doi: 10.1108/IJOPM-12-2019-0800.

Schulz, S.F. and Blecken, A. (2010), "Horizontal cooperation in disaster relief logistics: benefits and impediments", *International Journal of Physical Distribution & Logistics Management*, Vol. 40 Nos 8/9, pp. 636-656, doi: 10.1108/09600031011079300.

Sheu, J.-B. and Pan, C. (2014), "A method for designing centralized emergency supply network to respond to large-scale natural disasters", *Transportation Research Part B: Methodological*, Vol. 67, pp. 284-305, doi: 10.1016/j.trb.2014.05.011.

Sigala, I.F. and Wakolbinger, T. (2019), "Outsourcing of humanitarian logistics to commercial logistics service providers: an empirical investigation", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 9 No. 1, pp. 47-69, doi: 10.1108/JHLSCM-12-2017-0073.

Sopha, B.M., Achsan, R.E.D., Asih,. and A.M.S. (2019), "Mount Merapi eruption: simulating dynamic evacuation and volunteer coordination using agent-based modeling approach", *Journal of Humanitarian Logistics and Supply Chain Management*, Vol. 9 No. 2, pp. 292-322, doi: 10.1108/JHLSCM-05-2018-0035.

Stephenson, M., Jr. and Schnitzer, M.H. (2006), "Interorganizational trust, boundary spanning, and humanitarian relief coordination", *Nonprofit Management and Leadership*, Vol. 17 No. 2, pp. 211-233, doi: 10.1002/nml.144.

Tatham, P., Spens, K. and Kovács, G. (2017), "The humanitarian common logistic operating picture: a solution to the inter-agency coordination challenge", *Disasters*, Vol. 41 No. 1, pp. 77-100, doi: 10.1111/disa.12193.

Thomas, A. and Mizushima, M. (2005), "Logistics training: necessity or luxury", *Forced Migration Review*, Vol. 22 No. 22, pp. 60-61.

Tomasini, R.M. and Van Wassenhove, L.N. (2009), "From preparedness to partnerships: case study research on humanitarian logistics", *International Transactions in Operational Research*, Vol. 16 No. 5, pp. 549-559, doi: 10.1111/j.1475-3995.2009.00697.x.

Unisdr, C. (2015), "The human cost of natural disasters: a global perspective".

Urrea, G. and Pedraza-Martinez, A.J. (2019), "Private donations for humanitarian operation", *Decision-Making in Humanitarian Operations*, Palgrave Macmillan, Cham, pp. 31-54, 10.1007/978-3-319-91509-8_2.

van der Laan, E., Dalen, J. V., Rohrmoser, M. and Simpson, R. (2016), "Demand forecasting and order planning for humanitarian logistics: an empirical assessment", *Journal of Operations Management*, Vol. 45 No. 1, pp. 114-122, doi: 10.1016/j.jom.2016.05.004.

Van Wassenhove, L.N. (2006), "Humanitarian aid logistics: supply chain management in high gear", *Journal of the Operational Research Society*, Vol. 57 No. 5, pp. 475-489, doi: 10.1057/palgrave.jors.2602125.

Van Wassenhove, L.N. and Pedraza Martinez, A J. (2012), "Using or to adapt supply chain management best practices to humanitarian logistics", *International Transactions in Operational Research*, Vol. 19 Nos 1/2, pp. 307-322, doi: 10.1111/j.1475-3995.2010.00792.x.

Vidolov, S. (2014), "Collaborative re-orderings in humanitarian aid networks", *International Conference on Information Systems for Crisis Response and Management in Mediterranean Countries*, 120-134. Springer, Cham.

Whittaker, J., McLennan, B. and Handmer, J. (2015), "A review of informal volunteerism in emergencies and disasters: definition, opportunities and challenges", *International Journal of Disaster Risk Reduction*, Vol. 13, pp. 358-368, doi: 10.1016/j.ijdrr.2015.07.010.

Xu, L. and Beamon, B.M. (2006), "Supply chain coordination and cooperation mechanisms: an attribute-based approach", *The Journal of Supply Chain Management*, Vol. 42 No. 1, pp. 4-12, doi: 10.1111/j.1745-493X.2006.04201002.x.

Yadav, D.K. and Barve, A. (2015), "Analysis of critical success factors of humanitarian supply chain: an application of interpretive structural modeling", *International Journal of Disaster Risk Reduction*, Vol. 12, pp. 213-225, doi: 10.1016/j.ijdrr.2015.01.008.

Yin, R.K. (2009), *Case Study Research: Design and Methods*, 5th ed., Sage.

Further reading

Bakker, M.H., Kerstholt, J.H. and Giebels, E. (2018), "Deciding to help: effects of risk and crisis communication", *Journal of Contingencies and Crisis Management*, Vol. 26 No. 1, pp. 113-126, doi: 10.1111/1468-5973.12155.

World Health Organization (2008), *ReliefWeb Glossary of Humanitarian Terms*, United Nations Office for the Coordination of Humanitarian Affairs, available at: www.who.int/hac/about/reliefweb-aug2008.pdf (accessed 23 June 2020).

Appendix 1

As previously mentioned, the topics of the interviews with the affected families and emergency managers of HFIR embraced a wide-ranging issue from the initial hours immediately after the disaster to future planning. Some topics directly or indirectly related to the objective of this research study are mentioned in Tables A1 and A2. As shown in Tables A1 and A2, the topics are numbered with $T_{i,j}$, whereas i represents the main topic number and j represents the question (subtopic) number. It should be emphasised that T_7. *Humanitarian aid* in Tables A1 and A2 is the main topic directly related to the objective of this paper.

Figure A1 Percentage of different types of donations provided by respondents

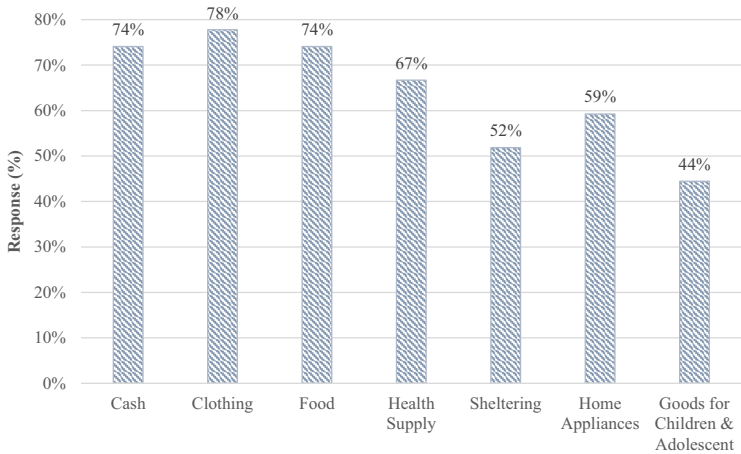


Figure A2 The percentages of channels used by humanitarians to identify displaced people demands

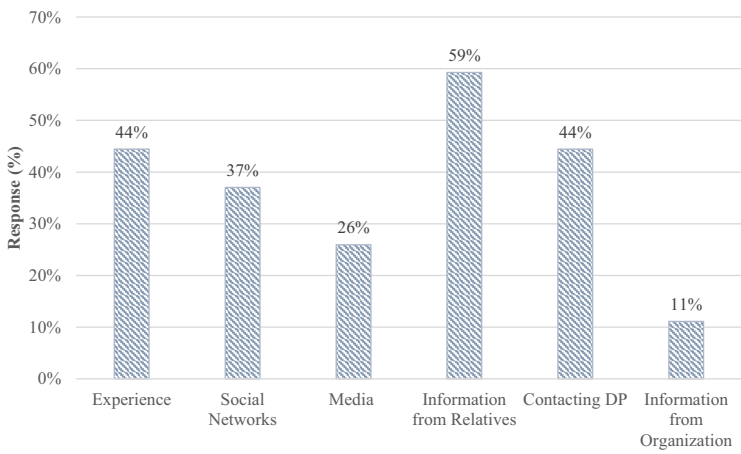


Figure A3 Percentages corresponding to approaches applied by respondents to choose distributions zones for their donations

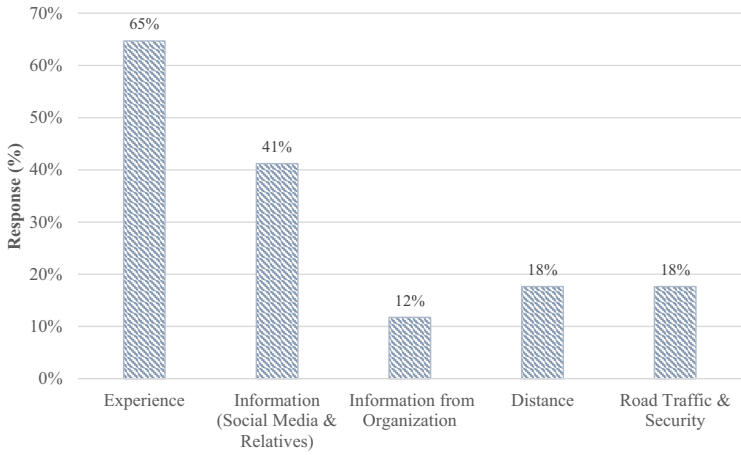


Figure A4 The frequency (%) of selected factors, which could lead to inappropriate humanitarian operations, by respondents

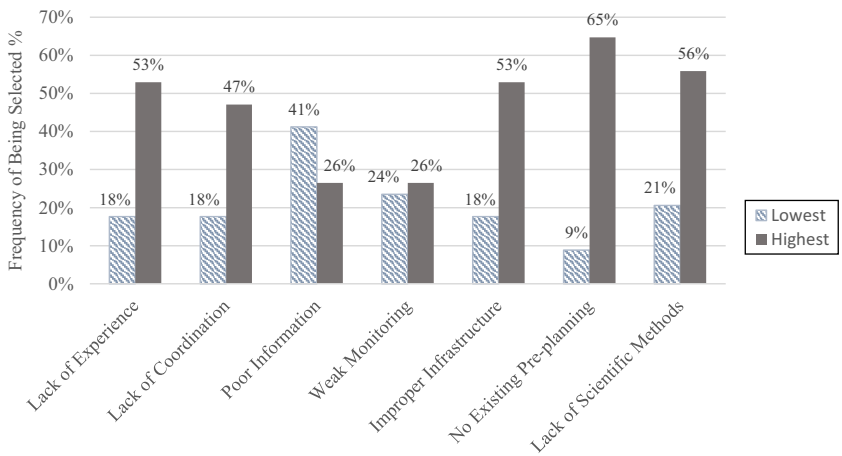


Figure A5 The impotence of the factors based on weighted means considering agents' experience

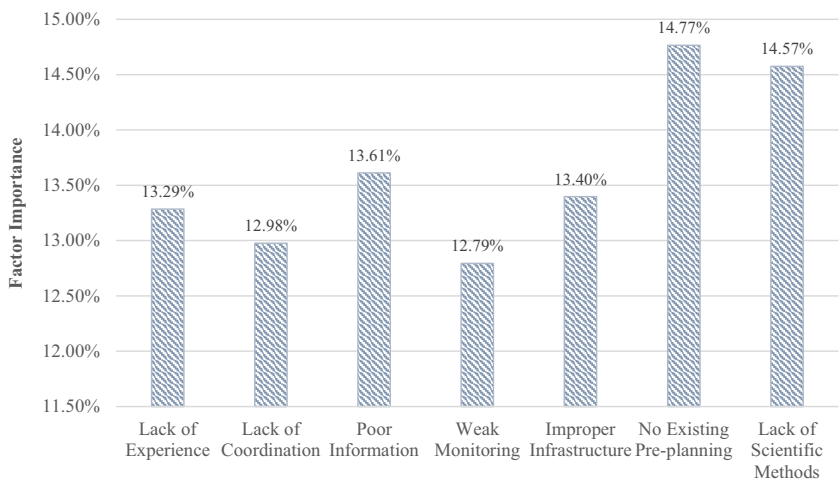


Figure A6 Influence rate of actors based on points (high: 8–10, medium: 4–7 and low: 0–3) assigned by respondents

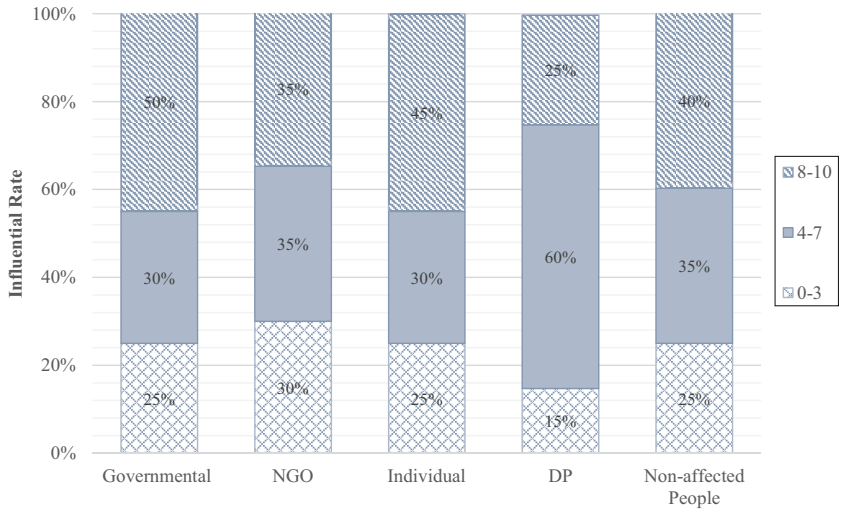


Figure A7 Influence rate of actors based on weighted means considering agent experience

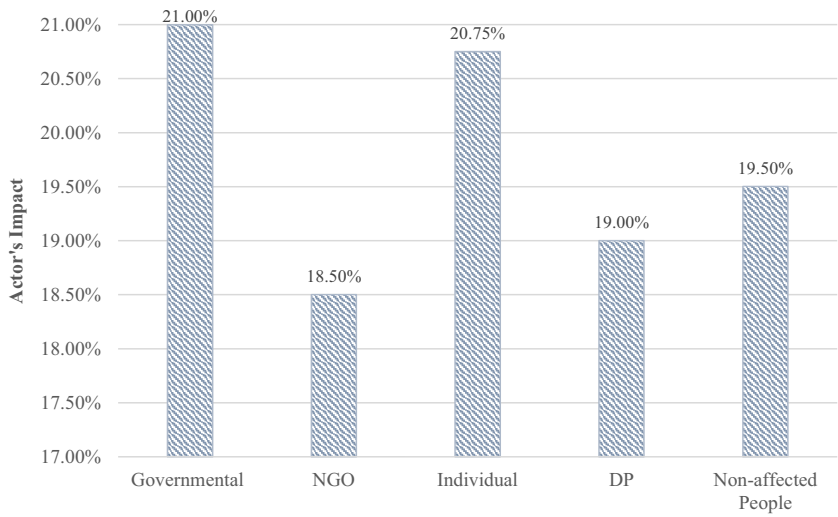


Figure A8 Ranking displaced people needs during the first three months by respondents

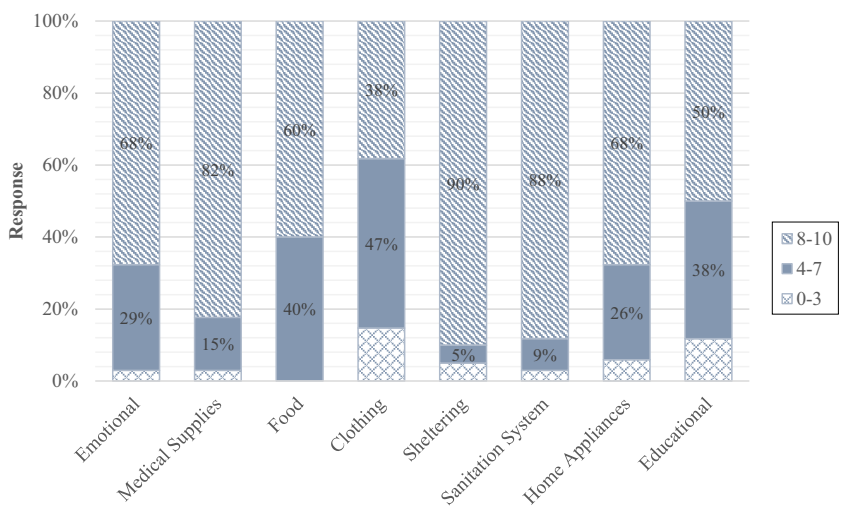


Table A1 Main topics of the interview with affected families

No.	Topic
T_1	Personal information (Number of households, Age, Sex, Disability, Education, etc.)
T_2	Loss caused by the event (casualty, death and damaged property)
T_3	Occupation status (pre- and post-disaster)
T_4	Habitation status (pre- and post-disaster)
T_5	Participation (all phases of disaster management)
T_6	Challenges and problems (Shelter, Food, Safety and Security, Health, Economic, Education, etc.)
T_7	Humanitarian aid
$T_{7.1}$	How did you provide for your basic needs?
$T_{7.2}$	What is the role of official organisations in meeting your needs?
$T_{7.3}$	What is the role of individuals and private organisations in meeting your needs?
$T_{7.4}$	What percentage of your needs have been provided by individuals and private organisations?
$T_{7.5}$	How have you received donations from individuals and private organisations? (How were the donations distributed by individuals and private organisations?)
$T_{7.6}$	Have organisations (official and others), and individuals asked you about your exact needs? If so, how?
$T_{7.7}$	Have you collaborated with organisations (official and others) and individuals? If so, how?
$T_{7.8}$	What are the weaknesses and challenges of providing and delivering your needs by organisations (official and others) and individuals?
$T_{7.9}$	What is the negative impact of private organisations' and individuals' humanitarian operations on other sections, such as the local market?
T_8	What solutions would you suggest for the existing problems?

Table A2 Main topics of the interview with emergency managers from Housing Foundation of the Islamic Republic of Iran

No.	Topic
T_1	Personal information (Position at HFIR, Work experience, Age, Education, etc.)
T_2	Activity area within HFIR, including duties and areas of responsibility in all phases of disaster management
T_3	Specific activity of the department, to which the interviewee is affiliated
T_4	System to evaluate the damage rate and required actions
T_5	The master plan for disaster management, mainly accommodation provision after the event
T_6	Approaches to communicate and collaborate with upstream and downstream organisations
T_7	Humanitarian aid
$T_{7.1}$	How have you provided for the needs of the affected people?
$T_{7.2}$	How have you identified the affected people?
$T_{7.3}$	With which organisations and institutions have you been collaborating and cooperating to provide for the needs of the affected people?
$T_{7.4}$	How do you see the role of individual helpers and private organisations in humanitarian operations after the Kermanshah earthquake?
$T_{7.5}$	Have you collaborated or cooperated with individuals and private organisations in humanitarian operations? If so, how?
$T_{7.6}$	What are the main features of individuals and private organisations working with your organisation?
$T_{7.7}$	What were the challenges of having many individual helpers in the affected areas?
$T_{7.8}$	Which approaches would you suggest to get the most from the individuals' potential?
T_8	How do you document the operational aspects in the Kermanshah case?
T_9	What is your plan to modify the system, including all parties, as well as the operational structure of HFIR, to overcome the existing challenges for future events?
T_{10}	Have you used academic potentials to overcome the problems? If so, how?

Appendix 2

As previously mentioned, the questionnaire comprises three sections. The first part of the questionnaire was designed to collect information about the respondents' familiarity with humanitarian operations and the affected areas, as shown in Table A3.

The second section of the questionnaire considered the respondents' humanitarian activities in the aftermath of the Kermanshah earthquake. The third section of the questionnaire was designed to consider respondents' ideas and knowledge on improving humanitarian aid operations. Table A4 shows questions and answers to the second and third sections of the questionnaire. As shown in Table A4, the questions are numbered with $Q_{i.j}$, whereas i represents the section and j represents the question number. Additionally, in Table A4, A-$Q_{i.j}$ refers to the analysis or comparison of the answer to $Q_{i.j}$ with other answers.

Table A3 General information on the respondents

Place of residence		Humanitarian experience (Years)				Experience (Phase)		Familiarity with local culture			
Kermanshah Province	Others	<1	1< <5	5< <10	>10	Pre-disaster	Post-disaster	High	Medium	Low	NAA
14%	86%	40%	23%	14%	23%	15%	85%	12%	47%	35%	6%

Table A4 The second and third sections of the questionnaire

No.	Question	Answer
Second section		
$Q_{2.1}$	In which section of humanitarian operation have you participated?	85% were involved in providing and collecting monetary and in-kind donations, 44% in transportation and distribution, 22% in rescue activities and 19% in preparing shelters
$Q_{2.2}$	Which type of donations have you provided?	The donations provided by the participants could be categorised into the seven main groups, as shown in Figure A1
$Q_{2.3}$	Did you distribute the collected donations to the affected populations by yourself?	63% answered "Yes"
$A\text{-}Q_{2.3}$	29% of agents who distributed donations by themselves had no humanitarian experience or less than one year of experience. The familiarity range of this group of actors, shown in Table A3, was not high	
$Q_{2.4}$	Have you provided in-kind donations from the local market? If yes, what is the percentage?	6% of actors provided all their supplies from the local market of the affected area. 35% of all actors provided very low percentages of supplies from the Kermanshah local market, and 41% of all actors did not provide anything from that market
$Q_{2.5}$	Have you considered whether supplies had been covered by others to avoid wasting in-kind donations?	59% answered "Yes"
$A\text{-}Q_{2.5}$	60% of these actors, who considered donation coverage, had more than five years of experience in humanitarian operations. These actors mainly shared information and supply inventories with others to avoid providing more donations than the demand. One individual agent, who had more than 10 years of humanitarian experience, contacted one of the warehouses through his friends to obtain an inventory list and analysed DP demands	
$Q_{2.6}$	Have you used local workforces? If so, for what purpose?	90% answered "Yes" 88% of agents used local people to get the required information, 56% used local people to distribute in-kind donations. Additionally, 34% of agents asked local people to supply the required donations
$A\text{-}Q_{2.6}$	Only 10% of agents did not use local potential, even if these agents did not have enough manpower. All respondents in this 10% group had less than one year of humanitarian experience	
$Q_{2.7}$	How did you identify DP and their needs?	41% of the respondents chose one of all the aforementioned channels (personal experiences, non-affected local people, trusted people, and organisations) to identify DP to deliver the donations. 65% of all responses recognised DP based on their experience and trusted local people. Only 12% of agents used the help of a responsible organisation/institute to recognise DP To recognise and supply the demands of the affected people, 52% of agents used more than one of the channels, which are presented in Figure A2
$Q_{2.8}$	When did you deliver supplied needs to DP?	82% of all actors delivered the donations within one week of knowing the demand. Meanwhile, 63% mentioned that delivery time was less than three days
$Q_{2.9}$	Which criteria have you considered for choosing distribution zones for your donations?	As shown in Figure A3
$A\text{-}Q_{2.9}$	80% of respondents mentioned that they focused on more than one affected region to deliver aid to DP. Meanwhile, the remaining actors only concentrated on one region. All respondents who focused on only one region were individuals, of whom 67% had more than five years of experience in humanitarian operations	

(***continued***)

Table A4

No.	Question	Answer
$Q_{2.10}$	Have you documented your activities, including the amount of donations, costs, delivery time, distribution locations, and so on?	55% answered "Yes"
$Q_{2.11}$	Have you applied any technique/approach to minimise operation costs?	58% answered "Yes"
$Q_{2.12}$	If there were a scientific approach that could improve your humanitarian operation efficiency, would you use it?	90% answered "Yes"
$Q_{2.13}$	Do you agree to receive accurate information from official organisations?	45% answered "Yes" 15% of all respondents do not trust these organisations at all. In total, 60% of all respondents prefer not to coordinate with governmental or non-governmental organisations when distributing donations
Third section		
$Q_{3.1}$	Which factors could lead to inappropriate humanitarian operations? What is the impact rate of these factors?	As shown in Figure A4
$A\text{-}Q_{3.1}$	Agents (41% of respondents) who selected the *poor information* factor as the least important, 65% had less than one year of humanitarian experience. The *no existing pre-planning* factor was selected as the most influential factor by 65% of all respondents Additionally, as shown in Figure A5, weighting the factors based on agents' experience demonstrates that the *no existing pre-planning* factor has the highest impact on the humanitarian operation success rate from respondents' point of view	
$Q_{3.2}$	Which actors have had a negative impact on humanitarian operations in the aftermath of the Kermanshah earthquake? What is the importance (weighting) of the impact of these actors on problems of humanitarian operations?	The actors could generally be categorised as shown in Figure A6. As shown in Figure A6, the points assigned to the actors are categorised into three groups, including 0–3, 4–7, and 8–10 rates, which represent low, medium, and high impacts, respectively
$A\text{-}Q_{3.2}$	From high impact (8–10 rates), 50% of respondents considered that governmental organisations played the greatest role in problems concerning Kermanshah humanitarian operations. From this group of 50% of respondents, 30% had more than five years of experience, and 45% had less than one year In general, as shown in Figure A6, governmental organisations, individuals, and local non-affected populations are assigned to a group of actors with highly influential roles in the problems concerning Kermanshah humanitarian operations As shown in Figure A7, weighted means of all factors based on the agents' years of experience shows that the governmental organisations were selected as the most influential actors in humanitarian operations by the respondents	
$Q_{3.3}$	What are the most important needs for affected people for the first three months after the event from your point of view?	All types could be broken down into eight groups, as shown in Figure A8, which presents results of weighted means based on the respondents' experience confirming this order of needs

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