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Exploring the role of the sharing economy in disasters management

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ABSTRACT

Improvements in information and communications technologies (ICTs) have facilitated the inclusion of the sharing economy (SE) in societies more than ever. In the aftermath of recent disasters, the SE played significant roles to help the affected people and support official responders. However, the literature has not effectively explored these roles, and thus, no framework can support the systematic inclusion of the SE in disasters management. This paper aims to address the gap through a two-stage exploratory research approach. First, we conduct a systematic literature review to identify the extent to which the SE is taken into consideration in disasters. After that, we investigate the role of three Iranian SE-based companies that were involved in the 2019 Iran floods response. We collect empirical data by conducting semi-structured interviews and reviewing official reports.

Our findings indicate that very few studies discuss the different roles of the SE in disasters, although SE companies have often provided effective solutions to address critical post-disaster logistics challenges. Four research propositions are presented to describe emerging roles for SE companies. The contribution of our study is twofold. First, our research identifies the different roles that the SE could play in disasters and therefore, brings a new perspective to the literature. Second, the study suggests opportunities for collaboration and partnership models from the point of origin to delivery that can support coordination and logistics in disasters.

1. Introduction and research design

The social and economic impacts of disasters on people and societies has increased over the last years. In 2019, sudden-onset disasters such as floods, hurricanes, and earthquakes affected over 25 million people and caused US$ 17 billion in economic damages [1]. Pre- and post-disaster logistics is central to saving lives and alleviating the sufferings of affected people [2]. However, multiple studies contend that challenges such as information gaps, damaged infrastructure, funding shortfalls, and limited resources (vs. many actors) hinder effective, efficient, and timely disasters response [3–5]. Recently, developments based on information and communication technologies (ICTs) have shown potentials to facilitate sharing resources and therefore, contribute to addressing shortfalls in pre- and post-disaster logistics [6].

The sharing economy (SE) is an economic model based on sharing, swapping, bartering, gifting, trading, or renting access to products as opposed to ownership [7]. The SE enables sharing goods, services, ideas, information, and skills through a network of individuals, facilitated through social networks and websites via computers, mobile applications and other information systems over the Internet [8]. For instance, Airbnb[1] (the well-known SE-based house-sharing company), runs a disaster relief service which helps hosts to offer free, temporary housing to people affected by disasters or relief workers in need of shelter or a place to stay [9]. According to Wong and Shaheen [10], the size and reach of large SE-based companies, such as Airbnb, suggest that their presence (or lack thereof) in disasters could significantly impact sheltering or transportation in affected areas. As such, there is a need to investigate the roles of the SE in disasters management phases, i.e., preparedness, response and recovery. Although several reports exist on the benefits of incorporating the SE in disasters, literature calls for research that can foster a systematic inclusion of the SE in disasters management (e.g., Heaslip [11] and Proserpio and Tellis [12]).

Our study aims to explore and shed light on the roles of the SE in disasters management. In our work, we investigate the following research question (RQ): *Does the SE have a role in disasters management, and if yes, what roles does (or could) the SE play in disasters management?* We follow an exploratory approach to address the RQ (cf. Section 1.1) and the contribution of our paper is twofold. First, by identifying different roles of the SE in disasters, we propose four propositions for

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[1] Airbnb provides an online platform that allows users to participate in a marketplace of homes and rooms where people can rent out their space or rent other's places (source: airbnb.com).

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future research and an empirically validated framework that provides key directions for a systematic use of the SE. Second, our study suggests opportunities for new collaboration and partnership models from the point of origin to beneficiaries in disasters prone areas. It is not only in the interest of practitioners to consider potential partnerships and address shortfalls in post-disaster logistics but also of the SE that seeks for ways to increase their social impact.

1.1. Research design

The nature of our study is inductive [13]; it uses available literature and insights from the field to derive evidence-based propositions. Our study follows a two-stage exploratory approach: (i) a systematic review of the literature to identify what extent the SE was discussed and (ii) a case study to investigate the roles of the SE from empirical data. We aim to identify and triangulate complementary information to address the RQ. Our rationale for choosing these approaches refers to their strengths for addressing the intention of the study as follows. The literature review sheds light on how scholars have discussed the inclusion of the SE in disasters. The case study shares empirical insights on the commitment and services that the SE can contribute to real-world operations.

Two authors conducted analysis separately without any interactions, although the overall process was carried out in parallel. The two approaches led to distinct findings for the literature review and the case study that are described in Sections 2 and 3, respectively. The cross-analysis approach was then employed to collate and compare the two findings and helped us to derive four research propositions in the discussion (cf. Section 4). In Section 5, we conclude with the main implications of our work and suggestions for further research.

2. Literature review

We conducted a systematic review of the peer-reviewed academic literature [14] to identify and collect as many logistics-related applications of the SE in disasters as we could. Although there are papers in the gray literature that discuss the SE in disasters (e.g., Wong and Shaheen [10], we decided to focus on the academic literature to ensure research rigour. The review approach consists of four main steps such as (i) identification of data and selection of research papers, (ii) description and classification of selected research papers, (iii) detailed content analysis of selected research, and (iv) reporting of findings [14].

2.1. Identification, classification and content analysis of papers

To conduct the review, we used the following search string ("sharing economy" OR "collaborative economy" OR "peer to peer") AND ("humanitarian" OR "disaster" OR "crisis" OR "emergency") in the Web of Science and Scopus databases. With the increasing development of the SE, many different similar and related terms have been used in the literature for the SE, e.g., the "collaborative economy" and "peer to peer" [15]. We considered January 1, 2009 to August 30, 2019 for our search timeline as the SE contributions were mainly developed during this period [15]. The restrictions for the searches were narrowed down to English language, academic articles and the field tags topic and title. These tags where chosen to increase the relevance of the generated results. We included papers only in the following subject areas: 'Computer Science', 'Business, Management and Accounting', 'Economics, Econometrics and Finance', and 'Social Sciences'. The list of subject areas was derived from similar literature reviews regarding ICT in emergency management. Having removed duplicated results, we also excluded papers with primary focus on market trends due to our scope criterion.

Our initial search resulted in the display of more than 80 peer-reviewed research articles with details such as the title of the paper, author(s), journal title, year of publication, and most importantly the number of citations. We sorted out the initially obtained articles by the number of citations and selected only those articles that have 30 or more citations as of August 30, 2019. We have chosen the threshold of 20 so that our sample comprises reasonably impactful articles and remains free from any criticism related to quality and duplication [16]. This step of sorting reduced the number of papers to 27. After that, we reviewed abstracts and introduction sections of 27 remaining papers. Our objective was to identify studies that discuss SE applications in the contexts of 'crisis' or 'emergency' or 'disaster' or 'humanitarian'. Papers with a primary focus on using the sharing concept in mathematical models were excluded (e.g., Rodríguez-Espíndola et al. [17]. The filter left a total of eight papers (cf. Appendix A) for analysis. We followed the widely used Krippendorff [18]'s content analysis approach and coded the eight papers using the NVivo 11 software.

Table 1
The engagement of the SE in disasters [7,15,19,20].

Activity	Airbnb	Lyft	Uber	Waze	WalkScore	TaskRabbit
Accommodation provider	✓					
Transportation provider		✓	✓	✓		
Volunteer management			✓		✓	✓
Information sharing					✓	✓

We conducted an inductive approach to define relevant criteria for analysing the role of the SE in the literature. We coded the articles that discuss the SE using a two-level coding process, (a) open coding and (b) axial coding. The former was used to "examine, compare, contrast and categorise" data [17]. For each relevant text identified through the text search query, we analysed the resulting data to reveal the roles of the SE by gathering similar descriptions of the SE. We refined the labels as new insights emerged. The outcome of (a) helped us to develop a first category of engagements for the SE, as shown in Table 1, and provided an answer to the first part of our RQ. Next, the axial coding was used to relate codes (categories and concepts) to each other and identify subcategories [17]. As (a) and (b) were dependent, we carried out multiple iterations. The results constructed the answers to the second part of our RQ.

2.2. Reporting of findings

Does the SE have a role in disasters management?

Our literature review revealed remarkable results for this RQ. Our analysis shows that papers discuss the SE in disasters often from two directions. First, some papers argue for a direct role and contend that the SE enables a decentralised disasters response compared to the common command and control disaster management practice: "a few days before Hurricane Irma made landfall in Florida, Airbnb activated its disaster response program, encouraging hosts to list their homes for free and inviting evacuees to seek shelter through its peer-to-peer platform [...] at the same time, Uber said it would cap fares to avoid higher than usual prices [...] such practices can generate a shift in emergency transportation and sheltering policy" [12]. Second, other papers discuss the SE through indirect roles that provided ad hoc information support for responders and affected people: "the SE enables the sharing of concern and information which is different from the status quo materialistic treatment focusing on economic transactions and property rights transferred via sharing platforms" [20].

We found different perspectives regarding the extent to which an SE can be engaged (directly or indirectly) in disasters management. Li et al. [23] argue that the SE can play an essential role in disasters due to the continuing trend towards sharing resources and information in these constrained and uncertain contexts. Kornberger et al. [20] highlight the positive impact of the SE on collaboration and coordination in disasters response and refer to the ability of the SE to develop value-added services in contexts where information is not shared effectively. Hajibaba et al. [24] note that the SE could offer

Table 2
Emerged roles for the SE in disasters (descriptions adapted from Vega and Roussat [21] and Baharmand et al. [22])

Role	Sub-roles (if any)	Description
Actor	Partner	The SE supports responders offering some kinds of logistics activities with the ability to design while keeping the ownership.
	Coordinator	The SE implements some parts of or the overall management of physical and informational flows through the preparedness or response phases.
	Infomediary	The SE fills the information gap between affected people and responders.
Tool	–	The SE provides distinct logistics services and act as operator. The inclusion can vary depending on the specialization degree of the SE, from simple logistics activities (warehousing, inventory, transportation), to last-mile distribution and specific support.
Contributor	–	The SE plays a significant role in improving the performance of disasters logistics with respect to effectiveness, efficiency, sustainability, and flexibility.

substantial benefits to address problems related to resource deficiency, slow responsiveness, poor communication, and low support for specific vulnerable groups, such as pregnant women, kids and older people.

Despite the potential, there is no study, to the best of our knowledge, that specifically realises different roles of the SE in disasters response. Interestingly, similar findings holds true for the broader humanitarian operations literature (which often covers disasters preparedness, response, and recovery phases). Heaslip [11] contends that "the rise of social media, particularly beneficiary-to-beneficiary delivery of aid, [...] and the sharing economy have been largely ignored in humanitarian operations research". This finding is supported by the recent Besiou and Van Wassenhove [5]'s study that identifies the SE and its potential for disasters management as a gap between research and practice. That said, we think that fostering a formalised framework is necessary to leverage and incorporate the SE in disaster management more effectively.

We have also observed the following points in our analysis:

- Four articles (50%) discuss the impact of the SE on disasters response (e.g., evacuation) through case studies,
- Four articles (50%) note the application of the SE to disasters response only while exploring a general research topic related to the SE,
- Among the four papers in the first category, two studies focus on evacuation and two on social help for refugees, while other potentials like accommodation, information sharing and inventory management were not explored,
- None of the studies has offered policy recommendations to systematically include the SE in disasters response.

What roles does (or could) the SE play in disasters management?

Results of our open coding showed multiple roles for the SE in disasters, as listed in Table 2. Some of the reviewed papers referred to the active role that the SE plays in responding to disasters. We note that the engagement level, as well as the capacity and the capability of the SE, have been considered differently in these papers. However, they have commonly discussed the SE with respect to other response "actors" who aimed to alleviate the sufferings of the disaster affected people, as Kornberger et al. [20] inform "The decentralised network of persons, organisations, and resources from across the spectre of sectors has been activated for short-term needs (e.g., responding to local natural or weather disasters) or longer-term humanitarian efforts, such as refugee resettlement". Similarly, Cukier and Jackson [25] note that "SE can act as the first mode of receiving information as well as reorganising and delivering the same to governmental agencies. Each driver participating in the evacuation program can be considered as an information receiver; this number would far exceed that of telephone operators hired by responders".

Some other papers referred to the SE as "tool" which could help responders to carry out specific tasks. One task related to shelter provider: "Peer-to-peer networks, such as Airbnb, enable quick distribution of accommodation capacity and other services [...] residents can become accommodation providers by listing their properties online" [24]. Another task referred to providing transportation capacity "SE can support mass evacuation of people especially vulnerable people such as children, disabled and disadvantaged in disasters" [12].

The third role that emerged from our analysis was "contributor" referring to the positive impact of using the SE on the performance of disasters response logistics. Research shows that the SE can contribute to a more effective (improved demand coverage) and efficient (decreased logistics costs) disaster response. According to Frenken [26], the SE can "serve rare peaks in demand, for example, during natural disasters (e.g. floods) or humanitarian crises (e.g. refugees) [so that] fewer public investments have to be made as to deal effectively with peak demands". We also found evidence in the literature that the SE has a positive impact on flexibility. Prasad et al. [27] contend that shared warehousing and storage initiatives offer flexible storage solutions across multiple locations and closer to demand. Such solutions could improve the network flexibility of disasters response effectively [27].

From the findings and through our axial coding, we could distinguish some sub-roles for the "actor" namely partner, coordinator, and infomediary. Peer to peer networks such as Airbnb can provide effective and efficient shelters for disaster-affected people. For instance, in the aftermath of the 2018 Philippine typhoon, several hosts proposed to provide accommodation for disaster-affected tourists. Tourists in disaster-affected areas are typically among the most vulnerable because a) tourists are often unfamiliar with the region, and (b) damaged transportation infrastructure or loss of property (e.g., ID or money) can hinder travelling to the countries of origin for a long time [24]. The difference between partner and provider refers to the fact that in the former, the SE manages the task, while in the latter, the responders would be in charge.

Another important sub-role, coordinator, emerged from matching volunteers to relief tasks, For instance, in the aftermath of 2012 hurricane Sandy, TaskRabbit[2] called for volunteers that could help and support first responders with different tasks such as tree removal, taking pictures of damaged property, and transporting donations to those impacted. As Ganapati and Reddick [19] note, the inclusion of TaskRabbit has shown such a great impact that they got into partnerships with federal and local officials for future emergencies and disasters.

The other identified sub-role, infomediary, emerged from practices where the SE collects and disseminates information (with or without) important conclusions to beneficiaries or disasters responders. Cukier and Jackson [25] inform that the SE can support sharing information on different categories such as pre-settlement (legal advice), arrival (housing), settlement (services), and management (tracking) in disasters response. However, the SE might share information "in various degrees that they may decide", according to Frenken [26].

We note that some disasters may not lend themselves to shared mobility at the time of immediate response (e.g., emergency conditions

[2] TaskRabbit is an online marketplace for matching demands and offers for carrying out temporary jobs in different categories such as cleaning, transporting, and item delivery (source: taskrabbit.com).

Table 3
Emerged roles for the SE in disasters management.

Role	Preparedness	Response	Example source
Actor	Partnership for preparedness planning.	Partnership for response logistics.	Ganapati and Reddick [19].
Tool	Providing logistics capacities and capabilities for preparedness planning.	Providing logistics activities whilst holding management and control.	Hajibaba et al. [24]
Contributor	–	Contributing to effectiveness, efficiency and flexibility of response logistics.	Frenken [26]

may adversely impact cellular or data coverage, and earthquakes that do not provide much warning). However, homesharing and shared mobility may be able to provide critical housing, transportation, and delivery services in the aftermath of disasters before a community has completely recovered. Hajibaba et al. [24] contend that shared services through SE platforms have the potential to serve a variety of use cases during the preparedness and response phases of the disaster cycle. As such, we argue that the identified roles can be distinguished in both phases of preparedness and response.

2.3. Conceptual framework

Given the above findings, we now propose a conceptual framework, as shown in Table 3, to demonstrate the roles of the SE in disasters. We note that we found no literature that discuss the SE for the context of disaster recovery. In the following section, we will use our empirical findings to validate this conceptual framework.

3. Case study

3.1. Context

From mid-March to mid-April 2019 (Norouz holidays in the Persian calendar), massive spring floods affected at least 26 out of 31 provinces of Iran. Officials reported that more than 70 people died and 260,000 were displaced due to the widespread impact. The provinces of Golestan (north), Fars(centre), Khuzestan (south-west) and Lorestan (located in the north, centre, south-west, and west part of the country, respectively) were the most severely affected areas [28].

Due to widely spread effects, poor communication, traffic congestion, and transportation and shelter shortfalls, responders faced considerable challenges to address the urgent needs [29]. More than 140 rivers burst their banks and 409 landslides reported around the country. About 1900 cities and villages were partly or entirely destroyed, 78 roads vanished, and 84 bridges collapsed in the affected areas. Some estimations showed that floods caused at least US$ 2.2 billion in economic damages and left two million people in-need of urgent assistance with respect to evacuation, food, and shelter [30].

For the purpose of our study, we select three SE-based companies (cf. Table 4) that were actively involved in relief operations after the 2019 Iran floods. We chose to select these because one author was involved in the coordination meetings with the headquarters (HQs) of SE-based companies as a representative of official responders.

3.2. Data collection and analysis

In total, six semi-structured interviews were conducted with senior managers of Iranian Red Crescent Society (IRCS) (representing humanitarian actors) in multiple severely affected locations. All interviewees were involved in the 2019 Iran floods response and had been working in IRCS for at least eight years. To prepare our list of interviewees, we first identified key informants in our networks and then emailed them an interview invitation. Attached to this email, the interviewees received a short summary of the study, a primary list of questions, and a consent form. The group of interviewees consisted of five men and one woman. The interviews lasted between 30 to 60 min, and the took place between April 25th–May 30th 2019. Further details of the interviews and the interview protocol are presented in Appendices B and C, respectively.

All interviews were audio-recorded (given the consent of interviewees which allowed us to audiotape and transcribe the interviews) and one author wrote complementing notes when necessary. The semi-structured interviews followed a protocol that we developed based on our observations during the flood response. The protocols aimed at collecting insights from the humanitarian actors regarding the role of the three above-mentioned SE-based companies in Iran floods response. We also allowed participants to tell their story without being interrupted. Moreover, we followed emerging topics of interest during the interviews and asked follow-up questions to fully grasp interviewees' notions and opinions. In addition to interviews, two other resources were considered in data collection. We reviewed news and articles on six websites (including the SE and highly visited news agencies websites) and used our observation notes from the field. Triangulating data helped us to validate findings in case studies [31]. For data analysis, interviews were transcribed verbatim and coded through MAXQDA 18. We sent the transcribed interviews to the interviewees for review and comment. Four themes were defined for analysing the data included SE name, roles, actions, and focused location. These themes were derived from our RQ (cf. Section 1).

3.3. Empirical results

Does the SE have a role in disasters management?

According to the interviewees, the 2019 Iran floods response was their first experience with SE-based companies assisting during a disaster in many different ways. One interviewee mentioned that Digikala followed a successful campaign of relief distribution based on identified needs. We found that Digikala modified its online platform to facilitate collecting aids and distribution of relief based on needs assessed by IRCS. Digikala put a link to the results of needs assessments results on their homepage and offered required items with discounts. People as customers could buy blankets, warm clothes and hygiene kits from Digikala and Digikala consolidated the relief items every day. The collected aid was then sent to IRCS offices in different provinces. According to information on their website, the campaign was online for six days and 7,700 items worth 50,000$ dispatched.

Our interviewees also shed light on the impact of ride-sharing SE in disasters. In the aftermath of 2019 Iran floods, Snapp offered free rides for two days to affected people (including tourists) in two severely affected provinces of Fars and Lorestan. According to the interviewees, this initiative helped several survivors – who had lost their personal belongings – to reach safe places free of charge. Also, because of this initiative, responders, volunteers, and NGOs could distribute relief items for free.

We found evidence in our interviews that the SE could support shelter shortfalls too. In the aftermath of the floods, many people living in the Fars province offered free accommodation to tourists on the Divar website. Furthermore, our interviewees highlighted other free services to affected people posted on Divar, such as cellphones repair, vehicle repair, laundry and the like. According to the interviewees, such contributions not only helped the passengers and tourists to cope with

Table 4
Information of studied SE-based companies.

Name of company	The SE business model	Scope	Summary
Digikala	Customer-to-Customer and Business-to-Customer	Online goods market	Digikala is the largest e-market in Iran and has 1,700,000 unique visitors per day. More than 85% of Iran's e-commerce takes place on Digikala's online platform. Digikala provides a registration service for providing and selling legal products for public. Digikala is also a retailer with three warehouses in Tehran and 33 distribution centres across Iran (source: Digikala.com)
Snapp	Customer-to-Customer	Ride sourcing	Snapp is a match-making service to willing participants in Iran that has been launched in 2014. Its users can request a ride via windows, IOS or android applications. Snapp has more than 300,000 drivers and 10,000,000 registered passengers that use the application every day (source: Snapp.ir)
Divar	Customer-to-Customer	Online market for goods and services	Divar is an online market for services and new/second-hand goods in Iran. Over 2,000,000 people use the market for a diverse set of goods and services every day (source: Divar.ir)

the impact but also helped the responders to focus on other urgent needs in the area.

What roles does (or could) the SE play in disasters management?

According to several interviewees, two of the three studied SE-based companies offered logistics services such as the shared use of a transportation mode for passenger mobility and goods delivery (shared mobility). Since the SE managed the scheduling and shipping process, we refer to this role of the SE as "partner" (cf. Table 2). One interviewee noted that the Iranian Crisis Management Organisation have started to look into partnering with the SE to pre-position supplies, plan for shipping/transportation, and train volunteers for response, investing in resilience against inevitable crises. While there are legitimate questions to be raised about discrimination or disability, and whether such public–private collaborations meet the needs of all populations in terms of access, our interviewees think that such arrangements between responders and SE would provide additional logistics options.

Finding professional volunteers is another role that the SE played after the 2019 Iran floods: *information disseminator*. In the aftermath of the disaster, many professionals offered their services to affected people via the Divar website. One interviewee noted that: "In IRCS we have many volunteers for search and rescue but we have always problem in finding professional volunteers for disasters response [...] however, after this flood, it was our first experience to find specialised volunteers who offered their services via Divar website. It is so relieving for the affected people to find a free service when everything does not work properly". This interviewee referred to the SE as a dissemination service that improved information management in the response.

The SE could play a significant role in receiving and forwarding in-kind donations: *facilitator*. One interviewee informed us that "in our traditional way of getting donation, people helped by cash and non-cash items [...] we could then buy relief items using the cash donations but the non-cash donation was hard to distribute because their donated goods were old or not needed for people. When Digikala asked us about the needs of the affected people, we informed them and they announced the list on their online website and as a result, all of non-cash items distributed between affected people by flood". According to the interviewee, the SE "facilitated" bridging the information gap between beneficiaries and responders.

Another role of the SE after the 2019 Iran floods was shipping relief items and human resources: *logistics provider*. One interviewee mentioned that: "in last disasters we had problem in aid transportation [...] because we have limited heavy vehicles in IRCS in different provinces and it is hard to find vehicles like that in disasters time [...] But Digikala "provided logistics" and delivered all of in-kind donations from their warehouses to our distribution centres in the Golestan province. I mean their transportation network helped us during the disaster". We found similar evidence that Snapp supported responders in transporting affected people and delivering relief items. Another interviewee referred to the *operating* role of the SE in the disaster: "[SE-based companies] have trained staff in their warehouse and also for transport and it helped us to do a better response. They could help us to operate our warehouses, and navigate fleets".

Although the IRCS's volunteers organisation is responsible of distributing aid to affected people in disasters and emergencies response, the SE offered solutions to improve the performance of the disasters response logistics: *contributor*. One interviewee informed us that: "After the flood we noticed how the SE could be important in disasters response [...] to address deficiencies and shortfalls , and having an effective and efficient response". According to the interviewees, lack of transportation capacities makes a massive difference in the timeliness of response. As such, the SE not only can contribute to decreased logistics costs, but it also helps to shorten response time. Other interviewees also commented on the role of the SE in enabling optimised use of resources and vehicles which had "positive impact on the sustainability and flexibility of operations". By sustainability, the reference was made to a healthy environment, a strong economy and the well-being of the people living in the community. For flexibility, an interviewee noted that "[the SE] can contribute to the flexibility of disasters response logistics by providing more reliable and updated information, better tracking and monitoring, and access to a variety of fleets". We also found some evidence in our interviews regarding the positive impact of the SE on community resilience. According to an interviewee, "The SE contributes to community resilience because it supports resource robustness through redundancy [...] the SE enables access to several resources to perform the same logistics activities by redundancy of resources [...] which is very important in case of failure of the unit in use [...] for instance after floods. Redundancy could include alternative shelters, warehouses, or transportation mode". We refer to resilience by the ability of individuals, environments, or systems to respond to shocks and changes while continuing to operate and/or improve under the stress of the challenge [32]. Redundancy, however, is a system property that creates conditions where a failure in a key system will be immediately substituted by a backup (redundant) element [33].

Our interviewees also confirmed that the SE present an opportunity for disasters responders and support functions to incorporate the warehousing, transportation, and sheltering resources into both disaster preparedness planning and emergency response. This entails coordinating with the SE for shared mobility and other logistics functions to leverage, for instance, underused transportation capacity. According to interviewees, more engagement of the SE could provide additional resources for communities to explore in disaster recovery, too.

In summary, our case study confirmed the various literature driven roles the SE can play in disasters preparedness and response, although different names were derived such as infomediary vs. facilitator, tool vs. logistics provider, and coordinator vs. information disseminator. The differences refer to the outcome of conducting distinct coding

Table 5
Validated roles for the SE in disasters management.

Role	Preparedness	Response
Actor	Partnering with officials to design and prepare preparedness plans.	Partnering with officials for logistics, information sharing, and volunteer coordination.
Tool	Enabling capacities and capabilities for preparedness plans.	Providing distinct logistics services as logistics service providers or partners.
Contributor	Enhancing the community resilience while accessing to a wide network of resources and people.	SE contribute to effectiveness, efficiency, sustainability and flexibility of operations through sharing resources.

processes. We note that the *contributor* role emerged at both analyses; however, our empirical findings shed light on the role of the SE as a contributor to community resilience in disasters preparedness. We also found very few evidence on potential roles for the SE in disasters recovery, although we could not confirm this through the majority of interviews.

3.4. Validated framework

Given the empirical findings, we can validate our conceptual framework (cf. Table 3). Our empirical findings confirmed the main elements of the conceptual framework while adding the contributor perspective on community resilience for the preparedness phase. We present our validated framework for the role of the SE in disasters as Table 5. We note that, due to the lack of evidence, we decided to not include any role for the SE in disasters recovery and propose more investigation on that as one of the future research directions.

4. Discussion

4.1. The SE in disasters management: opportunities vs. challenges

Despite several opportunities pointed out by our interviewees about the inclusion of the SE in disasters management, we also discovered that incorporating the SE in the flood response was not easy. Several interviewees informed that the coordination between SE-based companies and responders was a great challenge: "Before the floods we didn't have any coordination with SE companies [. . .] we weren't aware about their potential and they weren't aware from our needs in disasters [. . .] it all resulted in a lack of coordination between us during the floods response. We had a meeting after the flood with the involved SE-based companies and I think it will improve next cooperation in disasters response". Another challenge was anonymity and lack of trust. One interviewee noted that: "We couldn't trust the free services offered on Divar because we didn't know who is behind of the offer [. . .] also officials announced a warning note about the offers because some of them were fraud and fake". We elaborate on these two issues in the following.

Our findings regarding the coordination and collaboration issues support previous literature that notes challenges in public–private collaborations. Tomasini and Van Wassenhove [34] argue that collaboration is a vital matter between stakeholders, the private sector, and local communities. Bisri [35] argue that disasters responders often have challenges such as lack of resources and skilled personnel. As such, they should collaborate with the private sector to be more efficient and effective. However, in high-stress disaster contexts where external resources must be mobilised immediately, and decisions must be made promptly, there is no time to determine which best resources are available [22]. Other challenges that can hinder effective collaboration may refer to different mandates and objectives, and unsuccessful experiences from previous collaborations [36]. As Baharmand et al. [22] discuss, observations from the field show that due to tremendous time pressure and the peak in demands, some contracts for disasters relief in the aftermath of the 2015 Nepal earthquake were awarded to inexperienced or unreliable organisations unable to honour their commitments.

Furthermore, our other finding related to a lack of trust also supports the literature that notes that such an issue can lead to poor collaboration between actors. Baharmand and Comes [37] note that building trust with actors willing to participate in the relief effort is a crucial success factor for effective and efficient disaster response. It is common that multiple responders operate within ad hoc and hastily formed networks in disasters response; as such, actors build temporary relationships within short time frames, i.e., "swift trust" [38]. Swift trust is a form of trust occurring in temporary organisational structures, which can include quick starting groups or teams [39]. However, the large number and variety of actors, the chaotic response context, and the lack of sufficient resources are often cited as the main reasons that can hinder swift trust [36,40]. We reflect on issues in our propositions.

4.2. Suggestion of propositions

In this section, we discuss the implications of our key findings for future research and the use of responders and policy makers. Although our study could validate literature driven roles through a case study, we think that our findings provide general indications for other similar contexts as well. We argue that first, the challenges and shortfalls of sudden-onset disasters have proved to be similar to a great extent in several cases [4]. Second, the SE that we studied were large in terms of size and customers, and our interviewees encompassed key informants from a key actor in disasters management. Third, the context of the 2019 Iran floods entailed a widespread impact, several roadblocks, and long lasted communication issues for responders. Hence, any robust solution that could support addressing logistics challenges in such a context can be counted as one of the best practices for future disasters management.

The first proposition concerns the need for academic research on the SE in disasters. Some reports after the 2019 floods showed that official authorities were not prepared for the disaster [28]. Also, warehouses, inventories, vehicles and other capacities were not in-place for disasters response in 26 out of 31 provinces in Iran [30]. One interviewee confirmed that effective and efficient response to the 2019 Iran floods suffered from duplication of efforts, transport and infrastructure breakdown, and needless in-kind donations.

Accordingly, interviewees shared several stories of how using SE platforms helped them to support people in need of urgent help. Examples range from cooperatives that allow people to share cars and homes, to crowdfunding and crowdsourcing initiatives that allow large undertakings to be accomplished through the combined efforts of many. Digikala provided a considerable capacity to address shortfalls in funding and procurement, and Divar enabled access to a vast network of suppliers and goods. Our findings are in line with the few research studies that investigated the impact of the SE in emergencies, such as Uber in USA and DiDi in China [19,23–25]. We also observed that the idea of leveraging the SE to improve disasters response and recovery received positive attention in the Iranian media and newspapers [30]. Despite the potential, we identified a lack of academic research on this domain which could foster more inclusion of the SE in disasters. Furthermore, as SE-based companies get more involved in disasters management, unforeseen obstacles are likely to emerge. Therefore, we define our first proposition as follows:

- The SE enables access to logistics resources and services that are often severely constrained in disasters contexts, and therefore the inclusion of the SE in disasters requires more research.

The second proposition relates to the emerging roles that the SE can play in disasters management according to our findings from the literature and case study. Tapping into existing platforms that offer a built-in structure for resource-sharing allows community members to make resources available to people in need during or after a disaster. Some studies have described a service delivery role for the SE in disasters response [23,24]. Airbnb, for example, acted as a tool for finding emergency shelters after the hurricane Harvey. Our study confirms the role of the SE as a tool as well. Divar, as a peer to peer service delivery SE, helped affected people through its website with various services such as finding shelter and fixing damaged critical utilities (cars and cellphones). Many people gave up their house or rooms to accommodate affected people, especially tourists who came to Shiraz town for a holiday via Divar's website and mobile application.

Other roles that we could identify in our study refer to actor and contributor. The importance of such finding is for official responders and policy makers who often suffer from shortfalls in disasters management and look for potential partnerships [26]. Our study confirmed that the SE could support responders in terms of transferring information (infomediaries), managing information flow (coordinators), and logistics providers. Our study also showed that the SE could play roles in both preparedness and response phases.

- The SE can play multiple roles in disasters management ranging from tool supporting responders to full actor sharing the supplier, coordinator, or infomediator of relief operations with other actors.

The third proposition concerns the impact of the SE on key performance indicators of disasters management. Although the SE will not act as a substitute for official professional responders, they can provide complementary resources or services. The SE can indeed help to address logistics challenges that arise due to urgency, unpredictability and or high quantity of demand in the existence of short time and high uncertainty. In the absence of complementary resources, official responders can be overwhelmed by the widespread impacts of disasters.

The impact of the SE on pre- and post-disasters logistics can be discussed with respect to common key indicators for disasters management [4]. On the one hand, the SE supports delivering the right product or service to the right person (effectiveness) by enabling access to an extensive network of volunteers and transportation means. On the other hand, it supports relief operations' time- and cost-efficiency by avoiding duplication and enhancing coordination among actors. Furthermore, sharing resources – whether through the SE or more traditional means – is more sustainable and helps to address some risks in relief distribution in the aftermath of a disaster [22].

- Using the SE implies performance improvement in disasters management with respect to sustainability, efficiency, effectiveness, and flexibility.

The last proposition reflects the facts that engagements in disasters management can benefit SE-based companies as well. From the interviews, we found that responders want to "explore what can be done together to help the cities become more resilient before, before and after a disaster". Meanwhile, we found some online evidence that the studied SE companies want to be involved in disasters management because it fits with their mission and they can help in an impactful way [41]. Our observations show that after the 2019 floods, Snapp reworked its emergency protocol prepared for the times of disasters such as earthquakes and floods to serve the affected people by free rides to shelters, shipping meals for first responders, evacuation of injuries, transporting volunteers and supporting local NGOs with logistics. Similar evidence can be observed in well-known SE-based companies, too. In their mission, Airbnb mentioned that they aim to: identify hosts who will house emergency workers and survivors; provide preparedness materials to hosts; provide emergency alerts to hosts and their guests; and provide community response training to hosts, helping them to become community leaders. Hosseini [28] contends that such efforts can be positioned as the corporate social responsibility commitment.

The SE can certainly play different roles depending on their degree of interest/involvement from corporate social responsibility commitment to the development of a strategic business activity. One of our interviewees noted that "after the initiative of Digikala for floods, [...] Bamilo [another SE-based company in Iran with similar function of Digikala] approached us for similar collaboration". One report has found a growth in the core businesses of SE-based companies after providing transportation and warehouse management services to the disaster responders [42]. Therefore, on the one hand, the partnership between the SE and responders helps to increase disasters preparedness/response capacities at the local level. On the other hand, it can provide new business opportunities, although planning to gain profit from disasters response might raise the question of ethics. Although more reflection is needed on this topic, the last proposition can be developed as follows:

- Disasters management is not only an excellent chance for the SE to advocate their corporate social responsibility commitment, but also a business opportunity to get into partnerships with response actors.

4.3. Limitations of the study and future research directions

In this section, we elaborate on the limitations of our study for each stage of the study and discuss future research directions. First, our literature review is limited as to the variety of perspectives; the considered databases, the inclusion of peer-reviewed studies only, the time-span of search, the limited number of keywords, and the focus on research articles related to disasters. The resulted sample of studies is certainly smaller than several exhaustive literature reviews that cover a broader scope including practitioner journals, white papers, and reports. As such, one research direction would be to conduct the first stage while considering a broader scope of literature. Alternatively, some other keywords can be considered when identifying relevant literature such as "peer-to-peer economy" or "platform-based".

Second, we note that the limited number of interviewees in our study might have led to potential bias in the information provided, which are difficult to overcome. We argue that the limited access to experts active in disasters management to conduct research has been widely recognised in the literature [4,5]. To address this limitation, we suggest conducting more interviews or cross-checking statements with other experts. Third, empirical investigation is needed in order to identify the criteria used by disasters responders to involve the SE in the operations systematically. Fourth, further research could also quantify the potential impact of involving the SE on different performance criteria of disasters management.

5. Conclusions

Advances in information and communication technology (ICT) envision a more effective and efficient disaster response in the future. The sharing economy (SE) is commonly described as a model using ICT and social media to promote the sharing and reusing of assets, and it received positive attention in the literature over the last few years. Such experience of sharing resources is certainly of interest for disasters responders who often have access to limited monetary and non-monetary resources while dealing with huge demands in the affected areas. However, the literature has so far hardly explored the role and capacity of the SE in disasters management. Our study addresses the gap and aims to foster a formalised framework that leverages SE platforms, including carpooling apps, and benefits disasters preparedness, response, and recovery while embracing social equity objectives.

5.1. Implications for theory

Our study sheds light on the significance of incorporating the SE for disasters management. Having explored the different roles of the SE to address information and material flow challenges within a real case, we empirically confirmed their roles as "actors" and "tools" in disasters management. We think shortfalls in shelters, relief supply and transportation can be reduced or mitigated by the SE thanks to their wide-ranging access to potential hosts, suppliers, and drivers, through their online platforms.

Our findings also show another role for the SE in disasters management; "contributors". Our review showed that the SE was previously mainly discussed as a tool that emerged to address economic crises. However, our exploratory study shows that the SE can play a significant role in improving the logistics performance and community's resilience in the aftermath of disasters. Our rationale refers to the positive impact of the SE on flexibility, effectiveness, efficiency, and sustainability of logistics in disasters management. Incorporating the SE not only improves the flexibility of disaster response – due to better access to information and resources – but also contributes to increased demand coverage, reduced logistics costs, and decreased response time.

Our study has other implications for theory as well. First, while our findings support the positive impact of the SE on disasters management, research towards which selection criteria for cooperation with SE-based companies are to be considered in the context of a disaster is missing. Official responders and other actors may need some practical key performance indicators that facilitate evaluation before getting into partnerships with the SE. Second, there is a need for research on using the SE potentials to address logistics shortfalls in the contexts of disasters recovery. Furthermore, we could identify only a few examples in our case study regarding where the SE can play a role in disasters management. More verification and empirical studies appear to be required.

5.2. Implications for practice

Our study suggests that the systematic use of the SE can support responders to address logistics shortfalls in disasters management. The SE offers vast and diffuse networks of people and resources that can be called upon with little more than a text, email, or push notification, and can be rapidly scaled up or down. Furthermore, users often underpin and support SE platforms (vs. corporations), which enhances the agility and flexibility of deployment for response (compared to bureaucratic, multi-management level, official response organisations).

However, some challenges may hinder the cooperation and collaboration in the field such as differences in mandates or goals, differences in working rhythms, culture, and individual perspective, limited resources for developing partnerships, field problems for commercial partners, different perspectives of affected communities, and lack of key performance indicators for SE companies in disasters management. Our observations showed that the inclusion of the SE in disasters management could also add to coordination challenges. Accordingly, we observed frequent communication between the responders and the HQs of SE-based companies. In this regard, we observed the importance of having ready-to-use transparent contracts for an effective cross-sector partnership.

Moreover, using the SE (or any ICT-based solution) to address logistics shortfalls in disasters management implies careful consideration of underlying risks and disruptions. ICT-based services are prone to connection issues due to the impact of major disasters. Thus, connection to SE services through webpages and mobile applications might not be possible in the aftermath of a disaster, specifically in severely affected areas. This suggests the importance of preparing for ad hoc communication services, improving the communities' resilience, and using other resources, such as logistics service providers. Baharmand et al. [22] suggests that using asset-owning logistics companies that perform physical logistics tasks can improve the effectiveness, efficiency and flexibility of disasters response significantly.

CRediT authorship contribution statement

Hamed Seddighi: Conceptualization, Investigation, Validation, Data curation, Writing – Original draft. **Hossein Baharmand:** Methodology, Resources, Data curation, Writing – review & editing, Project administration.

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Appendix A. Reviewed papers

Detailed information about our reviewed papers is provided in Table A.6.

Appendix B. Interviewees

Detailed information about our interviews is provided in Table B.7.

Appendix C. Interview protocol

Interview Introduction

Introduce the research team and briefly outline the research mission's background, rationale, objectives and intended deliverables: We want to investigate the role of three Iranian SE companies in the 2019 flood response from logistics and coordination perspectives.

Part 1: Information about the interviewee

1. Role of the interviewee in the response to flood and the job position,
2. Experience in humanitarian action,
3. Place of work (the flood region that the interviewee had role).

Part 2: Role of Digikala SE Company in flood response

1. Is Digikala participating in the response to flood in your region?
2. (If answer to 1 is yes:) What was the role of Digikala in the response?
3. (If answer to 1 is yes:) How Digikala supported the response and helped to your organisation?
4. (If answer to 1 is yes:) What were the challenges of Digikala participation in the flood response?

Part 3: Role of Snapp SE Company in flood response

1. Is Snapp participating in the response to flood in your region?
2. (If answer to 1 is yes:) What was the role of Snapp in the response?
3. (If answer to 1 is yes:) How Snapp supported the response and helped to your organisation?
4. (If answer to 1 is yes:) What were the challenges of Snapp participation in the flood response?

Part 4: Role of Divar SE Company in flood response

1. Is Divar participating in the response to flood in your region?
2. (If answer to 1 is yes:) What was the role of Divar in the response?
3. (If answer to 1 is yes:) How Divar supported the response and helped to your organisation?
4. (If answer to 1 is yes:) What were the challenges of Divar participation in the flood response?

Table A.6
Details of reviewed papers.

Author(s)	Year	Title	Outlet
Cukier, W. and Jackson, S.	2017	Welcoming Syrian refugees to Canada technology-enabled social innovation	IEEE Canada International Humanitarian Technology Conference
Frenken, K.	2017	Political economies and environmental futures for the sharing economy	Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences
Hajibaba, H., Karlsson, L. and Dolnicar, S.	2017	Residents open their homes to tourists when disaster strikes	Journal of Travel Research
Kornberger, M., Leixnering, S., Meyer, R.E. and Höllerer, M.A.	2018	Rethinking the sharing economy: The nature and organisation of sharing in the 2015 refugee crisis	Academy of Management Discoveries
Li, M., Xu, J., Liu, X., Sun, C. and Duan, Z.	2018	Use of Shared-Mobility Services to Accomplish Emergency Evacuation in Urban Areas via Reduction in Intermediate Trips—Case Study in Xi'an, China	Sustainability
Hajibaba, H., Karlsson, L. and Dolnicar, S.	2017	Residents open their homes to tourists when disaster strikes	Journal of Travel Research
Wong, S., Walker, J. and Shaheen, S.	2018	Bridging Troubled Water: Evacuations and the Sharing Economy	Journal of the National Academies of Sciences Engineering Medicine
Ganapati, S. and Reddick, C.G.	2018	Prospects and challenges of sharing economy for the public sector	Government Information Quarterly

Table B.7
Details of interviews.

Interviewee	Time	Mode	Duration (minutes)	Topics covered
IRCS Director in Chief	Apr. 19	In-person	30	SE capacities for disasters response, coordination issues between SE and responders, future collaboration plans
IRCS Deputy Youth Manager (Fars Province)	Apr. 19	In-person	60	Roles of Snapp and Divar in floods response in Fars province, IRCS plans to incorporate SE in disasters response, challenges and opportunities for incorporating SE
IRCS Deputy Search and Rescue (Fars Province)	Apr. 19	In-person	60	Roles of Snapp and Divar in floods response in Fars province, IRCS plans to incorporate SE in disasters response, challenges and opportunities for incorporating SE
IRCS Director in Chief (Golestan Province)	Apr. 19	Skype	35	Roles of Digikala in floods response in Golestan province, coordination issues between SE and responders, future collaboration plans
IRCS Deputy Volunteers Manager (Golestan Province)	May 19	Skype	35	Roles of Digikala in floods response in Golestan province, coordination issues between SE and responders, future collaboration plans
IRCS Director of In-kind Donations	May 19	In-person	30	SE capacities for disasters response, coordination issues between SE and responders, future collaboration plans

Interview round up

Explain the result of this study will be shared with the interviewee in the form of a paper. Ask if the respondent can recommend other contacts relevant to the research project. Ask if it is okay to get back to the respondent in the near future with additional questions (if required).

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