



# Quality management in humanitarian operations and disaster relief management: a review and future research directions

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## Abstract

Quality management has been widely discussed in the literature, and recent special issues on humanitarian supply chains and relief operations have emphasized the increasing importance of quality management in this key emerging area. In this paper, we provide an extensive literature review in the field of quality management in humanitarian operations and disaster relief management. Our comprehensive review, comprising 61 articles published from 2009 to 2018, leads to the identification of enablers (e.g., transparency, policy framework), challenges (e.g., financial services, identity protection), and theory development approaches, as well as numerous research gaps that must be addressed.

**Keywords** Humanitarian operations · Quality management · Organizational theories · Enablers · Challenges · Disaster relief

## 1 Introduction

Over the years, climate change, rapid urbanization, greenhouse gas emissions increase, unforeseen cataclysmic events, and natural disasters have frequently occurred (Cassar et al. 2017; Formetta and Feyen 2019; Hoeppe 2016; Paudel and Ryu 2018). Owing to extreme weather events, including floods, heatwaves, bushfires, and earthquakes, impacted populations must leave their homes every year (Fakhruddin et al. 2019; Goswami et al.

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2018; Miller et al. 2017). For example, about 17.2 million people were displaced from their homes in 2018 (Fuller 2020). Therefore, it is critical to handle disasters with the utmost care as they displace more people than any violence or conflict events (UNDRR 2020). Moreover, poverty increases owing to disaster displacement activities, especially in developing and low-income countries. Globally, US\$250 billion is lost due to natural hazards and this has forced around 26 million individuals into poverty (UNDRR 2020). Apart from displacement and poverty creation, increasing disaster frequency is one of the main reasons behind mass deaths, both during the event and post-disaster (EM-DAT 2020). Indeed, the current global scenario presents an alarming picture of events in the recent past. Examples include: (1) Cyclone Idai (2019) in Zimbabwe; around 1300 people died, with 1.5 million affected. (2) In 2018, the Sulawesi earthquake and tsunami in Indonesia together took over 4300 lives and left about 165,000 people homeless. (3) The earthquake in Nepal in 2015 had a death toll of 8964 (Daily Afrika 2019; Duggal et al. 2018; Pascapurnama et al. 2018; Paudel and Ryu 2018; Save the Children 2018). In addition, India witnessed disasters in Kerala, Assam, Bihar, and Maharashtra in 2018 and 2019 (Ali et al. 2019; Anusha and Bharathi 2019; Vishnu et al. 2019) that claimed about 150 lives and affected 15 million people in total (India today 2019). Overall, given the trend in the frequency and impacts of disasters, there is a growing need for quality management approaches within the field of disaster relief management.

Despite the fact that control over or prediction of disasters is extremely challenging, a series of principles and approaches exist for use during and post-disaster for addressing the basic needs for food, clothing, and shelter, and these can influence recovery (Aronson-Storrier 2017; Barabadi and Ayele 2018; Ersel 2015; Pascapurnama et al. 2018; Rufat et al. 2015; Tafti and Tomlinson 2019). Both the disaster and post-disaster phases require the integration of multiple stakeholders, such as non-government organizations (NGO), quick-response teams, local administration staff, nearby communities, and governments (Ritchie and Jiang 2019; Mojtahedi and Oo 2017), and structured responses in disaster-like situations are very important (Erbeyoğlu and Bilge 2020; Himes-Cornell et al. 2018; Zhou et al. 2018). Accordingly, there is a need for quality management in humanitarian operations and disaster relief management (HODRM), in which quality can be defined as “the degree to which stated results of the program at the conclusion level are being or have been achieved” (Hilhorst 2002). HODRM includes activities ranging from preparedness to the post-disaster settlement phase, and the outcome of any HODRM program is a result of the process followed (Prasad et al. 2018; Stephenson 2005); this includes security and safety for rescue teams as well as affected people (Sakurai and Murayama 2019; Whittaker et al. 2015). Quality management approaches in HODRM can help in achieving both enhanced accuracy and satisfaction regarding aid received during disasters (Craven 2017; Izumi et al. 2019; Larson and Foropon 2018).

Other aspects of quality management include appropriate transport networks and resources necessary for moving people, animals, and belongings (Baidya and Bera 2019; Pascapurnama et al. 2018; Sinha et al. 2017). Both coordination and agile structures can help agencies to respond better to the affected population (Abidi et al. 2013; Lukosch and Comes 2019; Oloruntoba and Gray 2006). Moreover, quality management practices in HODRM are associated with reduced risk to lives (Ivčević et al. 2019; Pettersson et al. 2019; Maio et al. 2018). For example, 187 UN members have indicated their agreement to adopt the Sendai framework for disaster relief operations; this framework emphasizes strengthening economic and social resilience in order to minimize the negative effects of natural and anthropogenic climate change (Aitsi-Selmi and Murray 2016; Aitsi-Selmi et al. 2015; Lassa et al. 2019). This framework emphasizes social resilience,

that is, strengthening local capacities and available infrastructure (Lyu et al. 2019; Sternberg and Batbuyan 2013; Hegde et al. 2009). On the economic side, various models, on both macro- and micro-scales, aim to estimate losses in such situations using both neo-classical and institutional growth theories (Botzen et al. 2019). Furthermore, the quality management elements of HODRM impact stakeholders and their respective involvements in decision-making processes and the assessment of the information required in disaster relief processes (Meesters and Van de Walle 2014; Zhou et al. 2018). Disasters require close coordination among different agents to ensure speedy response (Izumi et al. 2019; Mohammadfam et al. 2015; Park et al. 2013), and it is worth noting that previous studies have recommended the use of big data and predictive analytics to design a better response in HODRM (Akter and Wamba 2019; Dubey and Gunasekaran 2016, 2018, 2019b; Singh et al. 2019; Prasad et al. 2018).

Although the nature of each disaster is unique, humanitarian stakeholders need to make improvements in the process from rescue to the resettlement of displaced people (Sushil 2019; Van Well et al. 2018). Therefore, quality management approaches in HODRM are needed. The humanitarian response comprises volunteers and NGOs, and both effective and efficient management of resources is desired, which relates to lean aspects within the area of quality management in HODRM (Banomyong et al. 2019; Cozzolino et al. 2012). To save lives and maintain dignity during and post-disaster, sound quality management practices in HODRM are required (Sakurai and Murayama 2019; Kathleen Geale 2012). In addition, effective quality management approaches should strengthen vigilance for the occurrence of such situations in the future (Aliakbari et al. 2015; Al Thobaity et al. 2017; Rukundo et al. 2014). Attentiveness is crucial, as shown by the very recent example of COVID-19 (coronavirus), which has affected millions of people in more than 150 countries (The Guardian 2020). The approach recommended by the World Health Organization for mitigating such a crisis consists of finding, isolating, testing, treating, and tracing those who might have been in contact with affected people (World Health Organization 2020). This five-stage process defines quality management aspects and the approach to adopt in this particular situation, as well as scenarios and related implementations to consider. Overall, there is a clear need to incorporate quality management aspects within the area of disaster relief management.

Both cumulative complexity and uncertainty generate new challenges for humanitarian agencies dealing with disaster relief operations (Altay and Labonte 2014; Kovacic and Di Felice 2019). For example, people living in cities and urban areas are more at risk and, consequently, HODRM agencies face additional challenges in these crowded areas (Admiraal and Cornaro 2019; Dhyani et al. 2018). It is crucial to define specific role(s) for every actor involved in such situations; meanwhile, humanitarian stakeholders are also expected to innovate regarding responses to disasters (Baharmand et al. 2019; Dhyani et al. 2018; Sanderson 2019; Sushil 2019). In addition, public–private partnerships (PPP) can help with financing through, for example, corporate social responsibility programs (Behl and Dutta, 2019a, b; Chen et al. 2019; Staupe-Delgado 2019; Hildebrand et al. 2017; Whittaker et al. 2015). Moreover, appropriate HODRM funding can help in the execution and effective management of the entire humanitarian program. Another appropriate practice consists of maintaining transparency among coordinating stakeholders with a view to ensuring the quality of operations (Dubey et al. 2018; Hallwright and Handmer 2019; Nolte et al. 2012). Both coordination and collaboration can help HODRM (Moshtari and Gonçalves 2017; Moshtari 2016).

Previous studies have indicated that stakeholders' skills may not be fully utilized in such situations (Cid et al. 2018). Stakeholders range from religious organizations, affected

citizens, public–private sector, and military personnel, to local merchants (Fontainha et al. 2017; Jabbour et al. 2019; Jones et al. 2014). Stakeholders define the success of HODRM according to their respective criteria, that is, their perception of the situation requiring improvement (Gaillard and Mercer 2013; Izumi et al. 2019; Scolobig et al. 2015). Other studies have shown that stakeholders' roles and standards overlap and develop a conflicting environment that hampers the speed of disaster relief (Collins et al. 2018; Solinska-Nowak et al. 2018; Jones et al. 2014). Considering the criticality and importance of HODRM, it is essential to understand stakeholders' roles, responsibilities, and accountability while keeping common objectives in mind (Izumi et al. 2019; Lukasiewicz et al. 2017). A system with common objectives can be adopted as a means for accomplishing operational excellence and avoiding the interplay of power dynamics (Vij et al. 2019).

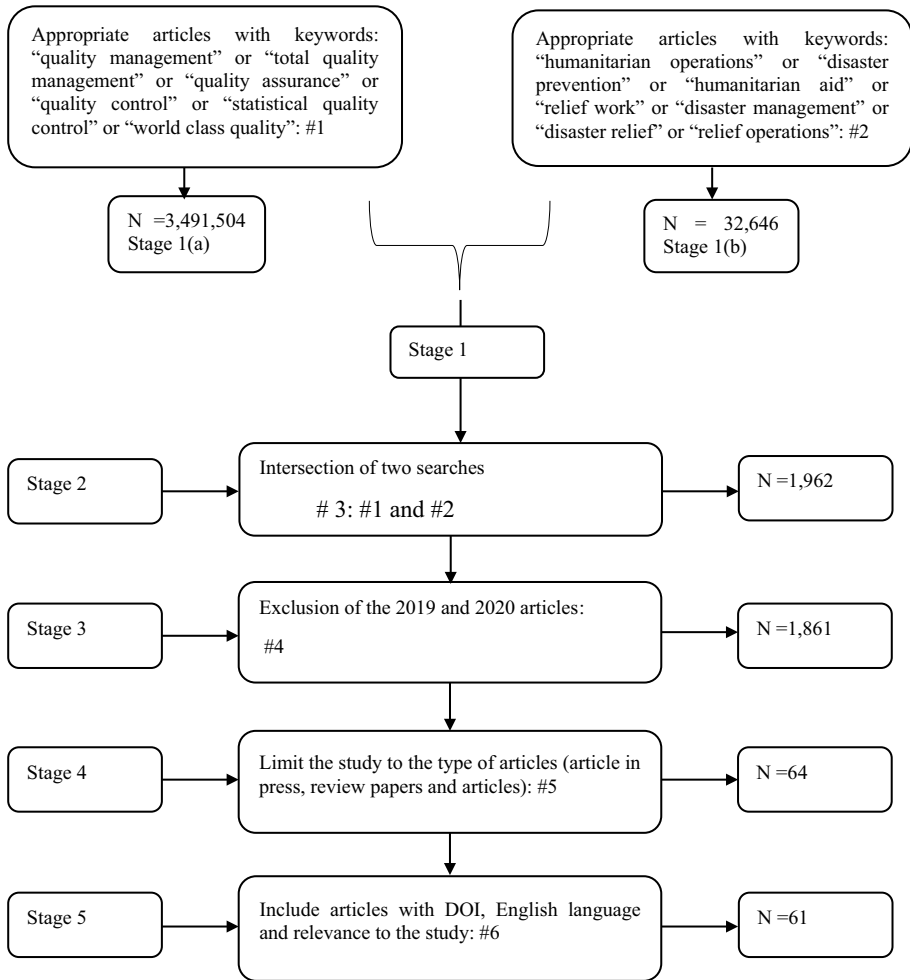
Quality management aspects in the field of HODRM can influence donors' perceptions and funding amounts (Dubey and Gunasekaran 2016; Michaud et al. 2019; Oloruntoba and Kovács 2015). During a few events, crowdsourcing has been adopted for fundraising in HODRM, whereas some other events have relied on gaming mechanisms (Han et al. 2019). Apart from funding sources, unequal power dynamics and the diverse range of actors and their philosophies affect HODRM from global to local levels (Jones et al. 2014; Lafrenière et al. 2019; Vij et al. 2019). The extant literature has indicated that it may be difficult to formalize roles and responsibilities, but it can be useful to visualize a shared view of HODRM independent of the contributions from individuals, groups, or government organizations (Twigg and Mosel 2017; Whittaker et al. 2015). Hence, to foster quality management practices in the area of HODRM, it is necessary to come up with a coherent system for providing aid for HODRM. Therefore, in this paper, we focus on the following objectives:

1. To carry out a state-of-the-art systematic literature review concerning Quality Management in HODRM;
2. To comprehend and describe grounded organizational alignment in the field of HODRM;
3. To identify and present enablers, challenges and future research directions in the field of quality management in HODRM.

The rest of the paper is organized as follows. The next sub-section focuses on core quality management aspects in HODRM. Section 2 presents the review design. Section 3 delineates the discussion emerging from the review. Section 4 indicates the conclusions, and the limitations and scope for future research follow in Sect. 5. To address the research objectives, we first establish a structured process (see Fig. 1) to filter out relevant articles. We then analyze and classify the articles according to different dimensions (presented in Appendices A through E) and further classify the articles through a grounded theory lens. Lastly, we analyze each article to present the challenges and research gaps associated with quality management in HODRM, and present these in Table 3.

## 1.1 Scope and importance of the study

Quality management practices among humanitarian players currently remain unaligned, thus leading to different value systems (Greer 2012; Hermansson 2019; Whittaker et al. 2015). In addition, it appears that good intentions are no longer sufficient in a world of rising accountability and professionalism (Bodin and Nohrstedt 2016). Accountability starts with affected people or at-risk societies and culminates with taxpayers (Alam et al. 2019; Scolobig et al. 2015). The focus here is on the level of quality that must be maintained



**Fig. 1** Data collection process. (Source Scopus Database, August 7, 2019; Author's compilation)

during such situations. Quality within the area of HODRM can be defined as the degree to which the results of a program or project have been or are being achieved (Puri et al. 2017). Hence, quality parameters can vary depending on the type, scale, and orientation of a disaster. The outcome of the operations performed depends on various factors (Bano-myong et al. 2019; Kovacs and Moshtari 2019; Yadav and Barve 2015). Considering the service orientation aspect of quality provided in HODRM, it becomes critical to provide smooth coordination between affected areas and agencies' headquarters (Larson and Foropon 2018; Paul and Bagchi 2018).

Another way to look at quality management aspects within HODRM is the relief-providing agency's certification and its associated value system (Clarke et al. 2019; Holmes 2011; Kovács et al. 2012). Moreover, the delegation of the right person at the right place at the right time with the right skills become crucial for the success of any HODRM program (Albris and Lauta 2019). Systems, tools and methods are effective when someone uses them appropriately. Even skilled personnel need to follow a systematized approach to solve

problems in order to achieve the expected results (Chandana and Leung 2010; Freitas et al. 2019). Hence, it is important to emphasize the provision of appropriate methods, tools, and systems in order to integrate all quality aspects.

A further way to look at quality management could be as a minimum standard requirement that can serve as an initial framework for involved stakeholders (Raikes and McBean 2016; Pothiawala 2015). It is worth noting that quality incurs costs that may occur in any of the critical components that help to outline, investigate, and measure response quality throughout HODRM activities, such as structure, process, and outcome (Kaku 2019).

*Structure* focuses on the quality of equipment, supplies, appropriate facilities, and strong administration (Cozzolino et al. 2017; Rodríguez-Espíndola et al. 2018). In other words, structure indicates better service access, professionalism, physical and managerial infrastructure. *Process* encompasses the interactions among affected people and the system of HODRM (Gotham and Campanella 2011; Klomp 2019). The quality of these interactions can be measured as the degree of efficiency, safety, continuity, and choice of services and technical performance, measured according to accepted standards (Aven 2016; Rezaei Soufi et al. 2019; Timms 2018). It is usually difficult to measure and predict actual impact when undersized timelines exist and, accordingly, well-known outcome measures, such as satisfaction of the end-user and degree of effectiveness in achieving the desired outcome levels, can be utilized (Ergun et al. 2014; Opdyke et al. 2019; Ma et al. 2019; Solinska-Nowak et al. 2018). The extant literature indicates that quality management in humanitarian operations emphasizes the needs of the affected population; however, focus is needed on both structure and process elements rather than specific outcomes because an outcome is a consequence of the structure and processes followed during HODRM (Gaillard and Peek 2019; Kim and Hastak 2018; Larson and Foropon 2018; Horita et al. 2018). Finally, end-user satisfaction is an essential component, and there is a need for evidence-based approaches and techniques to ensure the quality of operations in disaster relief (Izumi et al. 2019; Jillson et al. 2019; McCabe et al. 2013).

## 2 Review design

In this paper, the design of the review is based on those conducted by Gupta et al. (2020) and Dubey et al. (2017). The reasons for this inspiration are threefold. First, Dubey et al. (2017) presented a classification of the literature in terms of theory building and application, which are critical for review-based papers. Second, Gupta et al. (2020) have presented both an investigation framework and search syntax, which we have adopted as benchmarks in our study. Third, we have considered and followed the guidelines for systematic literature presented by Gupta et al. (2019, following Tranfield et al. 2003).

The review design is divided into three sections: (1) Preparing for the review, (2) steering the review, and (3) presenting and interpreting the review, as presented in the sub-sections below. Section 2.1 reports the planning for the review as well as the way in which the literature was explored. In Sects. 2.2 and 2.3 we present a diverse view of the quality principles, tools, and techniques used in HODRM.

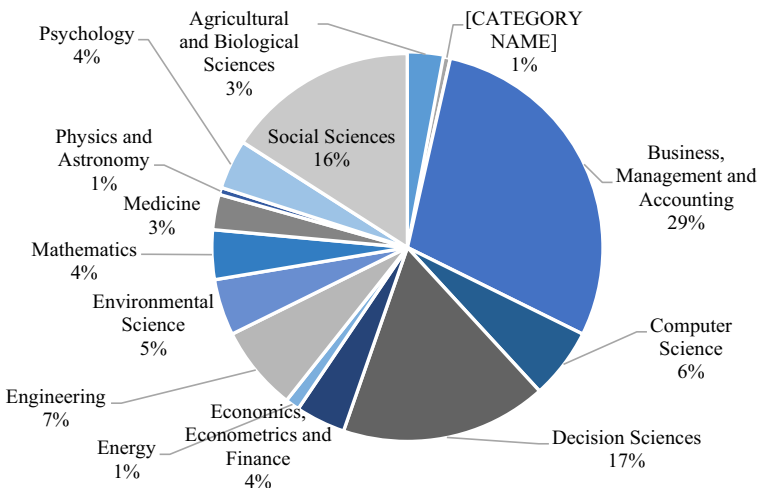
### 2.1 Exploring the literature

For the present study we utilized the Scopus database, which is a leading database comprising academic articles, books, and proceedings of distinguished conferences. In

addition, the Scopus database provides useful tools for analyzing, tracking, and carrying out research more effectively. For example, papers can be found from inter-disciplinary areas such as engineering, decision sciences, computer sciences, and social sciences. The performance of HODRM involves multiple stakeholders and different disciplines (Behl and Dutta 2019a, b). Figure 2 shows the array of subject areas selected for this review. Similar to other databases, such as World Cat or Web of Science, the Scopus database provides a leading record of academic journals.

In this study, our focus is to analyze HODRM from a quality management perspective. In the area of relief activities, humanitarian operations form one of the hard components, whereas quality management acts as a soft component (Martin et al. 2015). In humanitarian operations, continuous learning and the assurance of quick delivery of the best services play a critical role in addressing the pressing concerns of affected populations (Whittakar et al. 2015). The service orientation of quality management in relief operations emphasizes reducing waste, focusing on process engineering, and addressing issues raised by the public that help in removing potential obstacles to smooth operations (Larson and Foropon 2018; Tokman and Beitelspacher 2011). Priority services and their delivery design across different platforms play an important role in HODRM (Akbari et al. 2004). Along with process approaches, quality management also supports the adoption of lean methodology within HODRM operations (Larson and Foropon 2018; Cozzolino et al. 2012). Both lean orientation and process focus have played critical roles in increasing organizations' operational performance (Manikas et al. 2019). Both agile and resilient quality management approaches have enabled various stakeholders to respond to changes during relief operations and in the post-disaster phase.

HODRM itself is a complex task to handle owing to its scale and the geographic conditions (Clarke et al. 2019; Jabbour et al. 2019). Humanitarian supply chains and logistics have advanced in terms of coordination and digitization, along with the types of disasters in which they have been applied (Schniederjans et al. 2019). Consideration of human beings have been central to designing such programs in terms of rescuing them and providing food, clothing, shelter, and water and sanitation facilities (Krausmann



**Fig. 2** Areas of Journal Articles after stage 5. (Source Author's compilation)

et al. 2019). Therefore, the resiliency of these operations can be helpful for assuring quality and sustainable outcomes (Goldschmidt and Kumar 2016).

A search for articles relating to these two concepts was performed using the list of keywords disclosed in Table 1. Independent searches on quality and humanitarian operations were executed on Scopus through the OR operator. In addition, both concepts were integrated through Scopus using the AND operator. We have searched different platforms for other keywords mentioned in association with quality; a similar approach was adopted for humanitarian operations. To provide a common output, we used the AND operator in exploration, and Table 2 presents the syntax used in the advanced section of Scopus.

The data collection for this review was been limited to the period 2009–2018 inclusive (10 years), and the search on Scopus was performed on August 7, 2019. Up to 2009, quality concepts in general have been observed to mature enough to be applied in other fields, as exemplified by niche academic journals such as *Journal of Humanitarian Logistics and Supply Chain Management*, beginning in 2011. Recently, in 2020, the *Journal of Operations Management* has announced a special issue on “The Effects of COVID-19 on Global Supply Chains: Responsiveness, Resilience, and Restoration (3Rs),” in which the editors point out the importance of supply chain preparation in HODRM (Besiou and Van Wassenhove 2020; Gupta et al. 2016; Ye et al. 2019). In addition, the *Annals of Operations Research* has recently published a special issue on the “Application of Operations Research (OR) in Disaster Relief Operations (DRO), Part I and Part II.” This illustrates the increasing importance of HODRM and associated research topics. In this review, we excluded part of the year 2019 as the full list of published papers was not available on the date of search. Overall, the set of articles searched is a strict reflection of the data that appeared in the investigation and exploration on August 7, 2019.

The syntax presented in Table 2 resulted in the identification of 61 relevant articles that are reviewed in this study. Quality-related keywords were searched for first (see Table 1). The use of keywords is necessary to define the boundaries of any particular review and to identify related articles. This initial search identifies 3,491,504 documents. A parallel search regarding humanitarian operations was performed using the

**Table 1** Keywords used for searching the literature. (Source Author’s compilation)

Keywords			
Quality		Humanitarian operations	
	“quality management”	“humanitarian operations*”	
OR	“quality*”	“disaster prevention”	OR
OR	“total quality management”	“humanitarian aid”	OR
OR	“quality assurance”	“relief work”	OR
OR	“quality control”	“disaster management”	OR
OR	“statistical quality control”	“disaster relief”	OR
OR	“world class quality”	“relief operations”	OR
Search 1(a): 3,491,504 Documents		Search 1(b): 32,646 Documents	
Search 2: Search 1 and Search 2: 1962 Documents			
Search 3: Excluding 2019 and 2020 Papers: 1861 Documents			
Search 4: Limit to 2009 to 2018; Article, Article in Press, Review Papers; Business Management and Accounting and Decision Sciences Domain; English Language: 64 Documents			
Search 5: Limit to Documents with DOI and Excluding conference papers: 61 Documents			



**Table 2** Syntax used on Scopus. (Source Author's compilation)

Search Syntax on Scopus (Search performed on 7 August, 2019 on <a href="http://www.scopus.com">www.scopus.com</a> )	<pre> (( ( SRCTITLE ( "quality management" ) OR TITLE-ABS-KEY ( "quality*" ) OR TITLE- ABS-KEY ( "total quality management" ) OR TITLE-ABS-KEY ( "quality assurance" ) OR TITLE-ABS-KEY ( "quality control" ) OR TITLE-ABS-KEY ( "statistical quality control" ) OR TITLE-ABS-KEY ( "world class quality" ) ) ) AND ( ( SRCTITLE ( "humanitarian operations*" ) ) OR TITLE-ABS-KEY ( "disaster prevention" ) OR TITLE-ABS-KEY ( "humanitarian aid" ) OR TITLE-ABS-KEY ( "relief work" ) OR TITLE- ABS-KEY ( "disaster management" ) OR TITLE- ABS-KEY ( "disaster relief" ) OR TITLE-ABS- KEY ( "relief operations" ) ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) OR LIMIT-TO ( DOCTYPE , "re" ) OR LIMIT-TO ( DOCTYPE , "ip" ) ) AND ( LIMIT-TO ( SUBJAREA , "DECI" ) OR LIMIT- TO ( SUBJAREA , "BUSI" ) ) AND ( LIMIT-TO ( PUBYEAR , 2018 ) OR LIMIT-TO ( PUBYEAR , 2017 ) OR LIMIT-TO ( PUBYEAR , 2016 ) OR LIMIT-TO ( PUBYEAR , 2015 ) OR LIMIT-TO ( PUBYEAR , 2014 ) OR LIMIT-TO ( PUBYEAR , 2013 ) OR LIMIT-TO ( PUBYEAR , 2012 ) OR LIMIT-TO ( PUBYEAR , 2011 ) OR LIMIT-TO ( PUBYEAR , 2010 ) OR LIMIT-TO ( PUBYEAR , 2009 ) OR EXCLUDE ( PUBYEAR , 2020 ) OR EXCLUDE ( PUBYEAR , 2019 ) ) AND ( LIMIT- TO ( LANGUAGE , "English" ) ) ) </pre>
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keywords shown on the right side of Table 1; this identified 32,646 documents. The intersection of the data resulting from the keywords used in stages 1 and 2 provided the input for the third stage; this resulted in the identification of 1962 documents.

In the next stage, we limited our search up to 2018 only, as the year 2019 was still ongoing; this resulted in 1861 documents. In stage four, we limited our search to articles published or in press in the areas of business management and accounting, along with decision sciences. Decision sciences use multiple disciplines, including engineering, mathematics, and technology, to solve business problems. In addition, the journal *Applied Geography* encourages consideration of the spatial dimension in its articles, hence these aspects are appropriate to HODRM in the current context. We also included the *Journal of Humanitarian Logistics and Supply Chain Management* as Emerald categorizes this journal within the operations and logistics management category. Moreover, we restricted the fifth stage to the English language only; this resulted in 64 articles.

With the exception of those from a computer science background, academics and researchers prefer to publish in journals rather than in conference proceedings (Derntl 2014). Therefore, we used a digital object identifier to exclude conference papers. This resulted in the identification of 61 articles. This set of articles, shown in "Appendix A", reflects a sample of truly diverse academic backgrounds (see Fig. 2). Appendices A and E indicate that *Applied Geography*, *European Journal of Operations Research*, *International Journal of Physical Distribution and Logistics Management* and *Annals of Operations Research* are among the top journals in terms of number of papers published during the time period considered. Within the scope of humanitarian supply

chains, dedicated journals exist. These include the *Journal of Humanitarian Logistics and Supply Chain Management*, which has published two articles fitting our search criteria of quality and humanitarian operations. Additionally, journals including *Disaster Prevention and Management: An International Journal* have a clear focus on our areas of interest; nevertheless, these focused journals represent fewer papers in our search.

Figure 2 shows the increasing number of published articles located at the intersection of quality management and disaster relief operations, and shows that the field of humanitarian operations has attracted the attention of researchers over the last decade. This may reflect the occurrence of life-threatening disasters such as Hurricane Harvey and the East Africa Floods; these disasters caused significant damage to property and claimed many people's lives (Krausmann et al. 2019). Appendix D presents the citation index of the top 10 papers out of the sample of 61. Finally, "Appendix E" highlights the top 10 journals, institutions, and countries that publish actively in the domain of quality management in HODRM.

## 2.2 Organizing the literature

In the present study, the selected research articles are organized and classified through organizational theories (Arumugam et al. 2014; Gupta et al. 2020; Sarkis et al. 2011). The identified literature can also be classified according to enablers and building blocks (Gupta et al. 2019; Melnyk et al. 2014; Gunasekaran and Spalanzani 2012). The literature can also be viewed through the lenses of quantitative models (Branenburg et al. 2014). Moreover, we have been inspired by the literature review-based article published by Dubey et al. (2017), in particular the authors' presentation and classification of the literature through a systematic approach without the use of analytical software. These approaches distinguish practical and theory-building studies, and then classify them. Figure 4 and "Appendix B" indicate the status of these studies in this review.

Figure 3 describes the arrangement for classification along with the number of studies in each category. Appendix B provides additional information. As a field, HODRM involves multiple stakeholders and domains; therefore, we have taken a multiple-view approach in this paper. The 61 papers identified are divided into two broad categories, namely: (1) Research-based on the application side, and (2) Theory building. In the first category, the focus is on studies that have analyzed and reported disaster incidents and have identified

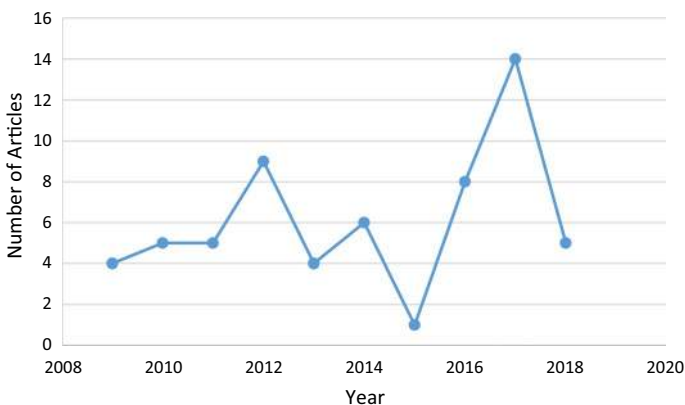


Fig. 3 Number of articles per year. (Source Author's compilation)

patterns and learning points for future planning through mathematical or expert views. In the second category, the focus is on studies supporting, extending, or refuting existing theories. This theory-building approach is further classified in terms of “rational” and “alternative” methods. Articles were further scrutinized according to their level of contribution as well as the current state of research emerging from a critical review; such articles fall under the rationalist approach. Articles were further classified on the basis of conceptual and empirical work or incident-based cases, and are classified as alternative methods. Finally, we have categorized papers with elements of theory and practice under “research based on application,” given that such papers involve experiments and theory-based research.

### 2.3 Understanding the concepts

We delineated the diverse set of enablers for quality management in humanitarian operations during and post-disaster relief activities on the basis of the 61 identified papers. We identified and listed building blocks and relevant enablers in order to understand how quality management can be maintained in humanitarian operations. Selected articles are classified according to a series of enablers and their respective constituents as presented in “Appendix C”. Apart from enablers, the study also identifies key challenges in disaster relief management.

Enablers support and facilitate the implementation of quality management components in HODRM, whereas barriers restrict both improvement and implementation of HODRM-related activities. We have utilized a thematic analysis approach based on Behl and Dutta (2019a, b) to classify enablers and barriers. A total of 39 themes have been identified from the extant literature with a view to facilitating quality management approaches in HODRM. We further grouped these 39 themes in terms of nearly matching sub-themes, thus resulting in eight new emerging themes classified under “enablers.” All enablers for maintaining quality in HODRM activities are indicated below.

#### (a) Policy framework

This is an important enabler that guides the entire management of the disaster. It includes the rope rescue method for human beings, animal evacuation, and dead body management to avoid any delay in cremation and handover to family members (Mei et al. 2013; Thompson 2018). In addition, the policy framework indicates the disaster response type and the role of equipment handling in effective disaster management (Jones et al. 2014). Moreover, the policy framework highlights the role played in supporting the coordination of and contribution to international disasters through the training curriculum for organizations’ own officers (Imperiale and Vanclay 2019). National-level policy in disaster management establishes the environment that enables the best relief efforts. The training of vulnerable communities also plays an important role in minimizing the risk of disaster situations (Cedergren et al. 2019; Griffith et al. 2019). Moreover, such frameworks help agencies to have ready their regional vigilance and mitigation strategy through coordination within and among multiple agencies. Identified articles under the policy framework enabler are classified according to the following categories (see “Appendix C”): (1) Guidelines to stimulate interaction between different stakeholders; (2) Guidelines to improve multi-agency coordination; (3) Encourage adaptability, agility, and alignment in value chain; (4) Exchange of ideas among policymakers and humanitarian operation experts; and (5) Common platform for decision making and coordination.

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(b) Commitment from stakeholders

Any disaster requires multidisciplinary activities to be performed and coordinated through a unified synergy between all stakeholders (Fakhruddin et al. 2019; Solinska-Nowak et al. 2018; Mojtahedi and Oo 2017). The list of stakeholders ranges from the affected population, to donors, to the task force and other volunteer groups involved in rescue and evacuation (Wilhite et al. 2014). Regional level disaster response teams and local communities can act more quickly than those that are located at the federal level (Carr and Jensen 2015; Edwards 2009). These special teams are trained to provide a specialized response to natural as well as man-made disasters. The teams involve a set of professionals including engineers, electricians, medical officers, paramedics, and a dog squad (Lynn et al. 2018). On the other side, trained volunteers and donors play an important role in supporting and recovering from a disaster. Suitable articles are classified within the following categories: (1) Supporting behavior; (2) Alignment between mandates, goals, and coordination; (3) Long-term vision; (4) Capacity building of humanitarian personnel; (5) Skills use of affected people in humanitarian operations; (6) Cross-community involvement; and (7) Opinion of affected population in disaster recovery.

(c) Transparency and information sharing

Fast information sharing across multiple platforms and maintaining transparency define the success of humanitarian operations. This transparency and information sharing help in cooperation and coordination of resources involved in relief operations at the agency, community, and individual levels (Aker 2017; Peltola and Hämmäinen 2018; Tsukahara 2017; Wamba et al. 2019). The division of tasks, roles, standards, rules, and expected performance can be shared across the network of resources of operations (Hallwright and Handmer 2019; Rodríguez-Espíndola et al. 2018). This helps in managing the time, propensity for innovation, and task execution in the field (Bharosa et al. 2010). In addition, agent-based modelling can be used to simulate the environment in a disaster situation and different ways to execute the task of saving lives (Wagner and Agrawal 2014). At the end of the program, the impact of information sharing and transparency can be evaluated (Dubey et al. 2019a, c; Reuter and Kaufhold 2018). Maintaining transparency also helps stakeholders to view how operations are being performed and how the flow and distribution of goods and funds are maintained. Relevant articles are classified under the following themes: (1) Accountable activities; (2) Flexible and agile flow of information; (3) Information quality; (4) Adequate information processing; (5) Usage of web-based systems to generate swift trust among the affected population and other actors; and (6) Adequate utilization of funds.

(d) Public–Private Partnership (PPP)

Municipalities and local regions can develop their capacity of resilience to tackle crises and catastrophes through the PPP model (Hernantes et al. 2019; Kapucu 2012). This integration can help to take advantage of the competencies and presence of private companies, and it also enables coordination with public organizations (Fontainha et al. 2017). The private sector can be further involved in emergency preparedness by providing training and helping in the response and recovery in such situations (Busch and Givens 2013). Locally

present private and public firms can help in initial actions and measuring the degree of emergency till the full-time taskforce arrives and takes over (Efendi et al. 2019; Moreno and Shaw 2018). Even post-disaster, these types of partnerships can help in overseeing the standards of reconstruction, training of the communities, and regular maintenance of equipment. In addition, this PPP model can help to build population confidence for tackling disasters more effectively (Weichselgartner and Pigeon 2015). Articles have been classified under the following themes: (1) Development of volunteers; (2) Regular training; (3) Developing a trustworthy environment; and (4) Involvement of NGOs and firms' corporate social responsibility arms.

(e) Support from government

Despite the involvement of international aid agencies in disasters, support from domestic government plays a significant role (Klomp and Hoogezand 2018). Effective governance during a disaster can bring many lessons about geography and can prepare the government for any future events in the same category (Dubey et al. 2019d; Walch 2019; Benali et al. 2018). The assistance and protection sought during disasters is a fundamental right of the affected population. For example, governmental nodal agencies such as India's National Disaster Response Force (NDRF) from India are involved in designing the training programs for the development of individuals, volunteers, and professionals to help in a disaster like situation (Rodríguez-Espíndola et al. 2018; Sahay et al. 2016). For crowdfunding, governmental platforms can be trusted by donors, thus enabling its further utilization and the distribution of funds to affected people and for restoring infrastructure (Dubey et al. 2019c). Governments can also support and encourage firms in the effective management of the supply of necessary goods through tax subsidies and other provisions (Kron 2009). Relevant articles have been arranged under the following themes: (1) Provision of human resources; (2) Aid to the affected population; and (3) Subsidies to firms for distribution in affected areas.

(f) Strategic planning

Increasing numbers of disasters across the world have led agencies and governments to be ready with their respective strategic plans (Bae et al. 2016; Sahebjamnia et al. 2015). Each strategic plan involves respective roles for each multi-sector actor in effective disaster management and reducing risk (Paul and MacDonald 2016a; Uhr 2017). Moreover, a strategic plan involves protocols for communication and the selection of resilient and agile suppliers (Venkatesh et al. 2019). Strategic planning includes the design of pre- and post-disaster responses along with location decisions for the relief supplies to be stored (Altay et al. 2009; Madu and Kuei 2014; Qin et al. 2018). The planning for HODRM includes internet restoration and physical infrastructure revival design, including routing and scheduling for evacuation (Cheng et al. 2015; Sabouhi et al. 2019). All options for the transportation mode and network need to be in place to ensure last-mile delivery during and post-disaster (Zhang et al. 2017). Relevant articles have been assigned to the following categories: (1) Planning for a resilient supply chain; (2) Strategic tie-up to fulfill demand via different distribution channels; (3) Disaster readiness; (4) Fleet size and routing decisions; (5)

Long-term planning to establish and advance the affected society; and (6) Establishment of robust and flexible infrastructure (soft and hard) for the future.

(g) Continuous improvement

Humanitarian operations are not just concerned with the evacuation of affected people to nearby shelters. Over the years, they have been extended to inventory planning and control, demand analysis, and collaboration with other organizations (Çankaya et al. 2019; Larson and Foropon 2018; Peng et al. 2014; Madu and Kuei 2014; Davis et al. 2013). Operations need to be further improved, extended, and linked to regional economic and political conditions in order to improve performance (Tang et al. 2019) in a continuous cycle that requires regular monitoring and measurement of activities (Larson and Foropon 2018). Tracking results can help to further improve performance and avoid strategies such as “truck and dump” that fail to establish whether supplies reach those who need them (Ozguven and Ozbay 2013; Rabta et al. 2018). Such operations can be further evaluated based on outreach to discover the perceptions of the affected population, rather than the criteria of efficiency and effectiveness (Utz et al. 2013). Key articles in this category have been classified according to the following themes: (1) Continuous monitoring and evaluation of performance; (2) Improving decision-making processes; (3) Improvement of balance between demand and supply along with appropriate price boundaries; and (4) Measuring the satisfaction level of victims.

(h) Relief speed and safety

Operations design and considerations of the timeframe lead to different phases of disaster management. The speed of the initial response depends upon the initial assessment, level of preparedness and planning, and agencies’ implementation capabilities (Galbusera and Giannopoulos 2018; Perry 2007). Response rate can be enhanced through the availability of information about the catastrophe’s background along with geographical conditions (Balcik 2017). Such information helps to embed and ensure the safety of the affected population during humanitarian operations, in which safety and security include basic needs and reliable transportation towards hospitals (Goerigk and Grün 2014; Tatham et al. 2017; Yahyaei and Bozorgi-Amiri 2018). Moreover, safety includes the effective treatment of infrastructure and preservation of natural resources (Nagurney and Qiang 2012). Along with safety, the coverage of population density under operations defines the success of a humanitarian program (Bastian et al. 2016). Related articles are categorized in the following themes: (1) Rapid response; (2) Effective reaction to the situation; (3) Ensuring the minimum risk to the public from activities; (4) Minimum risk to public and private infrastructure; (5) Avoiding the destruction of natural resources; (6) Rapid and adequate shelter and medical facilities.

After the analysis of 61 papers, the researchers developed a list of themes following Behl and Dutta (2019a, b). These themes encapsulate ensuring the quality and smooth working of HODRM. In total, 27 themes were identified, categorized under seven main headings. Overall, the seven main themes encompass challenges for ensuring quality in HODRM as described below.

(a) Access to financial services

Financial services are significantly hit in humanitarian crisis settings, and daily necessities become costlier owing to the surge in demand (Watanabe and Hayashi 2015), but affected communities do not have access to formal and informal financial services (Hong et al. 2018). Hence, challenges exist in the provision of affordable and safe access to financial services and their acceptance by local ecosystems (Lee et al. 2011). Further, in strategy terms, data privacy becomes an issue (Altay and Pal 2014). In addition, choosing and establishing a balance between cash disbursement and supply of fundamental goods represents a challenge for agencies. Appendix C highlights the following challenges corresponding to access to financial service: (1) Acceptance of e-money; (2) Cash assistance instead of in-kind items; (3) Profile security; and (4) Internet provision.

(b) Proactive identification

With rapid climate change, it is likely that disasters will become more frequent and more damaging (Shah et al. 2018). Hence, a proactive approach is required to identify communities vulnerable to different disaster types, ranging from droughts and floods to earthquakes (Nagurney and Qiang 2012; De Oliveira Mendes 2009). Agencies need to come up with effective ways to train and raise awareness even among those communities not formerly affected (Cohen et al. 2013). Communities need to be assessed on educational background, ethnicity, and tribal location to reduce risks from humanitarian operations during disaster management (Haworth et al. 2016). The challenges in identifying and preparing to mitigate risk, highlighted in “Appendix C”, are the following: (1) Difficult to map exact location; (2) Unknown scale; (3) Cultural differences; and (4) Non-cooperation for preparedness.

(c) Identity protection

In catastrophes—especially when disasters occur near national borders—it is highly possible that an affected population may become displaced to the territory of another country owing to an earthquake or heavy flooding (Martinez et al. 2018) and in such cases identity protection becomes an issue. For instance, in the last decade in India, the government has introduced the *Aadhar Card* system, a unique identification number provided to every citizen that is valid and digitally secure (Rao and Nair 2019). Nevertheless, it remains challenging to secure land maps and other personal documents that validate the authenticity of a person in such situations. Due to such gaps, identity protection faces challenges such as (1) Accurate land maps; (2) Digitization; and (3) Benefits of identity.

(d) Enhancing the flow of aid

According to Ophiyandri et al. (2013), in many disaster situations affected communities do not have sufficient funds or basic amenities. This is because of constraints associated with humanitarian agencies, public unawareness, and poor government arrangements (Walch 2019). The design of the most effective platforms for collecting money is also an important

question to consider (Kusumasari and Alam 2012). Rarely are there neutral regional bodies that can intervene to catalyze better coordination and help affected communities in the best possible manner (Clarke 2013). In addition, there is a lack of a mechanism that can voice the opinion of affected populations. Challenges regarding the flow of aid are the following: (1) Lack of innovative platforms; (2) Focus on in-kind items; (3) Division of funding lanes; and (4) Lack of transparency in fund utilization.

(e) Direct communication

Direct communication between regional bodies and affected people can act as a trust-building tool, as well as influencing perception of efforts deployed to save people (Dubey et al. 2019a, c). Such two-way communication between agencies, NGOs, and affected communities can help in addressing people's needs (Chen et al. 2013). Moreover, the plan for fulfillment can be divided among actors involved in relief operations. Both adequate information sharing and high quality information can help agencies to plan and design actions (Papadopoulos et al. 2017). Challenges lie in the development of technologies that can facilitate transportation and improve response times in such situations. The unavailability of direct communication can hinder both progress and the involvement of victims, and ultimately affect the actual pace of recovery. Direct communication has certain challenges, namely: (1) Complex environment; (2) Saving life is the priority; (3) Suspended networks, (4) Problems with broadcasting; and (5) Third-party assistance.

(f) Special health facilities

Different people, ranging from children to pregnant women, need special attention in terms of medical care compared with other citizens (Lavin et al. 2012; Sloand et al. 2012). Medical facilities have a responsibility to be effective and to care about culturally sensitive groups (Schulz and Blecken 2010). Mental health intervention and counseling programs can play an important role in stabilizing people who have lost family members and relatives through disasters (Moreno et al. 2018). The challenge lies in two key questions: How can this type of affected population be stabilized? And, what infrastructural arrangements are possible in such settings? Overall, the challenges are the following: (1) Carrying the supporting infrastructure is risky due to hazardous conditions; and (2) Allocation of funds to special health facilities.

(g) Price control

Disasters lead to disruptions in local markets and have an impact on local ecosystems (Sahin et al. 2016). Market disruption brings damage to property and a shortage of basic items in the short run (Cohen et al. 2013). Similar shortage trends have been observed during COVID-19 for hand sanitizer and face masks (ECRI 2020). Due to a sudden increase in demand and the disruption of regular supplies, there is a dearth of food, water, shelter, medicine, and clothing items, and this gives opportunities to local systems to exploit the situation (Ragini et al. 2018). Hence, controlling price gougers in such situations presents a challenge. In addition, on the other side, cost-free supplies from donors and agencies require optimal distribution, utilization and consumption. The challenges in price control



are highlighted in “Appendix C” and include: (1) Monitoring; (2) Supplies; (3) Corruption; (4) Suddenly increased demand; and (5) Opportunistic nature of the situation.

## 2.4 Underpinning theories

Quality management practices in HODRM during and post-disaster remain challenging and require an integrated approach owing to the involvement of multiple actors (Palttala and Vos 2011). The stakeholder theory argues that disasters impact all stakeholders’ life activities, and this is reflected in price surge situations in the post-disaster environment due to supply shortages (Freeman 2010; Friedman and Miles 2002; Freeman and McVea 2001; Gunasekaran et al. 2018). Supplies are dependent on firms that are either located in the affected geography or in other parts of the world. Firms further depend on their downstream supply chains, and disaster victims are dependent on supplies offered by relief agencies and various individual groups (Carter, 2015; Pfeffer and Salancik 1978, 2003). Behaviors and cooperation between actors define the success of disaster-related situations. Behavioral theory emphasizes that an actor’s behavior may be a result of previous experience with emergency situations (Paek et al. 2010; Petit 1967). This may have an impact on information dissemination approaches, and this can build or lower confidence depending on the prior experience. Behaviors among those involved can further influence the way in which information is provided, and this depends on the way that information is processed and channeled towards actual consumers of information in such situations (Cegielski et al. 2012; James 2011; Egelhoff and Sen 1992). Information flow is critical to social networks, and it defines the levels of interaction and coordination among different actors for better management (Cook and Whitmeyer 1992; Freeman 2004; Gunasekaran et al. 2018; Houston et al. 2015). Social network theory encourages people with similar interests to come together and contribute toward relief operations (Niles et al. 2019). Owing to the complexity and severity of disaster-related operations, relatively few actors act as principals and more as agents, and this situation leads to conflict and may hamper the provision of services and supplies to affected populations (Hoelscher et al. 2017). The “cash crunch” is another issue faced by ecosystems in such situations, and negotiation with vendors for supplies, procurement and low-cost transport route selection can be seen in terms of transaction cost economics (Cohen 2016; Kaur and Singh 2019; Ahrens and Rudolph 2006; Williamson 1979). In addition, the contingency and institutional theories are not exclusively related but explain the ways in which agencies and actors involved in disaster management change their processes and structures to provide efficient responses to geographically challenging environments (Bharosa et al. 2010; Galbraith 1973; Stinchcombe 1987; Drazin and Van de Ven 1985). Institutional theory explains the resilience of social structures and the pressure to perform experienced by actors (Dubey et al. 2015; DiMaggio and Powell 1983). The above-mentioned theories play crucial roles in designing quality management practices in the field of HODRM. Table 3 shows the important features of organizational theories with respect to quality management practices in HODRM and related research gaps that will provide future research directions.

## 3 Discussion

This section presents the results extracted from the classification derived from the literature review using the Scopus database.

**Table 3** Main organizational theories and future research directions. (*Source* Author's compilation)

Theory	Key articles	Key aspects of the theory	Research gaps and future research directions
Resource dependence theory	Lu et al. (2019), Sapat et al. (2019), Prasad et al. (2018), Pazirandeh and Maghsoudi (2018), Gao and Hafsi (2017), Maghsoudi (2016), Hillman et al. (2009), and Pfeffer and Salancik (1978, 2003)	<p>(1) Organizations are dependent on the external resources and actions and are affected by resource utilization</p> <p>(2) The firm's ability to gather, alter and deliver useful services or products at faster speed can augment the performance</p>	<p>(1) In the case of disasters, often demand surges and firms have to respond with their existing resource dependency. Technological platforms along with standardization may help to ramp-up agility internally and in coordination with external agencies (Lu et al. 2019)</p> <p>(2) In the interdependencies of firms, a few are more powerful than others (Skipper et al. 2008). Therefore, it may be noteworthy to uncover the influence of power relations to witness the long-term sustainability in post-disaster recovery (Filo et al. 2015)</p>

Table 3 (continued)

Theory	Key articles	Key aspects of the theory	Research gaps and future research directions
Contingency theory	Imperialte and Vancley (2019), Larson and Foropon (2018), Kunz and Gold (2017), Eriksson and McConnell (2011), Nilsson et al. (2010), Glenn Richey Jr (2009), Donaldson (2001), and Cancel et al. (1997)	<p>(1) There are different ways to derive a program for an organization</p> <p>(2) The optimal way of driving an organization and situation depends on a number of factors that are internal as well as external (Kunz and Reiner 2012)</p>	<p>(1) Contingency theory can be viewed from leadership and organizational perspectives (Shepard and Hougland Jr, 1978). Therefore, it is important to compare the influence of leadership versus the organizational capabilities in disaster relief scenarios</p> <p>(2) Disaster relief coordination needs to view multiple internal and external factors. The interplay of capabilities, resources and specific environment strategy may have an impact on coordination in humanitarian operations (Dubey et al. 2018; Rodríguez-Espindola et al. 2018). Also, agent-based simulation can be used to advance understanding (Altay and Pal 2014)</p> <p>(3) Different organizations have their own handling styles for crises. The government is one of the key players in most scenarios. Hence, it will be interesting to explore the different basic strategies emphasized according to nature, size, and scope (Sousa and Voss 2008) of the disaster and its relation to contingent factors</p>

**Table 3** (continued)

Theory	Key articles	Key aspects of the theory	Research gaps and future research directions
Behavioral theory	Sankaranarayanan et al. (2018), Jabbour et al. (2019), Liu et al. (2016), Kuligowski (2013), James et al. (2011), Paek et al. (2010), and Petit (1967)	<p>(1) Explanation of an actor's behavior either in an individual environment or through previous experiences</p> <p>(2) The observation of the subjects in different aspects of tasks in terms of maintaining the relationships, information dissemination and motivation level (Bronfman et al. 2019)</p>	<p>(1) Preparedness for catastrophes helps in mitigating the risk and its impact. The culture and attitude of affected populations play a significant role in emergency preparedness (Appleby-Arnold et al. 2018; Ejeta et al. 2015). Behavioral characteristics differ greatly from the developed to developing worlds. Hence, there is scope to test the relationship among culture, attitude, and governance to prepare the population for emergency situations (Walch 2019).</p> <p>(2) The process, structure, and individuals involved in an organizational framework define the culture (Appleby-Arnold et al. 2018). The multi-dimensional emergency response in a disaster relief situation makes apparent the degree of influence of structure, process, and people on fast recovery</p>

**Table 3** (continued)

Theory	Key articles	Key aspects of the theory	Research gaps and future research directions
Information processing theory	Sakurai and Murayama (2019), Fan et al. (2017), Olorunoba et al. (2016), Othman et al. (2014), Altay and Pal (2014), Preece et al. (2013), Cegielski et al. (2012), James (2011), Masten and Obradovic (2008), and Egelhoff and Sen (1992)	<p>(1) It emphasizes the capability of information processing and its requirement by an organization to achieve optimal performance</p> <p>(2) Organizations, programs, and networks need quality information to address the uncertainty and improve decision making (Kovacic and Di Felice 2019)</p>	<p>(1) Decisions in disasters are taken by different actors pre-disaster or during a disaster; operational decisions such as preparedness, awareness, and planning decisions str taken by urban planners, economists, and policymakers to reboot the entire system (González et al. 2018; Altay and Green III, 2006). Hence, the style of information processing and dissemination starting from pre- to post-disaster can be tracked from the view of its impact on recovery.</p> <p>(2) In most disaster response situations multiple religious, secular, and focused organizations participate along with mainstream military operations (Comfort 2007). Communication, swift trust, coordination and control (Dubey et al. 2019c) have become challenging in such situations and hence are a topic for further research</p>

**Table 3** (continued)

Theory	Key articles	Key aspects of the theory	Research gaps and future research directions
Institutional theory	Toinpre et al. (2018), Gupta et al. (2019), Boin et al. (2016), Dubey et al. (2015), Gao (2011), Harteis and Penning-Rowsell (2011), Maldonado et al. (2010), Muller and Whiteman (2009), and DiMaggio and Powell (1983)	<p>(1) The behavior of firms is bounded to isomorphic processes such as mimetic, normative, and coercive</p> <p>(2) Mimetic isomorphism is the resultant of the competitive spirit of a group or firm as it competes with rivals to gain advantage</p> <p>(3) Normative isomorphism is the resultant of self-drive, motivation, and monitoring to keep the leap with current and adapt accordingly</p> <p>(4) Coercive isomorphism is the resultant of pressure to perform from other players and perform within the legal boundaries and follow certain regulatory requirements</p>	<p>(1) The three isomorphisms that may have a great degree of impact on the accomplishment of the objectives of specific HODRM and type of catastrophe can be studied in the future</p> <p>(2) The donors or specific influencers in a particular secular or religious group and their contributions to generating mimetic pressure on other groups can be studied by future researchers (Gupta et al. 2019)</p> <p>(3) Disaster relief laws are instrumental in humanitarian response to natural disasters. (Babiak and Trendafilova 2011). Hence, it may be interesting to explore the situations in which these institutional frameworks act as guides to filter the unauthorized access and fasten the recovery of infrastructure and climate for sustainable living</p>

**Table 3** (continued)

Theory	Key articles	Key aspects of the theory	Research gaps and future research directions
Social network theory	Tacheva and Simpson (2019), Kim and Hastak (2018), Kapucu and Hu (2016), Houston et al. (2015), Spiekermann et al. (2015), Hamra et al. (2012), Borgatti and Halgin (2011), White et al. (2009), Varda et al. (2009), Suter et al. (2009), Kapucu (2006), Kapusu (2005), Freeman (2004), and Cook and Whitmeyer (1992)	<p>(1) This theory describes the interaction of firms, employees, and stakeholders with each other in that network</p> <p>(2) Social networks are self-organizing and the patterns can be decoded from their structures and levels of interaction.</p> <p>(3) People use social networks to represent their relationships and provide flow and exchange of information with similar interest groups</p>	<p>(1) There is a need to explore the role of network dynamics in relationship development and continuity through trust and goal for the speedy recovery of the affected population (Vasavada 2013)</p> <p>(2) New ways of coordination and new communication technologies may influence the network flexibility to cope with the desired level of humanitarian operations (Skipper et al. 2008)</p> <p>(3) The affected population and different actors consume information on resources and climate forecasts through a social network. There is a lack of studies that focus on how affected populations consume and share information through social networks compared to other sources (Jin et al. 2014)</p>

**Table 3** (continued)

Theory	Key articles	Key aspects of the theory	Research gaps and future research directions
Transaction cost economics	Cohen (2016), Goldschmidt and Kumar (2016), Ülkü et al. (2015), Shreve and Kelman (2014), Rose and Kustra (2013), Williamson (2008), Cardenas et al. (2007), Ahrens and Rudolph (2006), and Williamson (1979)	<ol style="list-style-type: none"> <li>(1) Economic exchange within two parties can define the cost of a product (i.e., provider and receiver)</li> <li>(2) The cost of delivery of products or services may rise due to bounded rationality and asymmetric information</li> <li>(3) These costs include the aspects of evaluating a route of delivery and choosing and negotiating with suppliers</li> <li>(4) Transactions can also be viewed from the perspective of the amount of information required to be shared</li> <li>(5) The transaction costs between the two subjects also depend on the organization of transactions and how they are governed through the hierarchy</li> </ol>	<p>(1) Along with the government, private players play a significant role in establishing the disaster-hit areas. Therefore, a matrix solution can be developed that supports institutional arrangements and reduces transaction costs (Ahrens and Rudolph 2006)</p> <p>(2) The disaster-hit areas require products and services in the initial period at high demand rate and lower price. Hence, there is an opportunity to develop a low-transaction-cost model for the supply chain in disaster relief situations</p> <p>(3) Emergency procurement for disaster operations has a huge opportunity for corruption and an increase in transaction costs in the entire process (Atkinson and Sapat 2012). Therefore, it will be interesting to record the loopholes in the current mechanism of emergency procurement and insulate it with an appropriate legal framework. Further, its effect on the performance of provided humanitarian aid and the level of satisfaction of affected populations can be studied</p>



**Table 3** (continued)

Theory	Key articles	Key aspects of the theory	Research gaps and future research directions
Agency theory	Swanson et al. (2017), Prozman et al. (2016), Bendickson et al. (2016), Curmin et al. (2015), Fayezi et al. (2012, Zu and Kaymak (2012, and Eisenhardt (1989)	<p>(1) Out of two parties one (principal) delegates the work/verdict to the other (agent) party</p> <p>(2) (i) Potential conflict can exist between two parties</p> <p>(ii) Each party has its own agenda</p> <p>(iii) Asymmetric information exists between the principal and agent</p> <p>(iv) Agents are usually more risk averse compared to the principal</p> <p>(v) Effectiveness is defined by achieved efficiency</p>	<p>(1) Humanitarian operations distribution echoes the agency system, in which the government quick response system acts as principal and other volunteers as agents (Diedrichs et al. 2016)</p> <p>(2) Most disaster recovery projects are pursued sincerely for a certain period of time post-disaster and then people are left on their own to progress and connect to the original economy. In this case, government officials act a principal and affected people as agents. Hence, there is scope to examine the inline agreement between agents and principals after 2 to 5 years to measure the effectiveness of the HODRM</p> <p>(3) The CSR arm of the corporate works as principal and exert the influence through NGOs in the disaster-hit areas. Therefore, the effectiveness of CSR programs in response to disaster relief can be explored under the dynamics of uncertainty (Hegelsteen and Becker 2019)</p>

Table 3 (continued)

Theory	Key articles	Key aspects of the theory	Research gaps and future research directions
Stakeholder theory	Mojtahedi and Oo (2017), Fontainha et al. (2017), McKnight and Limmenluecke (2016), Madsen and Rodgers (2015), Fawcett and Fawcett (2013), Palttala et al. (2012), Freeman (2010), Friedman and Miles (2002), and Freeman and McVea (2001)	<p>(1) The theory argues that the activities of a business should create value for all associated with and impacted by business activities</p> <p>(2) (i) Each stakeholder should have some advantage from the actions taken within organizations</p> <p>(ii) Each stakeholder needs to put effort into the long-term survival of the firm, including top management</p> <p>(iii) There need to be clear rules on who will be, and who cannot be, part of the stakeholder team</p> <p>(iv) The rules that govern the relationship between stakeholders and firm can be amended through unanimous consent</p>	<p>(1) Disaster affects everyone ranging from children to senior citizens. Both children and people 65+ need special attention in terms of healthcare and other daily life requirements (Sloand et al. 2012). Future studies can be conducted to identify post-disaster basic requirements for children, the working population and senior citizens in terms of infrastructure and healthcare and what role different players, ranging from government to private actors, can play in a given timespan</p> <p>(2) Stakeholders' attitudes toward supporting disaster-hit areas with the help of critical services such as distribution of safe drinking water and availability of basic medicines can play a major role in stabilizing the affected people (Reale and Handmer 2011; Han et al. 2011). Hence, the stakeholder perception of the importance of services will also play a crucial role in defining the plan</p> <p>(3) Governance during disaster and post-disaster play a key role in disseminating critical information that needs to consider all stakeholders including military personnel and volunteers and their belief systems (Papadopoulos et al. 2017; Ahrens and Rudolph 2006)</p>

### 3.1 Implications for research

The results emphasize the second and third objectives of the present research. We have described and highlighted research gaps, along with the scope for prospective research, on the basis of different grounded theories. We refer to the studies of Gupta et al. (2020), Dubey et al. (2017), Arumugam et al. (2014), and Bharosa et al. (2010) for identifying grounded theories associated with quality management in HODRM. We have assessed each grounded theory as a source of a short synopsis, potential research questions, and further directions for research in this area. Table 3 presents this in tabular form to provide a quicker and better understanding.

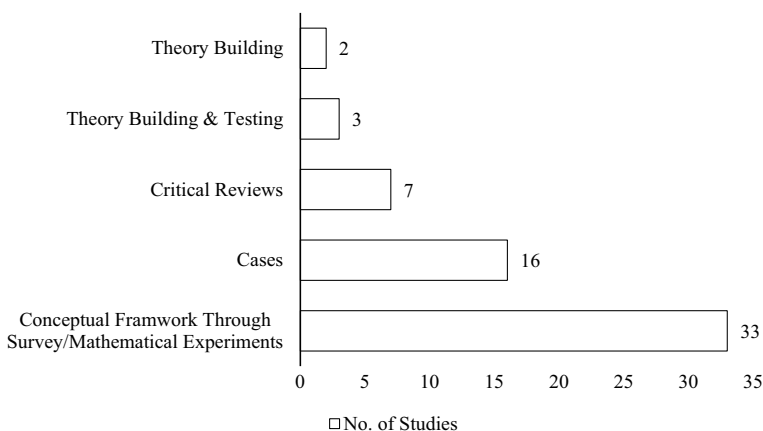
### 3.2 Implications for practice

The performance of a humanitarian program depends on factors such as the degree of preparedness of not only the task forces but also the local communities (Behl and Dutta, 2019a, b; Das 2018; Onuma et al. 2017). Community members can help in reducing the impact of disasters. For instance, local communities can provide quick response to acquire tangible facilities locally, such as food and blankets (Chamlee-Wright and Storr 2009). Hence, the quality of activities carried out in terms of rate of response, necessary items, security measures followed, and density of coverage in the affected area depends on the extent to which each stakeholder remains on the same page through cooperation, coordination, and collaboration (3Cs) (Aerts et al. 2018; De Camargo et al. 2019; Moshtari 2016). These 3Cs are critical for aid by agencies targeting efficient processes in local procurement, transportation, and the supply chain. In the immediate response phase, teams of NGOs practice the 3Cs to assess the needs of beneficiaries. Then, entire HODRM supply chains follow through with local procurement and distribution. Regarding transportation within HODRM supply chains, the number of delivery trucks, different routes dimensions, and the capacity of trucks and their scheduling also need to closely follow the 3Cs among different stakeholders. Finally, warehousing, for example, the number of distribution centers and temporary camps and shelters, also requires consideration of the 3Cs among the different agents involved (Roh et al. 2013).

We are witnessing more and more disaster events, and this trend presents an immediate challenge to professionals about the most effective ways in which they can prepare their teams to tackle situations effectively. Supporting NGOs and government agencies can also play an important role in infusing quality parameters in information sharing with victims and seeking their feedback to continuously improve the assistance (Reuter and Kaufhold 2018). Practical learning from different incidents can be helpful for coming up with strategies and future plans that are more robust and effective. Such experience may not be one hundred per cent applicable, but it should provide some clues about future disasters. Challenges including price control of commodities, identity protection, and financial service assistance are key aspects that need to be considered while designing an effective and resilient response plan to disasters (Gomber et al. 2018; Kratcoski 2018). Furthermore, our study offers clues to professionals about how to design rescue services in order to handle sensitive groups on the basis of cultural diversity and mental health. The design of robust shelter infrastructure, privacy, and an adequate transportation network for such situations are additional key elements that need to be considered by decision makers in disasters (Krausmann et al. 2019).

## 4 Conclusion

In this study, we have presented a systematic literature review regarding quality management aspects in the field of HODRM. We identified articles from the Scopus database through a structured process and finalized them for review. We classified the data into different categories to identify trends according to different aspects (see Appendices A through D) and presented our general findings in Figs. 2, 3, and 4. As a field, HODRM seeks the involvement of multiple agencies and multi-layer cooperation, coordination, and collaboration; it was therefore necessary to view the extant literature from different views and thereby fulfil the first objective of the study. Firms operating in the HODRM ecosystem are interdependent for their actions and must utilize resources (resource dependence theory) in such a way that quality management objectives in such operations are always visible. The firms need to have contingency planning in case the scenario or scale of disruption changes, and this planning needs close coordination among the leadership and core team in order to promote quality management practices in HODRM. In on-the-ground handling, the culture and attitude of local and affected people (behavioral theory) play a significant role, since they can influence the speed of facilitation, which is one dimension of quality management in HODRM. The success of HODRM in a disaster event mainly depends upon the processing capabilities of the system in which multi-dimensional information is flowing most of the time (information processing theory). Multi-dimensional information flow is due to multiple stakeholders, and it offers different type of isomorphism in HODRM events and poses a challenge to quality operations (stakeholder and institutional theory). Moreover, social networks can also be decoded for identifying both the pattern and level of information exchange among different actors in a system to ensure quality aspects (social network theory). Apart from information exchange, the hierarchy followed to disseminate the information and value of economic exchange also impacts on the perceived quality of HODRM (transaction cost economics). The quality of HODRM is also hampered because of internal conflicts among agencies where a principal–agent relationship exists (agency theory). These highlights concerning organizational theories and their alignment towards quality management in HODRM provide elements of the possible answers to the second objective of this paper.



**Fig. 4** Classification of the studies on the basis of approach

We have mapped the concepts delineated in the related articles to different organizational theories. This has helped us to identify possible research gaps and future research directions. We have further identified enablers through a structured process of thematic analysis for quality management in HODRM. We found that multiple enablers, ranging from the supporting policy framework to maintaining transparency through the quality of information and sharing—along with the rate of response and safety measures—define the quality of humanitarian operations. Moreover, we have identified existing challenges that need immediate action to extend the quality management aspects of humanitarian operations in disaster management. It was observed that there is a lacuna in the system of disaster management activities in terms of proactive identification of vulnerable communities and design of strategic programs, and in terms of the flow of funds through innovative platforms to achieve adequate distribution to the affected populations. Also, the way in which new technologies can be utilized to design various phases of emergency response, including resilient transportation network, remains an area of interest. Community protection, in terms of secure digital identity along with accurate land maps, needs to be stored and returned to affected populations during the recovery phase. This list of enablers and challenges fulfils the third research objective. Finally, the present study offers implications for research and practice. By considering these implications, professionals, researchers, individuals, volunteers, agencies, and government may find guidelines on how to address the abovementioned concerns for quality in humanitarian operations.

## 5 Limitations and scope for future research

In this study, we considered only research articles with DOI numbers and excluded books and conference papers. One further research direction could be to consider books and conferences in order to provide a different view. We chose the Scopus database instead of Web of Science, WorldCat, EbscoHost, or individual search engines such as Google Scholar. The Scopus database was chosen owing to its advantage of having a comprehensive database; this may have led to the exclusion of important articles not included in Scopus. Moreover, we searched for and extracted articles in August 2019. Cautiously, we covered articles only up to 2018 in Fig. 2, thus excluding articles from 2019 that are still in the process of publication and appearing in Scopus. The actual figures may have changed if we had considered 2019 in our search. Currently, the systematic literature review methodology is subjective (Tranfield et al. 2003) and there is the possibility that other studies in the future may come up with different key themes. Lastly, the identified enablers and challenges may be refined and verified with the help of empirical and case research methods for investigating ways of enhancing quality management in the field of HODRM.

## Appendix A

Journal Title	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Applied Geography		1				1		2			4
European Journal of Operations Research				1	1			1		1	4

Journal Title	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
Socio Economic Planning Sciences				2				1	1		4
Evaluation And Program Planning	1			1	1						3
International Journal of Physical Distribution And Logistics Management		2	1								3
Or Spectrum			1			2					3
Technological Forecasting and Social Change					2				1		3
Annals of Operations Research							1	1			2
Futures						1			1		2
International Journal of Production Economics				1				1			2
International Journal of Services technology and Management	2										2
Journal of Contingencies and Crisis Management				1					1		2
Journal of Humanitarian Logistics and Supply Chain Management									1	1	2
Cities									1		1
Decision Support Systems			1								1
Digital Policy Regulation and Governance										1	1
Disaster Prevention and Management									1		1
Disaster Prevention and Management An International Journal				1							1
Ecological Indicators									1		1
International Journal of Conflict Management									1		1
International Journal of Human Resource Management				1							1
International Journal of Organizational Analysis		1									1
International Journal of Quality and Reliability Management						1					1
International Journal of Systems Assurance Engineering and Management										1	1

Journal Title	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Total
International Transactions in Operational Research				1							1
Journal Of Applied Statistics		1									1
Journal of Cleaner Production									1		1
Journal of Communication Management			1								1
Journal Of Multi Criteria Decision analysis									1		1
Journal of Risk Research	1										1
New Space								1			1
Probability In The Engineering And Informational Sciences								1			1
Production And Operations Management						1					1
Quality and Reliability Engineering International		1									1
Scientific Data										1	1
Smart Innovation Systems And Technologies									1		1
Transportation Research Part-E Logistics and Transportation Review									1		1
World Bank Economic Review									1		1
Total	4	5	5	9	4	6	1	8	14	5	61

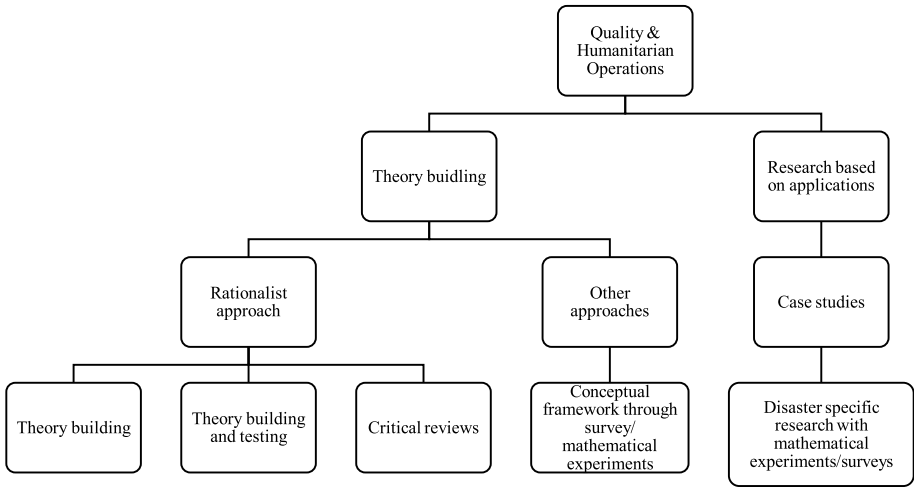
## Appendix B

See Table 4.

**Table 4** Classification of literature (from Fig. 3). (Source Author's compilation)

Theory building		Research based on application	
Rationalist approach	Alternative methods	Cases	
Theory building	Conceptual framework through surveys/mathematical experiments	Disaster specific research with mathematical experiments/surveys	
Theory building & testing	Critical reviews		
Herlin and Pazirandeh (2012), Nilsson et al. (2010)	Chen et al. (2017), Lee et al. (2011), Oosterhof et al. (2009)	Moreno et al. (2018), Qin et al. (2017), Yuan et al. (2018), Uhr (2017), Pérez-Galarce et al. (2017), Penadés et al. (2017), Tsukahara (2017), Marek et al. (2017), Aker (2017), Wu et al. (2017), Papadopoulos, et al. (2017), Haworth et al. (2016), Paul and MacDonald (2016b), Xiang and Zhuang (2016), Timotheou (2016), Ulkü et al. (2015), Najafi et al. (2014), Madu and Kuei (2014), Lue et al. (2014), Altay and Pal (2014), Goerigk and Grün (2014), Cohen et al. (2013), D'Ostie-Racine et al. (2013), Najj-Azimi et al. (2012), Merlot and De Cieri (2012), Berkoune et al. (2012), Palltala et al. (2012), Palltala and Vos (2011), McCoy and Brandeau (2011), Pazirandeh (2011), Liu et al. (2010), Wu et al. (2010), De Oliveira Mendes (2009)	Peltola and Hämäläinen (2018), Ortiz-Barrios et al. (2017), Balci (2017), Ludin and Arbon (2017), Tatham et al. (2017), Paul and MacDonald (2016a), Sahin et al. (2016), Hung et al. (2016), Contreras et al. (2013), Preece et al. (2013), McLay et al. (2012), Kusumasari and Alam (2012), Dunford and Li (2011), Nolz et al. (2010), Schulz and Blecken (2010), Banomyong et al. (2009)
	Oloruntoba and Banomyong (2018), Estoque and Murayama (2017), Murthi and Rao (2016), Baum et al. (2015), Baizerman (2012), Nagurney and Qiang (2012), Van Der Laan et al. (2009)		





## Appendix C

See Tables 5 and 6.

**Table 5** Enablers of quality in HODRM. (Source Author's compilation)

Enablers	Measures	Supporting Literature
Policy framework	<ol style="list-style-type: none"> <li>(1) Clear guidelines to stimulate interaction between different stakeholders</li> <li>(2) Guidelines to improve multi-agency coordination</li> <li>(3) Encourage adaptability, agility and alignment in value chain</li> <li>(4) Exchange of ideas among policy makers and humanitarian operation experts</li> <li>(5) Common platform to decision making and coordination</li> </ol>	<p>Oloruntoba and Banomyong (2018), Ludin and Arbon (2017), Hung et al. (2016), Madu and Kuei (2014), D'Ostie-Racine et al. (2013), McCoy and Brandeau (2011), Nolz et al. (2010), Schulz and Blecken (2010)</p>
Commitment from stakeholders	<ol style="list-style-type: none"> <li>(1) Supporting behavior</li> <li>(2) Alignment between mandate, goals and coordination</li> <li>(3) Long term vision</li> <li>(4) Capacity building of humanitarian personnel</li> <li>(5) Utilizing the skills of affected people in the humanitarian operations</li> <li>(6) Cross-community involvement</li> <li>(7) Opinion of affected population on disaster recovery</li> </ol>	<p>Uhr (2017), Penadés et al. (2017), Marek et al. (2017), Aker (2017), Wu et al. (2017), Ludin and Arbon (2017), Chen et al. (2017), Ülki et al. (2015), Baum et al. (2015), Madu and Kuei (2014), Cohen et al. (2013), Palttala et al. (2012), Kusumasari and Alam (2012), Oosterhof et al. (2009)</p>
Transparency and information sharing	<ol style="list-style-type: none"> <li>(1) Accountable activities</li> <li>(2) Flexible and agile flow of information</li> <li>(3) Information quality</li> <li>(4) Adequate information processing</li> <li>(5) Usage of web-based systems to generate swift trust among affected population and other actors</li> <li>(6) Adequate utilization of funds</li> </ol>	<p>Oloruntoba and Banomyong (2018), Qin et al. (2018), Yuan et al. (2018), Pelola and Hämäläinen (2018), Tsukahara (2017), Aker (2017), Papadopoulos et al. (2017), Ludin and Arbon (2017), Haworth et al. (2016), Murthi and Rao (2016), Lue et al. (2014), Altay and Pal (2014), Preece et al. (2013), Palttala et al. (2012), Palttala and Vos (2011), Lee et al. (2011), Schulz and Blecken (2010), Van Der Laan et al. (2009)</p>
Public-Private Partnership	<ol style="list-style-type: none"> <li>(1) Development of volunteers</li> <li>(2) Regular training</li> <li>(3) Developing trustworthy environment</li> <li>(4) Involvement of NGOs and CSR arms of firms</li> </ol>	<p>Pelola and Hämäläinen (2018), Uhr (2017), Penadés et al. (2017), Papadopoulos et al. (2017), D'Ostie-Racine et al. (2013), Herlin and Pazirandeh (2012), Merlot and De Cieri (2012), Nagurney and Qiang (2012)</p>
Support from Government	<ol style="list-style-type: none"> <li>(1) Provision of human resources</li> <li>(2) Aid to the affected population</li> <li>(3) Subsidy to the firms for distribution in affected areas</li> </ol>	<p>Oloruntoba and Banomyong (2018), Ludin and Arbon (2017), Chen et al. (2017), Madu and Kuei (2014), Merlot and De Cieri (2012), Kusumasari and Alam (2012), Dunford and Li (2011), Nilsson et al. (2010), Banomyong et al. (2009)</p>

**Table 5** (continued)

Enablers	Measures	Supporting Literature
Strategic planning	<ol style="list-style-type: none"> <li>(1) Planning for resilient supply chain</li> <li>(2) Strategic tie-up to fulfill the demand via different distribution channels</li> <li>(3) Disaster readiness</li> <li>(4) Fleet size and routing decisions</li> <li>(5) Long-term planning to establish and advance the affected society</li> <li>(6) Establishment of robust and flexible infrastructure (Soft and Hard) for future</li> </ol>	<p>Moreno et al. (2018), Oloruntoba and Banomyong (2018), Qin et al. (2018), Yuan et al. (2018), Pelola and Hämäläinen (2018), Uhr (2017), Ortiz-Barrios et al. (2017), Penadés et al. (2017), Tsukahara (2017), Balciik (2017), Marek et al. (2017), Tatham et al. (2017), Paul and MacDonald (2016a), Najafi et al. (2014), Madu and Kuei (2014), Goerigk and Grün (2014), Cohen et al. (2013), Contreras et al. (2013), Najj-Azimi et al. (2012), Berkoune et al. (2012), Palltala and Vos (2011), McCoy and Brandeau (2011), Nilsson et al. (2010), Nolz et al. (2010), De Oliveira Mendes (2009)</p>
Continuous improvement	<ol style="list-style-type: none"> <li>(1) Continuous monitoring and evaluation on performance</li> <li>(2) Improving decision making process</li> <li>(3) Improvement of balance between demand and supply along with appropriate price boundary</li> <li>(4) Measuring the satisfaction level of victims</li> </ol>	<p>Moreno et al. (2018), Tsukahara (2017), Tatham et al. (2017), Paul and MacDonald (2016b), Timotheou (2016), Madu and Kuei (2014), Lue et al. (2014), Contreras et al. (2013), Najj-Azimi et al. (2012), Herlin and Pazirandeh (2012), Berkoune et al. (2012), Barzerman (2012), Wu et al. (2010)</p>
Relief Speed and Safety	<ol style="list-style-type: none"> <li>(1) Rapid response</li> <li>(2) Effective reaction to situation</li> <li>(3) Ensuring the minimum risk in activities to public</li> <li>(4) Minimum risk to public and private infrastructure</li> <li>(5) Avoiding the destruction of natural resources</li> <li>(6) Rapid and adequate shelter and medical facilities</li> </ol>	<p>Oloruntoba and Banomyong (2018), Qin et al. (2018), Yuan et al. (2018), Uhr (2017), Ortiz-Barrios et al. (2017), Estoque and Murayama (2017), Sahin et al. (2016), Xiang and Zhuang (2016), Baum et al. (2015), Najafi et al. (2014), Altay and Pal (2014), McLay et al. (2012), Pazirandeh (2011), Liu et al. (2010), Wu et al. (2010), De Oliveira Mendes (2009)</p>

**Table 6** Challenges for quality in HODRM. (Source Author's compilation)

Challenges to	Measures	Supporting Literature
Access to financial services	<ol style="list-style-type: none"> <li>(1) Acceptance of e-money</li> <li>(2) Cash assistance instead of in-kind items</li> <li>(3) Profile security</li> <li>(4) Internet provision</li> </ol>	<p>Moreno et al. (2018), Ludin and Arbon (2017), Aker (2017), D'Ostie-Racine et al. (2013), Palttala and Vos (2011), Merlot and De Cieri (2012), Kusumamasari and Alam (2012) Nagurney and Qiang (2012), Liu et al. (2010), Wu et al. (2010)</p>
Proactive identification	<ol style="list-style-type: none"> <li>(1) Difficult to map exact location</li> <li>(2) Unknown scale</li> <li>(3) Cultural differences</li> <li>(4) No cooperation for preparedness</li> </ol>	<p>Oloruntoaba and Banomyong (2018), Papadopoulos et al. (2017), Estoque and Murayama (2017), Paul and MacDonald (2016a), Goerigk and Grtin (2014), Contreras et al. (2013), Berkoune et al. (2012), De Oliveira Mendes (2009)</p>
Identity protection	<ol style="list-style-type: none"> <li>(1) Location of land maps</li> <li>(2) Lack of digitization</li> <li>(3) Unaware from the benefits of identity</li> </ol>	<p>Oloruntoaba and Banomyong (2018), Peltola and Hämäläinen (2018), Baum et al. (2015), D'Ostie-Racine et al. (2013), Merlot and De Cieri (2012), Lee et al. (2011), Duntford and Li (2011), Nilsson et al. (2010), Van Der Laan et al. (2009)</p>
Enhancing the flow of aid	<ol style="list-style-type: none"> <li>(1) Lack of innovative platforms</li> <li>(2) Focus on in-kind items</li> <li>(3) Division of funding lanes</li> <li>(4) Lack of transparency is fund utilization</li> </ol>	<p>Yuan et al. (2018), Uhr (2017), Tsukahara (2017), Ludin and Arbon (2017), Chen et al. (2017), Aker (2017), Hung et al. (2016), Baum et al. (2015), Altay and Pal (2014), Cohen et al. (2013), Palttala and Vos (2011), Nilsson et al. (2010), Banomyong et al. (2009), Van Der Laan et al. (2009)</p>
Direct communication	<ol style="list-style-type: none"> <li>(1) Complex environment</li> <li>(2) Saving life is priority</li> <li>(3) Suspended Networks</li> <li>(4) Electricity not compatible with weather to broadcast</li> </ol>	<p>Oloruntoaba and Banomyong (2018), Peltola and Hämäläinen (2018), Uhr (2017), Estoque and Murayama (2017), Paul and MacDonald (2016b), Lue et al. (2014), Madu and Kuei (2014), Herlin and Pazirandeh (2012), Pazirandeh (2011), Wu et al. (2010), Banomyong et al. (2009)</p>
Special health facilities	<ol style="list-style-type: none"> <li>(1) Lack of supporting infrastructure</li> <li>(2) Extreme weather condition</li> <li>(3) Funds</li> </ol>	<p>Peltola and Hämäläinen (2018), Chen et al. (2017), Uhr (2017), Tsukahara (2017), Marek et al. (2017), Ülkü et al. (2015), Najafi et al. (2014), Herlin and Pazirandeh (2012), Palttala and Vos (2011), Wu et al. (2010), Nolz et al. (2010), De Oliveira Mendes (2009)</p>
Price control	<ol style="list-style-type: none"> <li>(1) Monitoring</li> <li>(2) Supplies</li> <li>(3) Corruption</li> <li>(4) Suddenly increased demand</li> <li>(5) Opportunistic nature of situation</li> </ol>	<p>Hämäläinen (2018), Uhr (2017), D'Ostie-Racine et al. (2013), Preece et al. (2013), Madu and Kuei (2014), Cohen et al. (2013), Palttala et al. (2012), McCoy and Brandeau (2011), Nilsson et al. (2010), Banomyong et al. (2009)</p>

## Appendix D

Table 7.

Table 7 Number of citations in the top 10 cited papers. (Source Author's compilation)

Publication year	Paper title	Authors	Journal title	<2015	2015	2016	2017	2018	2019	Total
2017	The role of Big Data in explaining disaster resilience in supply chains for sustainability	Papadopoulos T., Gunasekaran A., Dubey R., Altay N., Childe S.J., Fosso-Wamba S.	Journal of Cleaner Production	0	0	0	12	37	33	82
2010	Horizontal cooperation in disaster relief logistics: Benefits and impediments	Schulz S.F., Blecken A.	International Journal of Physical Distribution and Logistics Management	15	10	8	16	18	8	75
2012	Transportation in disaster response operations	Berkoune D., Renaud J., Rekiq M., Ruiz A.	Socio-Economic Planning Sciences	10	11	16	7	16	8	68
2012	Communication Gaps in Disaster Management: Perceptions by Experts from Governmental and Non-Governmental Organizations	Palttala P., Boano C., Lund R., Vos M.	Journal of Contingencies and Crisis Management	9	18	2	4	10	4	47
2011	Group value and intention to use - A study of multi-agency disaster management information systems for public safety	Lee J., Bharosa N., Yang J., Janssen M., Rao H.R.	Decision Support Systems	17	8	8	5	7	1	46
2009	Social vulnerability indexes as planning tools: Beyond the preparedness paradigm	De Oliveira Mendes J.M.	Journal of Risk Research	13	9	7	9	7	1	46
2014	Information diffusion among agents: Implications for humanitarian operations	Altay N., Pal R.	Production and Operations Management	0	2	12	11	9	11	45

Table 7 (continued)

Publication year	Paper title	Authors	Journal title	<2015	2015	2016	2017	2018	2019	Total
2013	The conjoint community resiliency assessment measure as a baseline for profiling and predicting community resilience for emergencies	Cohen O., Leykin D., Lahad M., Goldberg A., Aharonson-Daniel L.	Technological Forecasting and Social Change	4	3	11	8	8	11	45
2012	A covering tour approach to the location of satellite distribution centers to supply humanitarian aid	Naji-Azimi Z., Renaud J., Ruiz A., Salari M.	European Journal of Operational Research	6	4	4	6	14	5	39
2011	Earthquake reconstruction in Wenchuan: Assessing the state overall plan and addressing the 'forgotten phase'	Dunford M., Li L.	Applied Geography	12	7	6	5	6	2	38
Total				86	72	74	83	132	84	531

## Appendix E

Tables 8 and 9.

**Table 8** Top 10 Institutions with regard to number of papers

Name of the Institution	Country	No. of papers
Lunds Universitet	Sweden	3
Nanyang Technological University	Singapore	2
Delft University of Technology	Netherlands	2
Thammasat University	Thailand	2
Tianjin University	China	2
Monash University	Australia	2
Kennesaw State University	U.S.	2
DePaul University	U.S.	2
University at Buffalo, State University of New York	U.S.	2
University of Jyvaskyla	Finland	2

**Table 9** Top 10 countries with reference to number of papers

United States	6
Australia	3
China	3
Finland	3
Sweden	3
United Kingdom	3
Netherlands	2
Singapore	2
Thailand	2
France	1

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