Coordination Mechanism among Key Players during Disaster Relief Operations: A Case Study

Bertha Maya Sopha
Industrial Engineering Program, Department of Mechanical and Industrial Engineering
Universitas Gadjah Mada (UGM)
Yogyakarta, INDONESIA
bertha_sopha@ugm.ac.id

Abstract

Coordination in humanitarian operations has always been challenging due to the uncertainty and the complexity of the operations. Because no one collaboration strategy fits all, the exploration of coordination mechanisms for a particular context is therefore necessary. The present paper aims at investigating the coordination mechanism among the key players and identifying challenges of coordination in relief operations in Yogyakarta province, Indonesia. Qualitative research using semi-structured interviews focusing on coordination mechanism during the preparedness and response phases of humanitarian operations was conducted with representatives from governmental regional disaster management agency (Badan Penanggulangan Bencana Daerah – BPBD) in both provincial and district levels, governmental services, Indonesian bureau of logistics, suppliers, and volunteers including non-governmental organizations. The findings entail that the hybrid coordination approach, characterized by a centralized structure combined with vertical and horizontal collaboration to ensure smooth aid procurement and distribution, has been implemented. The BPBD serves as a director that leads and coordinates the humanitarian operations with other involved stakeholders including other governmental services, local and international non-governmental organizations, and local and regional communities. The collaborations are engaged at the strategic, tactical, and operational levels. The findings have indicated that trust, uncertainty/unpredictability, lack of or limited technology for information sharing, effect of media, diversity of actors, political issues, resource scarcity were the main reported barriers toward coordination in humanitarian operations. Avenues for potential future research are also discussed.

Keywords
Coordination mechanism, relief operations, regional disaster management agency, case study, Indonesia

1. Introduction
A large number of humanitarian organizations (HOs) are mobilized and assembled to save as many lives as possible during relief operations. The relief operations are quite complex due to uncertainty in terms of the disaster itself, the location of the affected population, the amount and the type of needs, available infrastructure aftermath of the disaster, and rapid change in the situation. It is unlikely that a single organization can fulfill the needs. The large number and diversity of HOs in terms of organizational size and structure, operational policies and procedures, missions, political positions, logistical capacities, experiences, and expertise, are usually involved, which then adds to the complexity of the relief operations. Therefore, to fulfill large and changing needs within a reasonable time, coordination is unavoidable among the HOs. Uncoordinated operations among the HOs usually result in imbalance relief. As evidenced in the case of the Mount Merapi eruption in 2010 (Sopha et al., 2019), uneven distribution occurred - some shelters experienced an excess supply while other shelters encountered shortages. Furthermore, expired good items, items that do not fit the needs, duplicated efforts for transportation, inappropriate personnel, and help are other observed problems in the field. These are contributed to inefficient (wasted valuable resources) and ineffective (mistarget beneficiaries) issues. Coordination has played an important role in efficient and effective disaster relief operations.

However, coordination in disaster relief operations is challenging. Different from coordination in a commercial setting which has been well-understood and successfully implemented, coordination is one of the fundamental weaknesses in humanitarian operations (Jahre et al., 2009). The coordination mechanism to connect heterogeneous players to share

and ultimately benefit from the collaboration needs to be explored to increase the robustness and responsiveness of the relief operations. Several efforts have been put to improve the coordination among HOs. For instance, the UN began to implement coordination clusters in 2005, each of which was led by a cluster lead agency. Jahre and Jensen (2010) further explained the challenges and tradeoffs in the cluster system in which the emphasis on coordination within a cluster makes it more difficult to achieve coordination between clusters. However, challenges still exist in coordination clusters such as the lead's dual role leading to trust issues, and subsequently hesitating to share information (Ruesch et al., 2022). In addition, Akhtar et al. (2012) have also suggested the concept of chain coordinators to improve the coordination along the supply chain.

The present paper, therefore, aims at investigating the coordination mechanism among the key players involved in disaster relief operations and identifying challenges of coordination in relief operations. Humanitarian operations in Yogyakarta province, Indonesia, coordinated by the provincial BPBD of Yogyakarta were selected as a studied case due to some reasons. The special region of Yogyakarta, located in the center of Java Island, has unique geographical profiles which lead to one of the disaster-prone areas in Indonesia. The province has posed several potential disasters such as the tsunami disaster in the south part of the province, landslides in the west part, a drought in the east part, and a fire disaster in the center part which is the densest area. The provincial BPBD of Yogyakarta is responsible for assessing the disaster risks and consolidating/coordinating various stakeholders such as governmental departments, non-governmental organizations (NGOs) including humanitarian organizations (HOs), and community organizations (COs) during humanitarian operations in the province. It was recorded that 1,015 disasters have occurred in 2021, in which landslides were the most frequent disasters, followed by earthquakes. Two effusive eruptions of Mount Merapi, the most active volcano in the world, have also taken place in 2021 (BPBD – Data Kejadian, 2022). All the above-mentioned disasters have affected 1,950 people (apart from the COVID-19 pandemic) and resulted in a financial loss of 17.855 billion rupiahs. Hence, a coordination mechanism that facilitates effective and efficient mitigation planning, and humanitarian operations are crucial. Third, the provincial BPBD of Yogyakarta, together with the district BPBD, is responsible for last-mile aid distribution, which is the most challenging operation.

Literature has discussed coordination in humanitarian operations and suggested various mechanisms of coordination such as coordination clusters by the UN (Jahre and Jensen, 2010), and chain coordinators (Akhtar et al. (2012). The uncertainty, the complexity, and the contextual aspect of the relief operations such as culture, work culture (Akhtar et al., 2021), organizational culture (Bharosa et al., 2010), politics (Balcik et al., 2010), technology (Kabra and Ramesh, 2015), competition among organizations (Stephenson and Schnitzer, 2006) are among the influential factors toward coordination. Subsequently, it is argued that appropriate coordination mechanisms may be different for different contexts and situations. The present study has therefore contributed to complementing the previous studies to explore coordination mechanisms in provincial-scale humanitarian operations in a developing country that has different cultures and technology.

The present paper is structured into five sections. This section has provided the background of the study and highlighted the contribution of the paper. Section 2 presents the theoretical lens of coordination in humanitarian operations. The methodology is presented in Section 3. Section 4 presents findings and discusses the empirical evidence of the coordination mechanism adopted by the governmental regional disaster management agency in the studied case, which is then concluded in Section 5. Avenues for potential research are also discussed in the last section.

2. Coordination in Humanitarian Operations

Due to the complexity of the humanitarian operations, a single organization is incapable to meet the needs of the affected populations, hence, collaboration and coordination are unavoidable. Lack of coordination leads to huge losses of human and material resources. Coordination is seen as an essential tool for effective and efficient humanitarian, thus requiring further investigation for various contexts of humanitarian operations. Coordination is defined as the relationships and interaction/interdependency among different actors in the humanitarian environments (international organizations, host government, aid organizations, military, private companies) (Balcik, 2010). Ozlem et al. (2014) have focused on the alignment of humanitarian actors in providing aid in the most possible effective and efficient way. Coordination reduces duplicated efforts and improves coverage areas, brings together diverse parties in relief operations (task division) involved, minimizes distorted information, and consequently facilitates efficient and

effective logistics operations. Furthermore, the humanitarian operations including collaboration can be evaluated using three sustainability indicators, i.e., efficiency, fairness, and environmental performance (Sopha et el., 2021).

Along with the development of coordination in the literature, coordination can be classified into various categories. Figure 1 presents the classification of coordination which can be categorized based on types of engagement (strategic, tactical, short-term coordination), dimension (horizontal, vertical coordination), and structure (centralized, decentralized coordination).

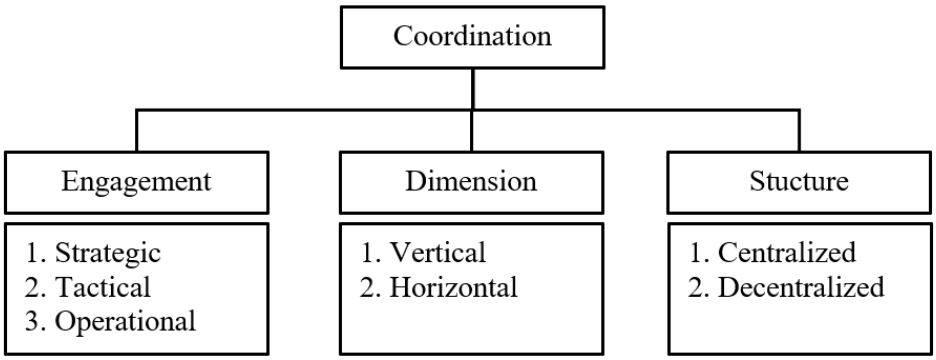

Figure 1. Coordination classification

Based on the types of engagement, coordination can take place at the strategic, tactical**,** and operational levels (Balcik et al., 2010). Coordination at the strategic level usually regards long-term such as a partnership with suppliers. The tactical level of coordination, which is medium-term, may involve decision synchronization, whereas the operational level of coordination which is short-term involves information sharing during evacuation or exchanging information during aid distribution.

Drawn from the coordination in the commercial context, coordination can be categorized into two dimensions, horizontal and vertical coordination (Lambert et al., 2005). Horizontal coordination concerns an organization that coordinates with other organizations performing similar operations at the same level such as collaboration among the non-governmental organizations in delivering aid. Horizontal collaboration may involve the partnership inside an organization or a community or the collaboration of an organization with its competitors or non-competitors. Different from horizontal collaboration, vertical collaboration refers to an organization that coordinates with those performing different operations/roles serving relatively similar end customers. In the context of humanitarian operations, the collaboration between regional disaster agencies with suppliers of aid kits is an example of horizontal collaboration.

According to Dolinskaya et al. (2011), coordination can be categorized into two types of structure, centralized coordination, and decentralized coordination. Centralization coordination is coordination in which a single agent, acting as a director of relief efforts, has the authority to direct activities, whereas decentralized coordination allows each relief organization makes its own decisions, in which no single organization has full authority. Relief operations in the 2000 Mozambique flood are an example of centralized coordination. The United Nations implemented the centralized structure by establishing the Office for the Coordination of Humanitarian Affairs (OCHA) (OCHA, 2014), which assesses needs, prepares operations, distributes information, and allocates work among organizations. Medical work in disaster response during the Haiti earthquake in 2010 is an example of decentralized coordination. The comparison between centralized and decentralized coordination is presented in Table 1.

There is currently no consensus on whether a centralized or decentralized system is the better option. Kehler (2004) stated that capacity and contextual conditions determine the appropriate coordination. In addition, the scale of disaster influences the required structure for coordination (Dolinskaya et al., 2011). The present paper hence contributes to providing insights on the appropriate coordination mechanism in humanitarian operations at the provincial level in which last-mile distribution of aid supplies takes place. It is argued that last-mile distribution has been considered critical and uniquely challenging in humanitarian operations due to high uncertainty and complexity (Balcik et al., 2020; Sopha et al., 2019).

Table 1. Comparison between the centralized and decentralized coordination (Dolinskaya et al, 2011; Sopha et al., 2019)

Component	Centralized coordination	Decentralized coordination
Approach	a single-player direct relief operation (gather and control information, make a decision)	activities are regulated by agreement by multiple organizations
Key player	as a single player as a director of relief efforts	absence of a central player
Decision-making	command	decentralized - each relief organization makes its own decisions
Control	top-down control	social networks
Advantages	easier responsibility placement, centralized data, control, reduced duplication, improved security, rapid system development, information flow, reduced cost, and fast movement of resources and information	faster decision making (each region is given the opportunity for decision making)
Disadvantages	Longer time	increased administrative costs, uneven distribution, less uniformity and consistency, the absence of control or definite procedures, and less optimal decision

3. Methodology

Qualitative research was selected as a research methodology to explore the coordination mechanism of humanitarian operations and to identify coordination challenges of humanitarian operations in Yogyakarta province. The qualitative research method was selected due to the exploratory nature of the present study (Creswell, 2015). The qualitative research is particularly beneficial for the present study because it provides a rich description of the implemented coordination mechanism, illuminates the experiences of the respondents with different stakes and roles during disaster relief operations, and enlightens challenges in coordination.

The empirical data was collected through a set of semi-structured interviews. The semi-structured interviews were selected because it enables to address the research questions while still open to exploring other aspects which have not the covered in the interview questions. The respondents of the present study are those involving in both the preparedness phase and response phase of the disaster in the province as shown in Table 2.

Table 2. The respondents of the study

Representing institutions	Number of respondents
Provincial BPBD	2
District BPBD	5
Governmental services (social department)	2
Indonesian bureau of logistics	1
Suppliers	10
Volunteers (NGOs)	10

Anchored from the research questions and the coordination classification presented in Figure 1, the questions for the interviews were constructed. The interview questions were formulated based on an initial investigation which involved a literature review, secondary source analysis, and observations. The research questions used for the study consisted of the motivation of coordination, involved stakeholders, dimension of coordination, coordination establishment, types of coordination activities (information sharing, division of task, resource sharing, joint projects, centralized decision-making, cluster-based system), the mechanism for coordination, influential factors for coordination, and coordination

challenges encountered in the field. The interviews have also identified in detail in terms of various types of resource sharing when collaboration occurs including processes, people, management skills, experience sharing, as well as the perceived coordination challenges. Each interview took about 45-60 minutes.

The collected empirical data was then analyzed. The first analysis aims to map the coordination mechanisms among the involved strakeholders in humanitarian operations ranging from disaster planning to relief operations (acquiring and distributing aid supplies). The second analysis was to identify challenges in coordination encountered in the field of operations.

4. Results and Discussion

Based on the research questions, this section is divided into three sub-sections. The first sub-section presents the brief profile and organizational structure of the Provincial BPBD of Yogyakarta as a government body that is responsible for disaster mitigation and response in the province. The second sub-section analyses the coordination mechanism of the hybrid coordination approach. The second sub-section reports challenges in coordination encountered in the humanitarian operations.

4.1 Profile of Provincial BPBD of Yogyakarta as a Coordinator in Humanitarian Operations

Provincial BPBD of Yogyakarta is a regional government institution, under the central government institution – the national disaster management agency (BNPB), that is responsible for the implementation of disaster management, according to Constitution on Disaster Management No. 27 of 2007. Provincial BPBD of Yogyakarta was established based on the regional regulation No. 8 of 2010 (BPBD – Sejarah, 2022). According to regional regulation No 1 of 2018 on governmental institutions, the provincial BPBD of Yogyakarta has its roles and functions as the following: to formulate technical policies for disaster management and carry out evaluations, determine standardization of disaster management needs, facilitate and coordinate human responses, map disaster risks and formulate disaster management procedures, integrate disaster risk management, order emergency responses, control and distribute aid supplies, recommend disaster status, coordinate, conduct guidance and supervision, carry out deconstruction and development.

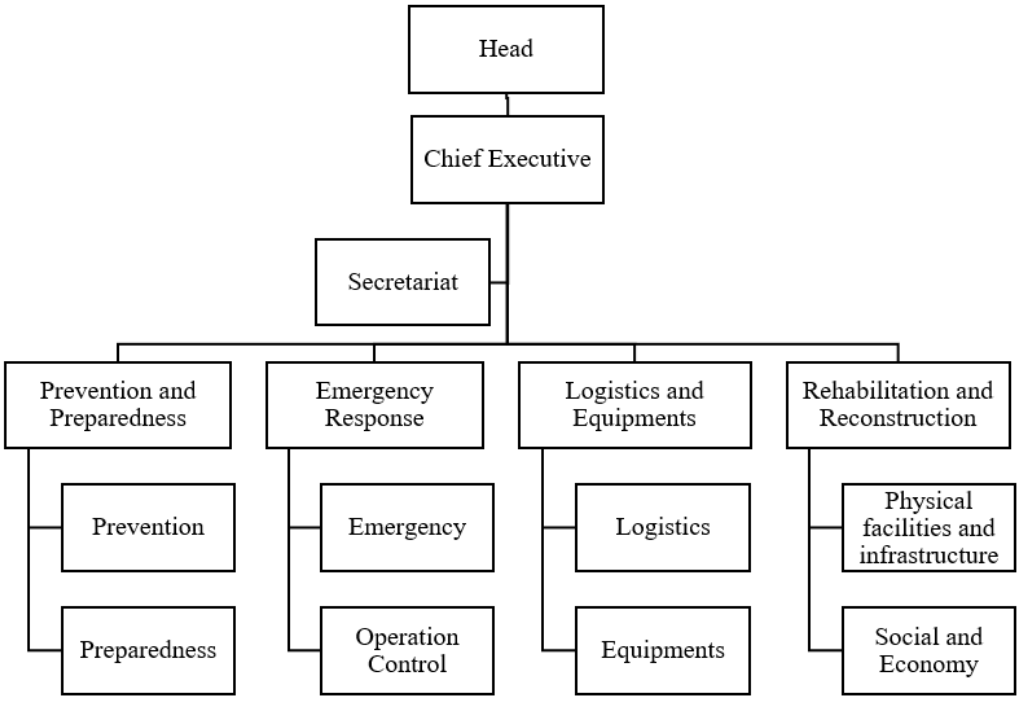

Figure 2. Organization structure of provincial BPBD of Yogyakarta (BPBD – Struktur Organisasi, 2022)

At its establishment, the provincial BPBD of Yogyakarta had three divisions, i.e., prevention and preparedness, emergency and logistics, rehabilitation, and reconstruction. In 2018, the provincial BPBD of Yogyakarta has undergone a restructuring of its bodies to expand its divisions into four divisions, i.e., prevention and preparedness, emergency, logistics and equipment, rehabilitation, and reconstruction, as shown in Figure 2 (BPBD – Struktur organisasi, 2022). The prevention and preparedness division is responsible for prevention and preparedness to improve disaster-resilient villages, particularly in disaster-prone areas. The emergency management and logistics division has responsibilities for emergency management and operation control to improve response time during emergency operations. The logistics and equipment division deals with logistics and equipment management. The rehabilitation and reconstruction division carries out post-disaster rehabilitation to improve the post-disaster recovery.

4.2 Coordination Mechanism - Hybrid Coordination Approach

Based on the roles and functions of the Provincial BPBD of Yogyakarta, disaster management in the area of Yogyakarta province is managed by the provincial BPBD of Yogyakarta which is supported by five BPBD districts in the province, i.e., Sleman district, Kulon Progo district, Bantul district, Gunung Kidul district, and the city of Yogyakarta district. Figure 3 visualizes the schematic diagram of the coordination mechanism during the preparedness and response phases.

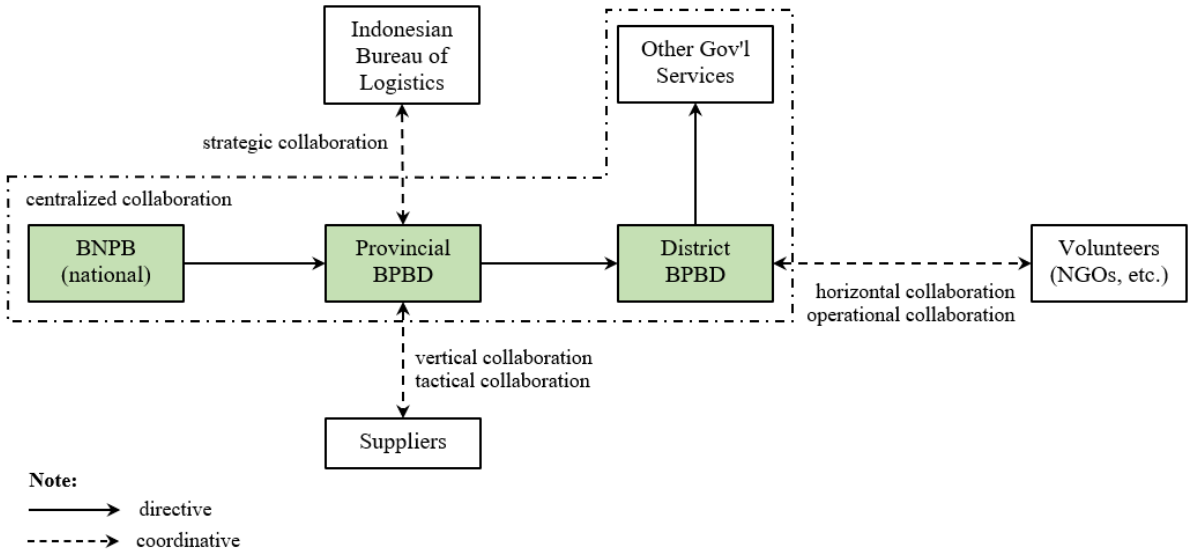

Figure 3. Schematic diagram of coordination mechanism during preparedness and response phases (Note: green boxes represent the central players)

The preparedness phase deals with disaster management planning. During the preparedness phase, the provincial BPBD of Yogyakarta and the BNPB exchange information regularly. BNPB sends aid goods to provincial BPBD of Yogyakarta according to the amount requested. The delivered goods are then stored in a warehouse at provincial BPBD that collaborate with the Indonesian Bureau of Logistics, a governmental institution that is responsible for securing staple foods in terms of amount and price at both producer and consumer sides. In addition to receiving goods from BNPB, the Provincial BPBD of Yogyakarta has also the authority to make purchases to suppliers based on the allocated budget according to the regional revenue and expenditure budget plan. The provincial BPBD of Yogyakarta lists the need for goods to be purchased to prospective suppliers so that the suppliers follow up by sending proposals including a price catalog. Based on the proposal, the provincial BPBD selects suppliers. The goods received by the provincial BPBD are then distributed to five district BPBD. Each district BPBD has one warehouse to be allocated for prepositioning inventory. However, Sleman BPBD has two warehouses. The provincial BPBD updates the availability of goods to the district BPBD. The district BPBD conducts a regular check on the prepositioning inventory. When the stored goods are nearing the expired date (less than 3 months), the inventory should be replaced by requesting replenishment to provincial BPBD. When the availability of goods at district BPBD is diminished due to shrinkage, damage, or loss, the district BPBD requests the aid goods to provincial BPBD. It is necessary to note that

provincial BPBD implements supplier memberships on regular basis and adopts e-procurement to smooth the procurement processes.

The response phase covers emergency response when the disaster occurs. In the event of a disaster in a region, the district BPBD is responsible to direct relief operations. In case of high disaster scale district BPBD cannot handle, provincial BPBD takes lead, and so when provincial BPBD cannot manage the disaster due to high scale, BNPB leads the way (centralized coordination). The district BPBD oversees the evacuation process and aid distribution from the warehouse to the shelters. The BPBD is responsible for disaster assessment, evacuation, and aid distribution. The evacuation process is particularly challenging due to the heterogeneity of evacuation decision-making by the affected population as demonstrated by Rahman and Sopha (2021), consequently more required resources in terms of human and vehicle resources.

The BPBD is also serving a center for logistics activities during the emergency response period. Both provincial and district BPBD can distribute aid supplies directly to shelters. The BPBD is responsible for distributing aid supplies to the affected population to refugees, including determining delivery routes. In dealing with the operation, the BPBD is also assisted by other government services such as the health department, social department, red-cross, and several volunteers including local and international non-governmental organizations (NGOs), and local or regional communities. During the high scale of a disaster such as the 2010 Mount Merapi eruption as well as the 2018 Palu earthquake and tsunami, the BPBD/BNPB is also supported by the military.

Extracted from the above description, Table 3 summarizes the coordination approach implemented by the provincial BPBD of Yogyakarta. It appears that the provincial BPBD of Yogyakarta has deployed hybrid coordination approach, referring to the combination of various coordination approaches. The hybrid coordination approach implemented by the provincial BPBD of Yogyakarta is characterized by the centralized structure in which BPBD Yogyakarta plays as a coordinator that directs and commands the humanitarian operations. Both vertical and horizontal collaborations are adopted to ensure streamlined aid supplies and distribute aid supplies respectively. Strategic collaboration has been implemented in the preparedness phase in terms of prepositioning inventory and sharing warehouses with the Indonesian Bureau of Logistics. Sopha et el. (2019) have demonstrated that prepositioning inventory is less effective that clustering strategy and delivery optimization. Hence, the efficient and effective approach favoring delivery optimization such as that of Asih et al. (2017) is of importance. Tactical collaboration, i.e., partnership through memberships, is adopted during the preparedness phase to ensure that aid supplies with good quality and reasonable prices are available when needed. Operation collaboration with various stakeholders such as local and/or international NGOs, and local humanitarian organizations through information sharing are established during aid distribution. It is worth noting that the operational collaboration is temporary and usually uses social media to exchange information, which facilitates shipment consolidation or transport sharing.

Table 3. Hybrid coordination approach

Classification	Collaboration type	Implementation
Structure	Centralized collaboration	BNPB as a central player for the national level, which is BPBD as a central player for the regional level
Dimension	Vertical collaboration	collaboration with suppliers (private companies), e-procurement (cost, quality, commitment/sustainability)
	Horizontal collaboration	collaboration within clusters (community – social networks)
Engagement	Strategic collaboration	prepositioning inventory (preparedness) - collaborative warehouses with the Indonesian Bureau of Logistics
	Tactical collaboration	develop collaboration with private/commercial suppliers in advance through memberships (preparedness)
	Operational collaboration	information sharing through social media, transportation-shared vehicles, shipment consolidation (response)

By adopting the hybrid coordination approach, expired food items to be delivered to the affected population, unmatched aid supplies, redundancy and shortages of goods, duplicated efforts, particularly for transportation can be reduced. In January 2019, the provincial BPBD of Yogyakarta has established four clusters including search and rescue, health, logistics, and residence, to improve the supply chain operations of aid supplies, which are coordinated

by the logistics and equipment division. Due to its recent establishment, the effectiveness of the cluster establishment has not been able to be assessed, thus suggesting that as future research.

4.3 Challenges in Coordination

It is also necessary to highlight that one successful practice might not be fit for another, because humanitarian operations are influenced by contextual relief situations. Based on the interviews, the factors influencing the successful practices of the coordination involve the number and diversity of actors, uncertainty and unpredictability, the effect of media, resource scarcity, competition for funding, donor expectations, and funding structure. Furthermore, cultural and knowledge barriers (different thoughts and perceptions), ego-sectoral, political issues, limited technology for sharing information (mostly using social media), and trust. Table 4 presents the percentage of the respondents who perceive the challenges in coordination during humanitarian operations.

Table 4. Coordination challenges during humanitarian operations

Coordination challenges	Percentage of the respondents mentioning the challenges (%)
Large number of actors in humanitarian operations	46
Diversity of actors	60
Uncertainty/unpredictability	90
Effect of media	67
Resource scarcity	50
Competition for funding	43
Donor expectation	10
Funding structure	10
Cultural and knowledge barriers	40
Ego-sectoral	10
Political issues	53
Lack of or limited technology for information sharing	73
Trust	97

It is also interesting to note that, in addition to external and organizational factors as above-mentioned, individual factors influencing the coordination is worthy of exploration. Hence, exploring behavioral factors such as that in Sopha (2013) but in the context of coordination behavior, swift trust development, sharing behavior (willingness to share), during humanitarian operations, is therefore suggested as potential avenues for future research. Moreover, identification of barriers and enablers for coordination is also worthwhile to explore.

5. Conclusion

Coordination has been given special attention in the literature due to its significant role in effective and efficient humanitarian operations. It is believed that appropriate coordination mechanisms may be different for different contexts and situations. Hence, the present paper contributes to investigating coordination mechanisms among the key players and identifying challenges of coordination in relief operations in a case study of humanitarian operations in Yogyakarta province, Indonesia. The BPBD is responsible for humanitarian operations during the preparedness and response phase of the disaster. The preparedness phase regards disaster risk assessment and preposition inventory, whereas the response phase includes disaster assessment, evacuation, and last-mile distribution of aid supplies. Qualitative research using semi-structured interviews with the representatives from governmental regional disaster management agency (BPBD) in both provincial and district levels, governmental services, Indonesian bureau of logistics, suppliers, and volunteers including non-governmental organizations. The findings indicate that the provincial BPBD has adopted the hybrid coordination approach characterized by a centralized structure, which is combined with vertical and horizontal collaboration to ensure smooth aid supplies and deliveries. Strategic, tactical, and operational levels are also adopted for different humanitarian operations. The number and diversity of actors, uncertainty and unpredictability, the effect of media, resource scarcity, competition for funding, donor expectations, funding structure, cultural and knowledge barriers (different thoughts and perceptions), ego-sectoral, political issues, limited technology for sharing information (mostly using social media), trust were perceived to be the barriers. Investigation of the effectiveness of cluster establishment and exploring the alternative approaches to dealing with the

coordination challenges are therefore suggested as potential future research. In addition, future research could focus on identifying barriers and enablers of coordination and exploring behavioral factors underlying coordination, swift trust, or willingness to share/cooperate during humanitarian operations.

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Disclaimer

The paper was prepared by the author in her capacity. The opinions expressed in the paper are the author's own and do not reflect any institutions of the respondents.

Biography

Bertha Maya Sopha is an Associate Professor of Industrial Engineering Program, Department of Mechanical and Industrial Engineering, Universitas Gadjah Mada, Indonesia. She was a former head of the Laboratory of Supply Chain Engineering and Logistics from 2013 to 2015, and a former director of the Industrial Engineering Undergraduate Program from 2016 to 2021. She currently serves as a chair of the Indonesian Association of Industrial Engineering Higher Education Institution (BKSTI), and vice-president of the IEOM Indonesia Chapter. She earned a Bachelor of Engineering (best graduate) from Universitas Gadjah Mada, a master's degree in Management of Production specialization in Transportation and Logistics (graduate with distinction) from the Department of Industrial Economics and Technology Management, Chalmers University of Technology, Sweden. She holds a Ph.D. from the Industrial Ecology Programme, Norwegian University of Science and Technology (NTNU), Norway. She has maintained a high quality of research throughout her academic career including international scholarly leadership in supply chain management and logistics, industrial ecology, and complex system modeling. She has also received various academic achievements, awards, and recognitions such as Distinguished Woman in Industry and Academia (WIIA) by IEOM Society, Editor Choice Award 2020 by Maritime Economics and Logistics Journal (Palgrave Macmillan), the Best Lecturer runner-up 2015 by Universitas Gadjah Mada, best paper awards at several international and national conferences, and research grantee awards from both Indonesia and abroad institutions. She has professional and community engagement activities to significantly improve the university's reputation through industrial projects and community services.