Disaster Response Operations of Brazilian Navy – A longitudinal case and a process perspective

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Abstract. The engagement of militaries in disaster response worldwide is fundamental, which is also true in the 2011 landslides response in Rio de Janeiro – one of the most significant in recent Brazilian history. Since then, the Brazilian Navy (BN) has experienced improvements in terms of regulations (e.g., written doctrine) and practice (e.g., disaster response simulations). Therefore, this study aims to analyse the longitudinal improvement of the BN from the disaster response in 2011 to the disaster response simulation in 2017 also related to the landslides in Rio de Janeiro. The case study considers a process model for disaster response as a reference for the analysis, as well as interviews and operational reports. Results bring evidence about the nonlinearity of the BN improvement in terms of practice and normative/regulations and also points for academic literature improvement. Future research includes a further comparison of other recent disaster response operations in the same location.

Keywords: Business Process Management, Operations Management, Humanitarian Logistics.

1 Introduction

The importance of disaster response lies in saving lives, providing immediate assistance, improving health, and sustaining the morale of the affected population (Eriksson, 2009). In this context arises the Humanitarian Operations (HOs), which involve activities performed by different stakeholders, with different cultures and satisfactions, that need to interact to solve a wide range of interdisciplinary tasks (Fontainha et al., 2022). A HO embraces the participation of several stakeholders, such as local aid network, international aid network, donor, direct supplier, private sector, media, government, legislative and regulatory, military, and beneficiary (Fontainha et al., 2017). Among them, the military has vital importance due to its flexible and varied participation, which may involve providing human resources into the disaster area, transport, and logistics to the disaster response. The military is also essential to the preparedness and recovery phases by providing housing construction and repair of

essential infrastructures such as roads, ports, airports, and railways (Thompson, 2010, Costa et al., 2017, Moreira et al., 2022).

A critical example of the military engagement in HOs includes the response to the landslides that affected the mountain region of Rio de Janeiro in 2011, which was considered the greatest climatic disaster in Brazil. The event caused 905 deaths in seven cities and affected more than 300 thousand people, almost 50% of the population of the municipalities hit by the landslides, and represented a significant milestone for the risk management policies in Brazil (World Bank, 2012). Due to the magnitude of this event, the Brazilian government assigned the three armed forces as primary stakeholders for leading the disaster response, and they divided the region to perform the required HOs simultaneously (Costa et al., 2017; Fontainha et al., 2022). Since then, the military started to deploy the Joint Civil Defense Support Exercise (JCDSE) to simulate how to proceed in case of massive disasters and test the integration among all the military forces and other stakeholders. The JCDSE 2017 edition simulated a similar event to the disaster that occurred in the mountain region of Rio de Janeiro in 2011 (Ministry of Defense, 2017), which represents an opportunity for analysing the evolution of the Brazilian military engagement in HOs within these years. This approach aligns with the research agenda Behl and Dutta (2019) proposed, which identified a research gap of longitudinal research in HO in their literature review.

Therefore, this research aims at investigating the evolution of the Brazilian military engagement in HO in terms of regulations (e.g., written doctrine) and practice (e.g., real-case disaster response and simulations) according to the perspective of the Brazilian Navy (BN). This objective represents an opportunity to discuss the changes in the regulations and operation, focusing on the gaps that still need improvement for better disaster response by the BN and the military perspective in general. This analysis adopts a process approach due to the presentation of the activities in structured models, which promotes several benefits, such as discussing more efficient and effective processes and best practices (Blecken, 2010; Fontainha et al., 2022).

After this introduction, Section 2 presents the research methodology. Section 3 offers the comparative analysis of the processes prescribed in the academic literature to which BN performed in the disaster response in 2011, in the JCDSE in 2017, and the BN regulations. Section 4 provides an overview of the main results. Section 5 covers an overview of the research and suggestions for future work.

2 Research methodology

The present research adopts the case study method, which is appropriate to investigate a contemporary phenomenon in-depth and in its real-world context, especially when the boundaries between phenomenon and context may not be evident (Yin, 2002). This research considers the following steps: plan, design, preparation, data collection, data analysis, and reporting (Yin, 2002).

The first step is related to the method suitability, discussed in the previous section. The second step involves the case study design. In this sense, the study adopts as units of analysis the activities of the BN in the disaster response in 2011 and the simulation

in 2017, also considering the distinction between regulations (e.g., written doctrine) and practice (e.g., real-case disaster response and simulations). Besides that, the research considers as a theoretical reference the "Reference Process Model for Disaster Response" developed by Fontainha et al. (2022) based on a structured literature review and considered a reference to guide the analysis of disaster response operations. This reference model describes nine processes in the general level presented in Fig. 1, which refers to disaster response processes in a higher level of abstraction. For each process at the general level, Fontainha et al. (2022) provide more detailed processes labelled as partial processes, which summarize 62 processes at this level. Appendix 1 presents these partial processes.

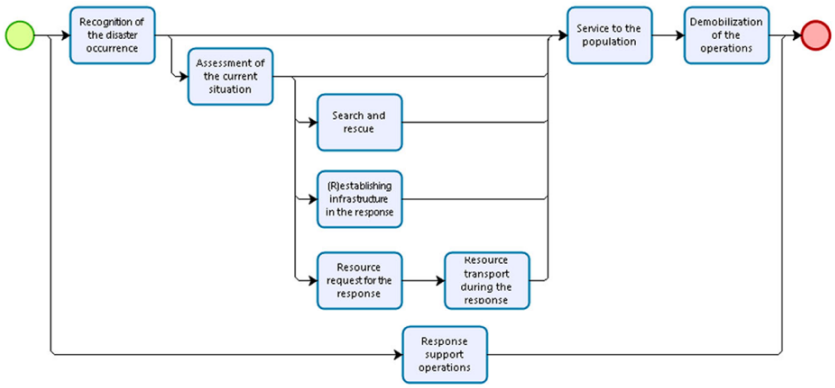

Fig. 1. Reference process model for disaster response – general level (Fontainha et al., 2022).

The third step concerns the preparation. In this research, the protocol embraces an auxiliary table that details all 62 partial processes indicated in Fontainha et al. (2022), representing all issues to be investigated in the data collection.

The fourth step embraces the data collection and consists of three different evidence sources: documents, interviews, and direct observation. For the disaster response to the landslides that occurred in Rio de Janeiro in 2011, the research considers the findings already presented in Fontainha et al. (2022), which covers the analysis of BN operational reports and interviews with BN professionals directly engaged in such disaster response. For the BN regulations, the search considered two databases, the Marine Corps Doctrine Development Command and the Commission Force of the Marine Corps Command, searching for publications whose titles contain any of the following terms: Civil Defense, search and rescue, natural disasters, humanitarian logistics, or field hospital. For the JCDSE 2017, the research considered mainly the final report of JCDSE 2017 and direct observations during the three days-simulation.

In the fifth step, the data analysis adopts the pattern matching technique, which compares a fundamentally empirical to a prognostic basis. If the patterns coincide, the results can help the case study reinforce its internal validity or suggest future research for divergences (Yin, 2002). Thus, the processes described in the Reference Process Model developed by Fontainha et al. (2022) is considered the prognostic basis to ana-

lyse the data of BN performance in response to the landslides in the state of Rio de Janeiro in 2011, the current BN regulations, and the data of JCDSE 2017. Such comparison considers an auxiliary table similar to Appendix 1. The last step, the reporting, considers the process description and comparison in the following sections.

3 Comparative analysis of the BN disaster response processes

3.1 Overview of the disaster response in 2011, the disaster regulations in Brazil, and the JCDSE 2017

The main objective of the disaster response operation in 2011 in Rio de Janeiro was to provide access to the local population for search and rescue and the distribution of emergency supplies (Costa et al., 2017; Fontainha et al., 2022). Due to the large area affected by the landslides, the Army, Navy, and Air Force divided the region and acted simultaneously independently at the operational level, integrating only within the scope of top management (Costa et al., 2017; Fontainha et al., 2022).

Regarding the legislation, the most important is law 12.608 promulgated in 2012, establishing the National Civil Defense and Protection Policy and also the National Civil Defense and Protection System (Brazil, 2012). The BN integrates the "Armed Forces Employment Plan" in case of disasters, which guides the response operations in the country (Ministry of Defense, 2013). Nevertheless, due to the magnitude of the disaster and the means demanded to deal with the large-scale disaster, the Ministry of Regional Development (the national level instance of the Civil Defense) can request the Ministry of Defense (the national level instance of the Armed Forces) to assume the overall coordination (Ministry of Defense, 2001). Nevertheless, the protocol of actions in disaster response (Ministry of National Integration, 2013) states that the Armed Forces, including the BN, is only activated after the general process “Recognition of the disaster”.

Besides the regulations, simulation of the JCDSE is another initiative to promote the continuous improvement of the disaster response operations. The first edition of the JCDSE occurred in 2013, and the edition in 2017 simulated the disaster preparedness and response to a similar event in the mountain region of Rio de Janeiro in 2011 (Ministry of Defense, 2017). The exercise employed tactical and strategical actions, with simulations in the internal environment, such as implementing workstations, meetings, decision making, and internal communications, without the effective employment and execution of the operational response activities. The protocols, plans, and actions were coordinated between institutions to test the integration between all the Armed Forces participating in situations of support to Civil Defense and other stakeholders involved in the disaster response (Ministry of Defense, 2017).

3.2 Detailed comparison

Appendix 1 summarizes whether the BN performed/discusses all 62 processes in partial level in the three perspectives: the disaster response in Rio de Janeiro in 2011, the BN regulations, and the JCDSE 2017.

Regarding the “Recognition of the disaster occurrence” process described in Fontainha et al. (2022), the BN did not perform any of them in the response in 2011, does not have any prescribed discussion in its current regulations or procedures, and was not involved in this action in the JCDSE 2017.

Regarding the process "Assessment of the current situation", in 2011, the BN engaged in the disaster response by deploying different field teams responsible for the identification of the type and magnitude of the disaster as well as to install and operate a Field Hospital (Navy Command, 2011c; 2015; 2011d). In terms of regulations, the BN published some operational procedures in 2013 and 2015 addressing the assessment of the current situation focused on the deployment of exploratory teams and field hospitals – in this sense, for instance, the troops must initiate the movement to the affected area in up to six hours (Navy Command, 2013a; 2015). The JCDSE 2017 simulated landslides reaching the infrastructure of a local hospital, damages to the water network for human consumption in the region, damages to two power stations, problems related to the collection of solid waste due to blocked roads and broken trucks, and unavailability of communications in the affected region (Ministry of Defense, 2017). Thus, all partial processes were recognized in the disaster response in 2011, in the BN legislation, and in the JCDSE 2017.

Regarding the process “Search and rescue”, the BN performed rescue actions in 2011, including transportation of material, food, medicines, and rescue personnel (Navy Command, 2011b; 2011c). All the interviewees indicated the BN also performed the collection and burial of corpses, although the final report does not portray this activity. In terms of regulations, BN has operational procedures related to Rescue Operations that can also be engaged in disaster response, including search and rescue, first aid, pre-hospital care, emergency and surgical procedures (Navy Command, 2014). Regarding the process of carrying out the collection of corpses, under normal conditions, the police authority is responsible for this task; however, in disaster situations, the BN should be ready to support this task by seeking information on the treatment policy for the dead and the needs such as, for example, cold rooms (Navy Command, 2015). In JCDSE 2017, the activities considered that 40 people were trapped and unable to be rescued by local Civil Defense, resulting in the adoption of BN helicopters (Ministry of Defense, 2017). Thus, all partial processes were recognized in the disaster response in 2011, in the BN legislation, and in the JCDSE 2017.

Regarding the process “(R)establishing infrastructure in the response”, the BN engaged in infrastructures related solely to the field hospital (Navy Command, 2011d). The BN did not perform partial processes related to "Requesting infrastructure restoration", "Clearing main roads and restoring access routes" and "Restoring water, energy, and communications supplies". Regarding regulations, BN procedures prescribe suggestions for equipment transport according to the means' availability and distance to the disaster area. Whenever a vehicle is required, the BN must create a Movement Order to define the current situation, mission, and purpose of the movement and the logistical procedures, responsibilities, and aspects of command and control (Navy Command, 2011a; 2013b). Besides the processes related to deploying a field hospital infrastructure (Navy Command, 2011b), BN can provide specific engineering equipment to clear main roads and reestablish access routes (Navy Command, 2015). “Re-

questing infrastructure restoration" and "Restoring water, energy, and communications supplies" are the only processes of this level not prescribed in the legislation. The JCDSE 2017 simulated several landslides that caused the interdiction of several access routes. Thus, it simulated the mobilization of equipment for clearing the roads by the BN but not the process "Restoring water, energy, and communications supplies" (Ministry of Defense, 2017). Besides, compared to the processes addressed by Fontainha et al. (2022), this research suggests an additional partial process labelled "Deploying infrastructure to support the response team" due to the need for a framework to support military personnel participating in the mission.

Regarding the process "Resources request for the response", the BN provided the initial allocation of equipment, medicines, and item replenishment but received complementation from local government and donations from the population (Navy Command, 2011c). Despite that, the BN did not have all the medicine required and provided locally in the disaster response in 2011 (Navy Command, 2011c). The BN plans already define a basic amount of material and personnel for employment in support of Civil Defense; the BN storages these emergency products in strategic warehouses within the country (Navy Command, 2011c; 2015). The Ministry of Defense must calculate the costs for the entire disaster response operation and charge the Ministry of Integration, currently Ministry of Regional Development (Ministry of National Integration, 2013). In the JCDSE 2017, the simulations considered drugs' requests to the field hospital and also the communication of donations needed for the population, which involved the request of emergency products in stock, mobilization of strategic resources, local purchase, communication of priorities to donors, and receiving of such donations (JCDSE Report, 2017). Thus, some partial processes performed in 2011 and in the JCDSE 2017 remain unofficially covered by BN procedures, such as "buying local products", "communicating priorities to donors" and "receiving donations". Moreover, some processes were no performed in the real disaster, nor in JCDSE 2017 and are not prescribed in BN regulations, such as "consolidating product requests", "hiring of transport resources" and "specifying special products".

Regarding the "Resource transport during response", according to the interviewees, this process was focused on the donations transport. The population outside the region affected by the disaster donated material to the militaries and transported it to the disaster area by BN trucks. The only three processes not performed in the event were "selecting the transport route", "scheduling transport", "preparing shipping documents of resources". According to the BN regulation, any transportation considers the preparation of a general convoy (Navy Command, 2015). In the case of road transportation, the BN is responsible for procedures and techniques of planning, preparation, execution, and control of motorized displacements, including the use of satellite positioning resources, tracking, geographic information systems, databases, and other means of information and communications technology (Navy Command, 2013b). Upon arrival to the operations area, the BN unloads the resources and confirms whether all material that has left the source has reached its final goal or not (Navy Command, 2015). In the JCDSE 2017, there was a simulation of transporting 10 tons of donations to the victims. The JCDSE 2017 considered the concentration of donations at the BN space in the International Airport of Rio de Janeiro, with the need to

deliver them quickly to the population, using trucks from the BN and airplanes from the Brazilian Air Force (Ministry of Defense, 2017). There is one partial process not performed in the JCDSE 2017, not performed in the real disaster as well as not covered in the BN regulations, which is the “preparing shipping documents of resources”. Moreover, the processes “selecting the transport route”, “scheduling transport” were performed in 2011 and in JCDSE 2017, but not covered in BN regulations.

Regarding the process “Service to the population”, in 2011, the BN performed activities during the operation of the Field Hospital through medical, dental, and emergency care and patient transportation in collaboration with the local public hospital network (Navy Command, 2011c). According to the BN regulation, the service to the population focuses on two aspects: provision of medical care and provision of emergency products (Navy Command, 2015). The reception of the affected population in the Field Hospital or any other structure of medical care starts with the installation and operation of the health structure (Navy Command, 2015). After receiving the resources in the area of operations, the material is sorted to establish the growing logistics as soon as possible to provide the best possible conditions to support Civil Defense actions (Navy Command, 2015). In the JCDSE 2017, the simulation considered approximately 500 families removed from their homes and taken to improvised shelters, necessitating the setting up of a camp structure for these people – a structure set up by BN considering the suggestion of locals such as schools, gymnasiums, and other open areas (Ministry of Defense, 2017). Thus, this research identifies that all processes were performed in 2017 JCDSE, that three processes are not prescribed in the BN regulations (i.e., “deploying inventory policy”, “identifying and marking the resources”, and “storing products required for the response”); and only one process (i.e., “allocating resources according to the requests”) was not performed in 2011.

Regarding the "Demobilization operations" process, it is worth mentioning that there is no specific measure to define when to finish the operation. In 2011, the demobilization occurred ten days of operations due to the return of the activities by the local public hospital (Navy Command, 2011c). According to the BN regulation, this process covers the demobilization, re-transfer of the means, and return of the Units Task (Navy Command, 2015). Upon completing the mission, the dismantling of structures and careful shipment of material and equipment shall start (Navy Command, 2011b). In the JCDSE 2017, as soon as the number of medical care procedures decreased at the Field Hospital and the city's structures began to normalize, the direction of the event suggested the demobilization of provisional care infrastructure (Ministry of Defense, 2017). All partial processes were performed in 2011 and in the JCDSE; however, some are not defined in BN procedures, such as “confirming normalcy restoration” and “demobilising unused resources (return/disposal)”.

Regarding the process “Response support operations”, in 2011, the BN acted mainly to deploy stakeholder communications and create daily reports due to the Field Hospital (Navy Command, 2011c). For the BN regulations, this process concentrates on four pillars: “establishing communication between stakeholders”, “operating operations and support system”, “law enforcement and order” and “create status report” (Navy Command, 2011a; 2012; 2015; Ministry of Defense, 2013). The last pillar focuses on the need to monitor the situation through daily reports, thus having a

standardization in the analysis of improvement or not of the conditions in the area of operations (Navy Command, 2015). Thus, only a few processes were performed in the disaster response in 2011. In the JCDSE 2017, the BN adopted a command-and-control system to contribute to situational awareness, the treatment of incidents, and the synchronization and monitoring of the actions taken during the events (Ministry of Defense, 2017). The only two processes performed in the JCDSE were "establishing communication with stakeholders" and "operating and support systems". The other processes were out of scope. Thus, only one process was not performed in 2011, but performed in 2017 and discussed in BN regulations (i.e., “Operating operational and support systems”). Other three processes were discussed in the three situations (i.e., “establishing communication with stakeholders”, “maintaining the order in the disaster area”, and “creating emergency summary report”).

4 Discussion of the results

Table 1 summarizes the analysis provided in the previous section in quantitative terms regarding the perspective of the Reference process model for disaster response operations in Fontainha et al. (2022).

Table 1. Summary of the comparative analysis of the processes described in the BN regulations, the response to the slides of Rio de Janeiro in 2011, and the JCDSE 2017.

Situations	Number of Processes
Reference Model (Fontainha *et al*., 2022)	62
Processes discussed in the regulations of BN and performed in the real case and the JCDSE	32
Processes not discussed in the regulations of BN and not performed in the real case and the JCDSE	16
Processes performed by the BN in the real case or JCDSE but not contained in the regulations of BN	11
Processes performed in the JCDSE included in the regulations, but not performed in the real case	3
Processes prescribed by BN and not included in the reference model (inclusion suggestion)	1

At first, comparing the BN processes with the academic literature, this research points out that the BN regulations do not cover 16 processes that were not carried out in the case of the Rio de Janeiro mountain region disaster in 2011 nor in the JCDSE 2017. This fact demonstrates the opportunity to extend the BN regulation to consider how to interact with the other stakeholders responsible for such processes, contributing to improved disaster response in future operations.

Secondly, comparing the process performed in the real case or JCDSE with BN regulations, 11 processes were not identified in the BN regulations, emphasizing the importance of updating the regulations so that the BN regulations cover future operations. The processes are: “requesting infrastructure restoration”, “buying products”, “communicating priorities to donors”, “receiving donations/funds”, “selecting the

transport route", "scheduling transport", "deploying inventory police", "identifying and marking the resources", "storing products required for the response", "confirming normalcy restoration", and "demobilising unused resources (return/disposal)".

Thirdly, three processes (i.e., "clearing main roads and restoring access routes", "allocating resources according to the requests" and "operating operational and support systems") are included in the BN regulations and performed in the JCDSE 2017 but not performed in the disaster in 2011. This analysis reveals that the BN aims to improve future disaster response operations continuously.

Last, the analysis of the BN operation led to the suggestion of one new partial process to the reference process model of Fontainha et al. (2022): "Deploy provisional infrastructure to support the response team". Costa et al. (2017) also suggest such process focused on the infrastructure for the response team.

5 Conclusions

Disaster response operations involve several activities vital to the affected population relief, and military engagement is fundamental due to the broad nature of expertise to act in this situation. The research reveals that engagement of the BN in responding to the 2011 disaster in Rio de Janeiro, the JCDSE 2017, and the BN regulations indicates a consistent presence, with consolidated knowledge obtained in previous actions. The results reinforce that the military, and more specifically the BN, is pivotal to the disaster response in Brazil. The in-depth analysis of each partial process, especially those already carried out in practice and not covered by specific BN regulations, is considered an opportunity to improve the military doctrine. Future work could enlarge this discussion by comparing how the military, specifically the BN, acted in other disaster response operations in the same region.

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Appendix 1

Table 2. Reference process model for disaster response.

Reference processes model for disaster response (Fontainha et al. 2022)	BN in 2011	BN Regulation	JCDSE 2017
1 - Recognition of the disaster occurrence			
1.1 - Identifying changes in local features	×	×	×
1.2 - Communicating the event to higher levels	×	×	×
1.3 - Triggering alarms	×	×	×
1.4 - Evacuating risk areas with activated alarms	×	×	×
1.5 - Implementation of containment measures or protection	×	×	×
2. Assessment of the current situation			
2.1 - Deploying disaster management centre	✓	✓	✓
2.2 - Deploying exploratory team	✓	✓	✓
2.3 - Identifying type and magnitude of the disaster	✓	✓	✓
2.4 - Deploying emergency team	✓	✓	✓
2.5 - Development of emergency plans	✓	✓	✓
2.6 - Deploying of emergency plans	✓	✓	✓
2.7 - Assessing needs and numbers of beneficiaries	✓	✓	✓
2.8 - Assessing type and quantity of resources required	✓	✓	✓
2.9 - Assessing local sources of supply	✓	✓	✓
2.10 - Assessing local infrastructure	✓	✓	✓
3. Search and rescue			
3.1 - Performing search and rescue	✓	✓	✓
3.2 - Performing screening for medical care	✓	✓	✓
3.3 - Transfer patient for medical care	✓	✓	✓
4. (R)establishing infrastructure in the response			
4.1 - Requesting infrastructure restoration	×	×	✓
4.2 - Mobilising equipment	✓	✓	✓
4.3 - Clearing main roads and restoring access routes	×	✓	✓
4.4 - Restoring water, energy, and communications supplies	×	×	×
4.5 - Deploying temporary infrastruct. for services to people	✓	✓	✓
5. Resource request for the response			
5.1 - Prioritising requirements	✓	✓	✓
5.2 - Requesting emergency products in stock	✓	✓	✓

Reference processes model for disaster response (Fontainha et al. 2022)	BN in 2011	BN Regulation	JCDSE 2017
5.3 - Consolidating product requests	×	×	×
5.4 - Buying products	✓	×	✓
5.5 - Hiring of transport resources	×	×	×
5.6 - Specifying special products	×	×	×
5.7 - Specifying human resources required	✓	✓	✓
5.8 - Specifying necessary financial resources	✓	✓	✓
5.9 - Communicating priorities to donors	✓	×	✓
5.10 - Receiving donations/funds	✓	×	✓
6. Resource transport during the response			
6.1 - Consolidating the transport	✓	✓	✓
6.2 - Selecting the transport route	×	×	✓
6.3 - Scheduling transport	×	×	✓
6.4 - Preparing shipping documents of resources	×	×	×
6.5 - Loading resources on vehicles	✓	✓	✓
6.6 - Transporting resources during the response	✓	✓	✓
6.7 - Tracking and locating resources in transit	✓	✓	✓
6.8 - Downloading resources from the vehicles	✓	✓	✓
6.9 - Confirming receipt of resources	✓	✓	✓
7. Service to the population			
7.1 - Accommodating the affected population	✓	✓	✓
7.2 - Receiving resources	✓	✓	✓
7.3 - Deploying inventory policy	✓	×	✓
7.4 - Identifying and marking the resources	✓	×	✓
7.5 - Storing products required for the response	✓	×	✓
7.6 - Allocating resources according to the requests	×	✓	✓
7.7 - Delivering products to the affected population	✓	✓	✓
8. Demobilisation of the operations			
8.1 - Confirming normalcy restoration	✓	×	✓
8.2 - Demobilising provisional infrastructure	✓	✓	✓
8.3 - Demobilising unused resources (return/disposal)	✓	×	✓
9 Response support operations			
9.1 - Establishing communication with stakeholders	✓	✓	✓
9.2 - Operating operational and support systems	×	✓	✓
9.3 - Maintaining the order in the disaster area	✓	✓	✓
9.4 - Creating special orders report	×	×	×
9.5 - Creating asset and inventory report	×	×	×
9.6 - Creating damage and loss report	×	×	×
9.7 - Creating donations and donors report	×	×	×
9.8 - Creating needs assessment report	×	×	×
9.9 - Assessing the disaster response performance	×	×	×
9.10 - Creating emergency summary report	✓	✓	✓