Scenario Planning and Simulation in Disaster Response

M Halizahari [a,*], Muhaimin Ridwan Wong [a], Noor Diyana Fazan Ahmad [a], Ruzaidin Zain [a], Noor Azmi Hj Zainol [a]

[a] *HADR Research Center, National Defence University of Malaysia, Kem Perdana Sg Besi 57000 Kuala Lumpur, Malaysia*
Corresponding author: *haliza.mz@upnm.edu.my

Abstract—**This study examines disaster response effectiveness. This workshop was preceded by a case scenario featuring an explosion in a heavily populated Kuala Lumpur City, Malaysia, produced by the researchers. The agencies involved used this case scenario as a storyline to implement the response. The coordination efforts undertaken by each agency can be seen. It is plain to see the efforts of collaboration that each agency has been putting forth. Focus group discussion served as one forum for debating the course of action taken; at the same time, the action taken by each agency involved should align with the roles and responsibilities outlined. During the workshop, it was revealed that it assisted researchers in better understanding agencies' disaster response process in identifying shortcomings, determining gaps, and improving on the processes already in place for disaster response. However, it was noted that the success of implementing SP&S lies in the involvement and participation of each agency. Therefore, it can be concluded that communication and coordination between agencies are very important in the success of an operation, not only during SP&S but also during disaster response.**

Keywords— **Scenario planning; simulation; collaborative disaster management; disaster management agencies; SP&S activity model.**

I. INTRODUCTION

Countries around the globe have faced the virtual certainty of encountering a disaster in one form or the other at some point in their history. However, disasters still occur regularly, regardless of the time of year or season. With the advancement in science and technology, disasters have evolved. In the past, disasters were mostly associated with natural conditions or wars. However, a paradigm shift is prominent with the evolution of civilization and technology regarding the severity of disasters, whether due to climate changes or nuclear wars. Over the last few decades, disaster risk has escalated across the world, and some horrific incidents from the past, such as World War I and World War II, Incident 9/11, and the rainforest fire in Amazon 2020, have engraved fear, influencing policymakers to direct their attention toward disaster management to prevent catastrophic losses. Agencies and non-governmental organizations (NGOs) must maintain a high level of preparedness at all times since disasters are unpredictable and uncertain [1], [2].

Underdeveloped and developing countries suffer more economic losses and deaths triggered by disasters, while the most vulnerable people in these countries facing the burnt are those living below average standards [3], [4]. There is an endorsement in economic losses almost seven times since 1960, whereas losses reported in the 1990s had reached up to 659.9 billion USD. More Developed Countries (MDCs) accrued two-thirds of this economic loss, while more deaths were reported in Less Developed Countries (LDCs). The fatality rate reported in 1992-2002 by the International Federation of Red Cross and Red Crescent Societies (IFRC) for MDCs and LDCs reached 27,464 and 594,899, respectively. Corresponding to the Human Development Indexes (HDI), countries with low HDI reported 1052 deaths, which was conspired to merely 23 in countries with higher HDI. Although MDCs suffer major economic losses compared to LDCs in case of disasters, this economic ramification was amplified for LDCs since the small economic loss is accountable for the countries with lower gross incomes (GNI).

The government's essential role under disaster circumstances is to protect against harm. This role has been widely accepted around the globe for the last two centuries, especially in the United States, which influences the formation of different government policies and actions to anticipate risks, train citizens to tackle risks, and aid them in recovery from the damage. Later, these policies are implemented in developing and underdeveloped countries

with some amendments according to their region and cultural norms. These policies consider the citizens as unintended victims of the destructive scenario and assume that government will remain intact for all the shield and recovery procedures from disasters. The fundamental role associated with the government in these policies is to provide resources to the affected region to mitigate the uncertainty and hazardous impact resulting from the occurrence of destructive events [5]. The formation of these policies is interpreted as extreme events that are relatively more likely to occur and are out of control for citizens.

A more careful approach has been adopted towards disasters, which embedded the documentation of losses due to destructive events and a critical analysis of government practices toward these haphazard [6]. Disaster is considered a problem that can be effectively managed with informed actions and venturing proper attention and resources in risk-prone regions. To perform informed actions, government-aligned agencies and professionally trained teams within the community offer preparedness for any possible disasters. The assessment embedded with the preparedness procedure reshaped the hazard from extremely destructive events with no human control to a probabilistic occurrence in which human actions and social and economic contributions significantly become vulnerable in mitigating risks. With this conception, extremeness in losses is more dependent on disaster management. When exposed to disasters, it becomes the product of inappropriate planning, ignorance, or uninformed tasks that cause cumulative failures in putting an objection on human development and engineering system.

Disasters are typically considered hazards that cannot be avoided but whose consequences can be reduced to a certain extent. In light of the facts, it is clear that hazards are influenced by human behavior and that how people respond to a disaster determines the extent of losses. However, the human role is not only concise to mitigating risks due to disasters, but many disasters result from human activities. Hazards can be naturally occurring events, but the cumulative impact of humans as a society has reshaped disasters in severity. For example, deforestation is a human activity that can result in floods; hence, more deforestation means more risk of losses due to flooding. The international community has made considerable efforts to ambiance the radical effects of disasters triggered by nature or technology. The necessity of disaster management in high-risk regions is underscored by natural disasters impeding economic progress. [4].

A. Disaster Management Approach

The primary focus of establishing disaster management is to prepare for the actual and potential haphazard events to mitigate the resultant loss. Planning to eradicate the disaster impact depends on the type of disaster, broadly categorized into three forms depending on the reasons that triggered hazards, mainly encloses technological, natural, or complex emergencies. However, it is important to note that disaster shape is also evolving due to the emergence of advanced technology and influenced by the disturbance in political or environmental balance within society. The change in disaster form can be best described as terrorist movements, destructive technologies, or outbreaks of unknown diseases like COVID-19. Henceforth, disaster management must also be upgraded to cope with the advanced shape of hazards and threats.

B. Natural and Technological Hazards

In case of natural and technological disasters, the main focus of the government's strategic plan in managing risk is to prevent society from hazards while protecting the relevant area under governmental jurisdiction, which is done by integrating legislation, allocating responsibilities to the relevant institutes, providing financial resources, and considering community involvement embedded with the local response. The Organization of Economic Cooperation and Development (OECD) comprehended the mentioned approaches, resulting from extensive research on anthropogenic disasters.

Disaster management results from continuous risk assessment and lessons learned from the past to improvise performance, which is embedded with emergency plans and disaster management approaches. The step of recurring improvement depends on the experience of the ally's government to define best practices, policies, and legislation to help the community overcome the damage due to disaster. Such type of practices for disaster management is common in areas prone to natural disasters, including floods, storms, or seismically active zones. The MDCs, including the US, Japan, Australia, and many other countries, confine the mitigation strategies with a high coping capacity that encloses the investment of income, insurance, and savings as a junction. The main purpose behind the extra step of preparedness is the assurance of less mortality rate and the fastest recovery despite the extreme disasters. The scenario above can be best understood by the examples of Florida (US), which recovered from multiple hurricanes [7], recovery of Japan from the 1995 earthquake [8], and Darwin, Australia recovered when prone to Cyclone Tracy with 70% destruction of building [9].

The ultimate goal of effective planning and preparedness is to shield losses and speedy recovery, but to achieve effectiveness; it is important to confine the factors of accountability, democracy in government institutes, political and financial support, and society's trust. Contrary to MDCs, LDCs also take precautionary measures to eradicate the risk factor associated with disasters. However, effectiveness can deviate from the developed countries due to the limited resources and ineffective policies and support from the political bodies of these countries. The emergence of the International Decade for Natural Disaster Reduction (IDNDR) from 1990 to 1999 influenced the strategic planning for disaster management in LDCs subdivided into different institutes or organizations at the national, sub-national, and municipal levels that have been improvised over time. A similar glimpse of this approach can be seen in the 1970s, entitled the 'environment decade', where institutions were built to monetize and shield the environment from the effects of pollution. However, LCDs lag when it comes to proper planning and institutional management. It is important to know that in MDCs and LDCs, the actions performed by civil institutions developed to tackle natural and technological disasters follow the bottom-up approach, while the efforts made by the citizens to protect against the hazardous effects of disasters are from the top-down approach.

C. Human Oriented Complex Emergencies

In complex situations resulting from political conflicts or severe natural destruction, government institutions working for disaster management may not access the affected people for social protection. For instance, refugees from international borders may urge support from the local government. Still, since they are in remote areas of the inaccessible border region, they might not get any help from the territory. In addition, Internally Displaced People (IDP) may build pseudo-economic and political pressure on the local government and the host population. Multiple International organizations like IFRC and United Nations (UN) agencies work to resolve these complex emergencies where disaster management involves the needs assessments and delivery of basic things to survive and sustain. The primary focus is to balance available resources against human needs, including food, water, shelter, protection, healthcare, sanitation, and children's education, to create a sustainable environment for the IDPs. Resources are allocated in response to the formulated appeal by refugees while these efforts are tailored to conflict resolution so that resettlement and repatriation can become possible.

In a complex environment where multiple agencies are involved, which may include intense international media, building pressure and determining success ratio under the influence becomes difficult. The humanitarian sectors that work for immediate relief for the stranded people mostly enclose neutral and state-independent non-profit organizations or agencies that focus on mere humanity [10]. On the other hand, development sectors associated with disaster management are more state-oriented and influenced by the political environment. Humanitarian sectors follow standard measures to evacuate the tense disaster that encloses well known Humanitarian Charter and Minimum Standards established to respond to the disaster carefully. On the contrary, the development sector implies strategies according to the standards of Poverty Reduction Strategy Papers (PRSPs), whose primary focus is to ensure the participation of stakeholders in development. However, stakeholders' participation depends on their growth and multiple other factors, leaving doubt over their contribution as a value. It is important to bridge the gap irrespective of the deployed approach, whether relief-based or development.

D. Case Study 9/11

The event of 9/11 impacted the public perception of risk [11] and questioned the government's roles and policies in managing the risk [12]. Although terrorism was not new, after the Japanese attack on Pearl Harbor in 1941, 9/11 was the most destructive event ever since the attack on World Trade Centre and Pentagon targeting civilians. The more devastating fact was the inadequate Government policies that failed badly in providing security to their citizens [13]. The interdependent services designed to facilitate global communication and transportation incorporated technology for exchanging goods, people, information, or knowledge to decrease costs became the frontline reason for the encountered event. The lag in coordination between departments and inadequate policies to ensure the secure exchange led to a devastating risk associated with human error and malfunction resulting in destruction. This ignites an urge to discover new methods and means to

cope with the deliberated disasters and mitigate security risks for civilians [14]. To achieve this, coordination is required between government agencies, private business firms, and non-profit organizations to perform informed actions.

The policy development intends to provide a guideline for practices, but the reverse can happen, as in the case of 9/11. The inability to consider such attacks on this massive scale limited the government's capability to provide effective planning and strategies for the encountered risks. There was planning by the government, but it failed badly due to the lack of coordination necessary to provide security to US citizens. The consequences precipitated by the terrorist attack 9/11 influenced the immediate modifications in government policy, which focus on enhancing security measures and mitigating the risk of such attacks in the future. The amendments in government policies exhibited almost zero tolerance against such security risks, introduced as the USA Patriot Act and the establishment of cabinet-level security management named the Department of Homeland Security. These policies were designed based on the previous policies' outcomes when implemented by agencies with different missions, backgrounds, and organizational cultures to eradicate the security risk and emergency management. Despite the systematic approach, security centers still failed to obscure the desired results in achieving the intended level of security and risk management, forcing them to think of why and how these efforts failed to succeed in merit examination.

During disasters, the problem of coordinating relief efforts is common [15] due to the involvement of numerous parties, each representing a different organization with a different level of expertise, knowledge, and work culture [2]. Furthermore, the methods of disaster management vary depending on the type of disaster that has been experienced [16]. Owing to this, the knowledge and experience gained in disaster management are invaluable and should be used as a model in the future. The work done in the field of disaster management must be documented continuously [5], [17], [18]. However, to ensure that the agency's ability in disaster response can always be implemented effectively, issues affecting the efficiency of disaster management must be addressed as soon as possible, such as uniformity in disaster management as well as the delivery and handling of information [2][19], [20] among other.

E. Disaster Management in Malaysia

Malaysia is extremely fortunate because it is not directly located within the Pacific Ring of Fire, which means that volcanic eruptions have never occurred there [21], [22]. Malaysia's location in the equatorial region, combined with the southwest monsoon and northeast monsoon, resulted in high humidity and heavy rainfall, which exposes the country to flooding regularly [15], [18], [23], [24]. Aside from that, Malaysia was also shaken by the Tsunami that struck the country in 2004 [22]. Apart from the haze that blanketed the entire country, Malaysia has also experienced a landslide, a synonymous event that occurred long ago [21]. A rare industrial disaster, however, should not be taken lightly since it occurred in 1991 due to an explosion at the Bright Sparklers fireworks factory, which provided the main reason for the disaster. This tragic incident was caused by the negligence of the factory, which conducted fireworks tests outside of a

designated area until it collided with a pile of firecrackers and fireworks nearby, causing an explosion that spread throughout the area and resulting in the deaths of 26 individuals [25]. This incident is known as Hiroshima Sungai Buloh.

The National Disaster Management Agency (NADMA) was established in 2015 to replace the National Security Council's (NSC) component for managing crises and disasters [23], [26]. The initiative was conceived following the 2014 Yellow floods that devastated Malaysia, resulting in 541,896 flood victims, 2.9 billion dollars in losses, 2,076 houses destroyed, and 6,696 houses severely damaged, according to official figures [18], [27]. The establishment of the National Disaster Management Agency (NADMA) was not intended to take over the responsibilities of the agencies that have been involved in disaster management for a long time before, but rather to be responsible for managing and coordinating disasters throughout Malaysia [28].

The Whole of Government (WoG) concept used to manage disasters in Malaysia has shown success, which can be seen from several incidents encountered where the coordination implemented while tackling the hazardous scenario resulted in successful disaster management. Each agency met all resources, energy, and needs as they understood their duties and responsibilities. This can be seen in the efficiency with which disaster management and response are carried out. Nonetheless, existing disaster management must be improved since every time a disaster occurs; the encountered challenges will differ from the last [16]. As a result, disaster management must be improvised to reduce the impact of disasters in situations where they are unavoidable. Since disaster management is not associated with a certain department but rather a communal approach, the competence and cooperation of each agency are essential in ensuring that coordination can be carried out effectively and efficiently [16], [20], [29].

The scenario planning and simulation process can be used in conjunction with on-site coordination to ensure that every obstacle encountered in managing a disastrous situation can be handled systematically [30]. This article demonstrates the scenario planning and simulation methods implemented to better understand how the disaster response process is coordinated between various agencies involved.

II. MATERIALS AND METHOD

The military first used scenario planning to develop war strategies in the early twentieth century. When considering the advantages of scenario planning, it is no surprise that most businesses employ it as a decision-making tool. Multiple approaches have been practiced in the literature to develop potential scenarios to understand risk management better, focusing on data collection, assessment, modeling, and derivation of findings based on the provided scenarios. Some of the most employed research methods for scenario development include:

- A systematic review of documentary reports, similar case studies, experiments, and sheer study of data, especially records of previous similar incidents, to analyze the structure, mode, and conditions of the encountered hazard.
- Characterization of the current scenario to determine the change or gap.

- Organizational assessment to determine the inter-dependencies by embedding computational approaches.
- The effectiveness of the existing risk management models is evaluated by practicing them in public, private, and non-profit organizations.
- Visual demonstration of findings to enhance the effectiveness and to provide space for improvement by exchange of dialogues, information, and organizational learnings.

This research employed a qualitative methodology based on a scenario study to better understand the coordination of efforts as a disaster response among various actors. A scenario study is planned in the same manner as a real incident so that the researcher can obtain real-time insights and implications of the decisions made during scenario execution and analysis. At the same time, after completing the scenario execution, a focus group discussion was conducted to evaluate the action taken. Accordingly, the researcher has implemented scenario analysis, which has been cross-checked with the activities process flow to measure performance and determine whether or not the actions taken by each actor are consistent with the disaster management standard operating procedure. From this point on, scenario analysis will re-evaluate all actions and decisions made during the execution. The advantages gained from the study conducted using this scenario can be used to improve decision-making and performance, as well as for the identification of issues and challenges that may arise in the context of a disaster environment that has been encountered. Apart from that, the researcher and the actors can use the results of this scenario study to improve the procedures, processes, activities, and actions that will be implemented in real-world incidents. Therefore, the scenario study can be used as a tool in real-world theorizing practice that can sometimes be used as a theoretical development instrument and as a forecasting tool for any required action. The detailed methodology is stated below.

A. Scenario Planning

This study began with the development of a scenario. In this case, the scenario was meticulously developed with the intention that the developed scenario should be close to the actual event. Each agency will be able to respond to the developed scenario if it appears realistic. This will allow each agency to demonstrate its functions, roles, and responsibilities when responding to disasters. Consequently, the team that worked on the scenario planning spent two weeks getting to know each of the agency's functions, duties, and responsibilities to ensure that the scenario developed included the roles of all of the agencies. This methodology was chosen as it is extremely appropriate for evaluating the functionality of each agency since there is no other platform or possibilities that can be used to gain an understanding of the coordination efforts undertaken by each agency other than the actual response during the study, which makes it a good fit for this type of investigation.

The following step was the execution phase, which involved both the researcher and the agencies. During this activity, the case scenario was tested. All actions and decisions were documented, evaluated, and managed to capture to obtain the practices. Audio and visual recordings of

conversation were made during the scenario execution based on the actions taken by each actor, which consisted of the Malaysia Civil Defense Force, the Fire and Rescue Department, the Public Works Department, the Kuala Lumpur Municipal Office, Royal Malaysia Police (RMP), the Meteorology Department of Malaysia, the Department of Mineral and Geoscience and the Department of Survey. First-hand experience was gained from each actor dealing with this incident. The researcher was then tasked with identifying issues and challenges and capturing all of the value created by each decision made by the actors during the scenario execution.

Following the execution of the scenario, an analysis of the situation was carried out. At the end of this session, an assessment was made, examining the actions and decisions taken during the scenario execution and how they intersected with current policies. This stage involved the researcher conducting cross-case analysis and cross-checking the results with those obtained from the scenario execution.

B. Cost of Action

The researcher used the findings to interpret the consequences of the actions and decisions. This method develops solutions to real-world problems and challenges during disaster response operations.
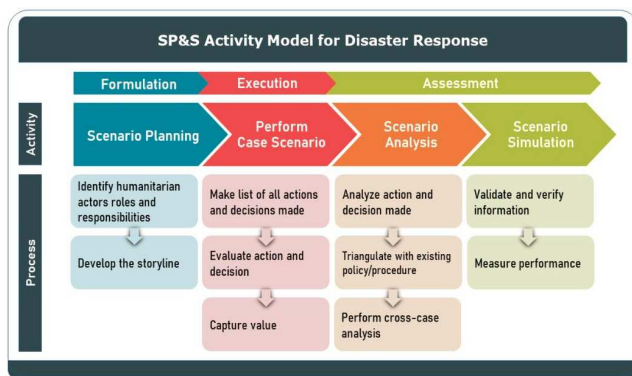

Fig. 1 SP&S Activity Model

C. Focus Group Discussion

Focus Group Discussion (FGD) was conducted to identify gaps in response coordination between agencies in the scenario and simulation activities. The researcher prepared a list of questions as guidance for the FGD session. The agency's composition with similar characteristics and backgrounds was sufficient to collect all the data needed. The agencies have been working together with each other, have a positive attitude, and are willing to engage in FGD fully. This dual moderator FGD was conducted by the researchers' team consisting of one facilitator, two moderators who performed different roles, and three assistants who assisted the whole process and took notes. This FGD was carried out during the phase of the analysis scenario and after the assessment scenario. The actions and collaboration among the agencies taken during the execution scenario were the subjects of discussion. As part of this process, researchers and government agencies collaborated to review the Standard Operating Procedure (SOP) and directive MKN 20 to identify gaps discovered during scenario execution and simulation.

D. Scenario Case

This scenario case was developed, executed (tested) during the workshop, analyzed, and assessed during the simulation activities.

1) The plot of the scenario - Storyline: It took place on a Sunday morning in March. It was the rainy season, and there was a chance of rain in the afternoon. The sky was partly cloudy. A fire broke out at a high-rise serviced apartment near the Kuala Lumpur City Center (KLCC) Twin Towers in the heart of Kuala Lumpur, Malaysia, and spread throughout the building. A fire broke out on level 27 of a 40-story apartment building in the golden triangle of Kuala Lumpur. This building is home to both locals and visitors from around the world, and numerous shopping malls are in the immediate vicinity. Following the explosion, there was a suspicion of terrorism, which necessitated an investigation. Later on, the fire spread to multiple floors of the building. Things happened very quickly, raising concerns about the structural integrity of the building while also necessitating a mass evacuation of residents and the surrounding population. Additionally, the area's community and non-governmental organizations (NGOs) immediately responded without being asked.

2) Hazardous Scenario: It was a significant blaze. There was a possibility of additional explosions. There has been a lot of falling debris since the structural collapse. Toxic fumes were coming from the building, which was dangerous—while on the road near the building, there was traffic congestion due to people driving and not paying attention to the road but to the situation. A large number of vehicles were parked along the side of the road. Some people were taking photos and spreading them around on social media. Panic spread through the general public.

3) Scenario with Casualties: There were five confirmed fatalities, ten red cases, twenty yellow cases, and fifty green cases. It was estimated that approximately 1,600 residents must be evacuated. Along with that, thousands of locals and foreigners in the surrounding area also needed to be evacuated.

4) Scenario Assessment: The assessment of the disaster response made by the agency to the case scenario was carried out using Mass Casualties Incident list by DeNolf and Kahwaji [31].

- Difficulties associated with gaining access to physical locations
- The locations of access points and the distance between them
- The volume of traffic, its location, and speed
- The road conditions, the surrounding environment, and the weather
- Time of day
- Staffing in terms of numbers and levels
- Debris fields on an enormous scale
- Additional concurrent incidents deplete available resources.
- The location of specialized teams and resources
- Ambulances that are unfamiliar with the MCI operational procedures in a given district.

- Failure to establish incident command when communication coverage shortfalls or the inability to connect with mutual response resources.
- The absence of scene vests or the failure to identify triage, treatment, or transport areas.
- Late or improper access directions or staging instruction to incoming units' explosions and other complicating factors

III. RESULTS AND DISCUSSION

During the scenario execution, agencies created a list of disaster response plans, and all actions and decisions were taken during this phase. It was evaluated and recorded as a valuable contribution to the project. During the scenario analysis phase, each agency's actions were categorized under MKN Directive 20 and current standard operating procedures. It was also utilized during the simulation phase to determine the gap in the scenario and simulation planning. Nevertheless, one weakness identified during this SP&S workshop is that some participants did not actively participate, were reserved, and did not contribute during the FGD. Based on this observation, communication is critical during this SP&S workshop and during the actual incident to ensure all agencies can effectively and efficiently work together while minimizing losses.

Based on the observation made by the researcher, the preparation of case scenarios and the facilitation of FGD were dependent on two important aspects of implementing the SP&S Workshop. Both were intertwined with preparing case scenarios as the focal point of the workshop. Without a realistic case scenario, the course of actions and decisions made during scenario execution cannot be adequately addressed. At the same time, monitoring coordination between agencies cannot be effectively implemented during scenario analysis. The case scenarios analyzed and tested during the simulation activities are also important. They will allow the researcher to observe any gap between the results obtained during the scenario execution and simulation of scenarios.

In addition, the FGD that has been implemented was proven extremely beneficial in understanding the actions taken by the actors in response to the scenarios developed. At the FGD session, all participants were very open in discussing the observations they made during the SP&S Workshop, which will enable the agencies to improve the existing response process, strengthen coordination and improve response performance as a result of their discussions.

On the other hand, the results of responses to the case scenarios presented during the SP&S Workshop are also important to be addressed since they can assist the actors in reconsidering any action and performing better during the disaster response. Agencies' primary responsibility is to assist in disaster response. Since the disasters faced are uncertain and unpredictable, the type of assistance and the level of aid to be channeled may not be very accurate at the outset due to the limited amount of disaster information gathered in the earlier stage of the disaster. It was observed that agencies involved in disaster management would be unable to accurately predict the type of assistance and the number of members required to respond. As a result, the response process to disasters will be slowed down significantly.

Moreover, the case scenario involved an explosion and a structure collapse; thus, heavy equipment may be required. All of this, however, will take time because there is uncertainty about the current state of the building and the infrastructure in place. Also, in reality, this information is critical and often lacking to assist in disaster response, causing the agencies to be unable to accurately estimate the impact of physical and infrastructure damage, as well as the severity of the damage. Although the information obtained is limited, making quick and efficient decisions during a disaster is essential. This type of information is critical for disaster management efforts and search and rescue operations.

IV. CONCLUSION

Since this SP&S is a situation-based research method, participation and collaboration from all participants are essential even though they are working toward a common goal. By conducting this scenario study, the researcher will be able to understand the coordination efforts undertaken by each organization. Using scenario analysis, researchers can systematically monitor and reflect on the process and outcomes of each action and decision. Furthermore, it allows the researcher and the agencies to learn from past mistakes, improve practices, and improve decision-making abilities. Suppose the simulation study is not carried out thoroughly. In that case, the weaknesses or challenges encountered during the response to the actual incident will not be identified and addressed, thus compromising the agency's performance. Therefore, it is suggested that this SP&S should be organized more frequently to assist the agencies to work more closely while minimizing the loss in an actual incident.

Even though this SP&S workshop was successfully implemented and achieved the objectives outlined, a small observation needs to be addressed. This SP&S workshop shows that not all participants can give opinions actively; some preferred to be reserved and were more comfortable not sharing their opinions during the FGD. At the same time, most of the information presented and decisions made were biased in favor of active participants. As a result, the FGD implemented became biased, and sometimes, the decisions made were more inclined toward the interest of the participants rather than the agencies. Hence, communication is critical not only during this SP&S workshop but also in the actual incident. By providing sufficient information and facilitating effective communication between agencies, it will be possible to expedite aid distribution while reducing the number of victims impacted.

REFERENCES

[1] V. Bollettino and B. Anders, "Civil – Military Coordination : A Frame- work for Measuring Effectiveness in Humanitarian Response," *J. Humanit. Aff. Vol.*, vol. 2, no. 1, pp. 3–10, 2020.
[2] A. D. B. Cook and S. Yogendran, "Conceptualising humanitarian civil-military partnerships in the Asia-Pacific: (Re-)ordering

cooperation," *Aust. J. Int. Aff.*, vol. 74, no. 1, pp. 35–53, 2020, doi: 10.1080/10357718.2019.1693498.

[3] W. J. W. Botzen, O. Deschenes, and M. Sanders, "The economic impacts of natural disasters: A review of models and empirical studies," *Rev. Environ. Econ. Policy*, vol. 13, no. 2, pp. 167–188, 2019, doi: 10.1093/reep/rez004.

[4] J. Santos, C. Yip, S. Thekdi, and S. Pagsuyoin, "Workforce/Population, Economy, Infrastructure, Geography, Hierarchy, and Time (WEIGHT): Reflections on the Plural Dimensions of Disaster Resilience," *Risk Anal.*, vol. 40, no. 1, pp. 43–67, 2020, doi: 10.1111/risa.13186.

[5] M. Crosweller and P. Tschakert, "Disaster management leadership and policy making: a critical examination of communitarian and individualistic understandings of resilience and vulnerability," *Clim. Policy*, vol. 21, no. 2, pp. 203–221, 2021, doi: 10.1080/14693062.2020.1833825.

[6] C. Huo *et al.*, "Scientific risk performance analysis and development of disaster management framework: A case study of developing Asian countries," *J. King Saud Univ. - Sci.*, vol. 33, no. 2, p. 101348, 2021, doi: 10.1016/j.jksus.2021.101348.

[7] A. Sharma, S. K. Ojha, L. D. Dimov, J. G. Vogel, and J. Nowak, "Long-term effects of catastrophic wind on southern US coastal forests: Lessons from a major hurricane," *PLoS One*, vol. 16, no. 1 January, pp. 1–27, 2021, doi: 10.1371/journal.pone.0243362.

[8] M. A. Thiri, "Uprooted by tsunami: A social vulnerability framework on long-term reconstruction after the Great East Japan earthquake," *Int. J. Disaster Risk Reduct.*, vol. 69, no. December 2021, p. 102725, 2022, doi: 10.1016/j.ijdrr.2021.102725.

[9] P. T. Buergelt, D. Paton, A. Campbell, H. James, and A. Cottrell, "Killing Two Birds with One Stone: Developing Northern Australian Adaptive Capabilities to Sustainably Develop Competent and Thriving Communities Capable of Responding Effectively to Natural Hazards," *Lead. from North Rethink. North. Aust. Dev.*, pp. 391–418, 2021, doi: 10.22459/ln.2021.18.

[10] A. M. Quarshie and R. Leuschner, "Interorganizational Interaction in Disaster Response Networks: A Government Perspective," *J. Supply Chain Manag.*, vol. 56, no. 3, pp. 3–25, 2020, doi: 10.1111/jscm.12225.

[11] N. Avdan and C. Webb, "The big, the bad, and the dangerous: public perceptions and terrorism," *Dyn. Asymmetric Confl. Pathways Towar. Terror. Genocide*, vol. 11, no. 1, pp. 3–25, 2019, doi: 10.1080/17467586.2017.1414276.

[12] S. Baadel, "20th Anniversary of 9-11 : Corporate Disaster Preparedness , Lessons Learned , 20 th Anniversary of 9-11 : Corporate Disaster Preparedness , Lessons Learned , and Ways Forward," no. August, 2021.

[13] B. M. Sibai, S. Caritis, and J. Hauth, "What We Have Learned About Terrorism since 9/11," *J. Econ. Lit.*, vol. 57, no. 2, pp. 275–328, 2019, doi: 10.1016/S0146-0005(03)00022-3.

[14] O. Navarro *et al.*, "Determinants of coping strategies in two types of natural hazards: Flash floods and costal flooding," *Int. J. Disaster Risk Reduct.*, vol. 46, no. January, 2020, doi: 10.1016/j.ijdrr.2020.101514.

[15] J. B. Jaafar, A. N. B. Ishak, S. Bin Hassan, K. F. Bin Adrutdin, and M. I. Qureshi, "A study of customer satisfaction with planning movement of goods during disaster aid programs: A case study of flood hit in segamat, johor," *J. Environ. Treat. Tech.*, vol. 8, no. 1, pp. 419–428, 2020.

[16] S. H. Hashemi Petrudi, M. Tavana, and M. Abdi, "A comprehensive framework for analyzing challenges in humanitarian supply chain management: A case study of the Iranian Red Crescent Society," *Int.*

J. Disaster Risk Reduct., vol. 42, no. July 2019, p. 101340, 2020, doi: 10.1016/j.ijdrr.2019.101340.

[17] S. K. Aros and D. E. Gibbons, "Exploring communication media options in an inter-organizational disaster response coordination network using agent-based simulation," *Eur. J. Oper. Res.*, vol. 269, no. 2, pp. 451–465, 2018, doi: 10.1016/j.ejor.2018.02.013.

[18] M. A. Azimi, S. A. Syed Zakaria, and T. A. Majid, "Disaster risks from economic perspective: Malaysian scenario," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 244, no. 1, 2019, doi: 10.1088/1755-1315/244/1/012009.

[19] R. A. Cook and E. J. Lodree, "Dispatching policies for last-mile distribution with stochastic supply and demand," *Transp. Res. Part E*, vol. 106, pp. 353–371, 2017, doi: 10.1016/j.tre.2017.08.008.

[20] E. Shittu, G. Parker, and N. Mock, "Improving communication resilience for effective disaster relief operations," *Environ. Syst. Decis.*, vol. 38, no. 3, pp. 379–397, 2018, doi: 10.1007/s10669-018-9694-5.

[21] S. Muiz, S. Abd, N. Z. Zainol, N. Yahya, A. N. Rizalman, and S. Characteristics, "A Historical Review of Significant Earthquake in Region Surrounding Malaysia," in *International Conference on Durability of Building and Infrastructure*, 2018, no. August, pp. 242–245.

[22] F. R. Ahmadun, M. M. R. Wong, and A. Mat Said, "Consequences of the 2004 Indian Ocean Tsunami in Malaysia," *Saf. Sci.*, vol. 121, no. December 2004, pp. 619–631, 2020, doi: 10.1016/j.ssci.2019.05.016.

[23] N. O. Chong and K. H. Kamarudin, "Disaster risk management in Malaysia: Issues and challenges from the persepctive of agencies," *Plan. Malaysia*, vol. 16, no. 1, pp. 105–117, 2018, doi: 10.21837/pmjournal.v16.i5.415.

[24] A. O. Wahba, N. Y. Azab, and K. Nabil, "Towards impact-based flood forecasting and warning in Malaysia: A case study at Kelantan river," *J. Crit. Rev.*, vol. 7, no. 8, pp. 622–626, 2020, doi: 10.31838/jcr.07.08.138.

[25] I. M. Shaluf, F. R. Ahmadun, S. Mustapha, A. M. Said, and R. Sharif, "Bright Sparklers fire and explosions: The lessons learned," *Disaster Prev. Manag. An Int. J.*, vol. 11, no. 3, pp. 214–221, 2002, doi: 10.1108/09653560210435812.

[26] L. M. Sidek *et al.*, "Towards impact-based flood forecasting and warning in Malaysia: A case study at Kelantan river," *IOP Conf. Ser. Earth Environ. Sci.*, vol. 704, no. 1, 2021, doi: 10.1088/1755-1315/704/1/012001.

[27] E. Sathiamurthy, S. A. Halim, L. M. Supar, A. A. A. A. Hamid, K. Y. Hui, and N. S. Pauzi, "Kelantan central basin flood, december 2014: Causes and extend," *Bull. Geol. Soc. Malaysia*, vol. 68, no. May, pp. 57–67, 2019, doi: 10.7186/bgsm68201905.

[28] M. R. Mohamad, S. Bachok, M. Z. Mohd Zahari, O. A. Olabayonle, and N. A. M. Zulkifli, "Agencies' Management Preparations and Proposed Evacuation Routes for Flood Disaster: a Case Study of Melaka," *Plan. Malaysia*, vol. 19, no. 16, pp. 199–212, 2021, doi: 10.21837/pm.v19i16.964.

[29] R. Dubey, N. Altay, and C. Blome, "Swift trust and commitment : The missing links for humanitarian supply chain coordination ?," *Ann. Oper. Res.*, vol. 283, no. 1, pp. 159–177, 2019, doi: 10.1007/s10479-017-2676-z.

[30] H. Gaspars-Wieloch, "Scenario planning combined with probabilities as a risk management tool - analysis of pros and cons," *Int. J. Econ. Bus. Res.*, vol. 21, no. 1, pp. 22–40, 2021, doi: 10.1504/IJEBR.2021.112015.

[31] R. L. DeNolf and C. I. Kahwaji, *EMS Mass Casualty Management*. 2023.