An Operational Framework Model for Geospatial Business Impact Analysis in West Coast of Sabah, Malaysia

Lehan Nur Fadzlina Aini M.[1], Razak Khamarrul Azahari[1,2*] and Kamarudin Khairul Hisyam[1,2]
1. Razak Faculty of Technology and Informatics, Universiti Teknologi Malaysia (UTM) Kuala Lumpur, Jalan Sultan Yahya Petra, Kuala Lumpur 54100, MALAYSIA
2. Disaster Preparedness and Prevention Centre (DPPC), Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia (UTM) Kuala Lumpur, Jalan Sultan Yahya Petra, Kuala Lumpur 54100, MALAYSIA
*khamarrul.kl@utm.my

Abstract
Population expansion and rapid urbanisation rate coupled with extreme changes of weather conditions have triggered more frequent disaster occurrences resulting in bigger economic and commercial losses. Like many other economic sectors that contributed significantly towards local socio-economic development, the small and medium enterprises (SMEs) also were not spared from being affected and/or disrupted by disaster events. In 2020, SMEs in Malaysia represented 98.5% of local business establishments and contributed approximately 41% to the country's GDP. Although Malaysia can be considered a relatively safe and stable country from a political and socio-economic tussle, as a country with tropical climate, Malaysia, is highly vulnerable to the risk of flooding, landslide and mudslide which jeopardise the sustainability of local SMEs in the long run. Unfortunately, until today, there is no locally-driven comprehensive framework for promoting SMEs resiliency that has been developed particularly in disaster-prone areas.

In this light, advanced geospatial technology that has been widely used in mapping for various purposes can be utilized or integrated into mapping of disaster risk profiles and providing significant inputs for establishing Business Continuity Planning (BCP) for disaster-prone areas. Using business impact analysis (BIA) approach, this study explains the operational framework model for business continuity and recovery. The case study of local SMEs in West Coast Sabah, Malaysia was adopted to explain the impacts of the 2015 earthquake and its cascading geohazards to local SMEs including severe disruptions to the main lifeline facilities e.g. telecommunication, electricity and transportation. The research design is based on the qualitative and quantitative methods including guided interviews with the affected local SMEs groups. The proposed operational framework is a result of integrated smart geospatial solutions for advancing business continuity and resiliency for SMEs in disaster-prone areas.

Keywords: Business Continuity Plan, Small and Medium Enterprises, Operational Framework, Business Impact Analysis, Geohazards, Geospatial solution.

Introduction

Flooding, droughts, landslides, potential tsunamis and a wide range of manmade hazards as well as diseases are all common occurrences in Malaysia[1]. Monsoon floods become one of the most severe threats and the country also has the highest percentage of the population exposed to floods among Association of Southeast Asia Nation (ASEAN) member states between July 2012 and January 2019[6,29]. Due to this event and the number of growing climate change concerns, Malaysia has invested in adaptation and mitigation efforts in addition to improving its disaster risk management structure. Other types of disaster including earthquakes are less common in East Malaysia, however the country is located in a zone where tectonic activity can pose a threat to people and infrastructure due to mass movements and landslides which are linked to seismic activities.

Many economic activities have been significantly hampered by disaster occurrences which have hampered the expansion of local companies. Malaysia's economy has seen a significant shift from agrarian to industrial during the previous several decades. Small and Medium Enterprises (SMEs) have been a significant contributor of employment and economic growth[8,24]. The Malaysian economy consists of almost 98.5% of SMEs where they contribute 38.3% of the country's growth domestic product (GDP), 66% of the country's employment and around 17.3% of Malaysia's exports[2,25].

Every country has its own definition of SME and various international institutions also use their definitions for interpreting SMEs based on certain criteria and indicators. However, since this study emphasised SMEs in the context of Malaysia, a currently available definition that was endorsed by the Malaysian SME Corporation (SMECorp) in 2013 was used by researchers.

As presented in table 1, there are two main criteria that have been used to characterise a SME, namely sales turnover or full-time workers. In relation to climate change and frequent occurrence of disasters, SMEs like major firms confront several threats and their survival and resilience are critical for national and global economies[2]. The economic losses of disasters have a profound effect on business recovery. The studies of disaster impact on businesses first appeared in late 1980s[9].

Most of the SMEs, especially in developing and emerging economies, often have been associated with lack of effective risk management, business continuity and crisis management cultures and processes[16]. Informal coping techniques are frequently forced in underdeveloped nations by the lack and/or inadequacy of official systems that ensure company owners' personal and economic survival. The aim of the business continuity plan (BCP) is to avoid or minimise the effect of a catastrophic situation before it occurs. A BCP is intended to minimise or mitigate risks to lessen the effect of a crisis (i.e. a disaster) and to shorten the time it takes to return to "business as usual."

There is no single recommended plan for business continuity; instead, every organization needs to develop a comprehensive BCP based on its unique situation. BCP is often embedded with a business impact analysis (BIA) in which risks to the business are identified, prioritized and contrasted with the company's available resources[23].

Outputs from the BIA include risk-related prioritization of products, services and critical functions. Such outputs offer a quantifiable assessment of the likely financial and operational consequences of disruptions. The BIA should be executed under the assumption of a "worst case scenario" that would impact most or all of the business activities at a significant company site in order to obtain a proper perspective on the relative significance of particular business functions and processes[3].

In this study, the BIA processes are integrated using geospatial solutions to boost up the BIA process. In Malaysia, the National Disaster Management Agency (NADMA) hosts a Disaster Portal which contains up-to-date information on regional flooding. Since 2013, the portal has collected all disaster and hazard-related information for the entire country[15,19]. The portal is an integrated gateway for information, cataloguing real-time events and displaying them using Geographical Information System (GIS) technology available to the public as well as to authorities who need to monitor disasters[20].

West Coast of Sabah was chosen as a study area for BIA due to its high vulnerability and possible risk, as it lies on a tectonically active region in Malaysia. All kinds of natural hazards were occurring within the area, especially after the earthquake in 2015. On the other hand, the Western Sub-Region has also been identified as Sabah's industrial belt. This region provides access to market, processing, packaging and port facilities[22].

According to the Sabah Structure Plan (SSP) 2033 (Figure 1), the west coast division encompassed seven districts out of which three of these districts namely Kota Kinabalu, Ranau and Kota Belud were selected as research areas. This is because these districts are the main areas for the west coast division's economy in SSP 2033 (mainly for industrial activities and tourism-related sectors as stated in Sabah Tourism Master Plan, 2011-2025) and secondly, having a significantly higher number of geohazards events as compared to other districts[18,22].

Kota Kinabalu was frequently impacted by a series of landslides and flooding[20,28]. In Kota Belud, the local community struggled with the flooding that occurred almost every year and the debris mud flow series from the earthquake in Mount Kinabalu affected their clean water supply[11],[26]. Ranau, which is famous as the tourism hub and development of the local community, especially in Kundasang, is also heavily affected by a series of multi hazards[12,15,17].

Sabah Economic Development and Investment Authority (SEDIA) was established in 2009 and since then has been entrusted as the One-Stop Authority to drive Sabah Development Corridor (SDC) with the responsibility to plan, coordinate, promote and accelerate the development of SDC. SDC is one of the five economic corridors initiated under the ninth Malaysia plan to bridge development imbalances bridging the rural-urban divide and ensuring sustainable management of the State's resources and spur economic growth through public-private partnerships. The SDC was implemented over a period of 18 years from 2008 to 2025[18]. Table 2 shows that the number of SMEs in Sabah and Kota Kinabalu is host to nearly 58% of the total number of SMEs in Sabah. This is due to its main function as the capital city of Sabah.

Other than that, Kota Belud and Ranau show the lowest in numbers within the division. This is due to the area which is remotely rural compared to other states and most of their local SMEs might have not registered in the system[9]. That is where the motivation of this study lies, which is to explore why the Kota Belud and Ranau, which are the areas always exposed to natural hazards, are very popular for tourism but number of SMEs was significantly small compared to other states in the division[9,13]. This study will approach the local SMEs within the disaster affected areas and get the details before executing and imposing the operational framework model to them.

Review of Literature on BCP

SMEs and Business Continuities: The resilience of SMEs is regarded as a pre-condition of sustainable development and improving society wellbeing, as the sector is a crucial provider of local jobs and household income among the ASEAN countries[27,29]. At the same time, SMEs are the most vulnerable businesses due to financial, technological and administrative limitations with the majority of SMEs still lacking the basic knowledge on disaster preparedness and response techniques[10]. Absent a Business Continuity Plan (BCP) among local SMEs operators was a clear indication of the training, awareness and knowledge on DRR[14]. Meanwhile, strongly built SMEs with consideration of the component of DRR and BCP might lead to resilience of business to shocks, hence expanding and diversifying the domestic economy.

Existing BCP framework to assist SMEs: Review of the existing BCP framework was based on approaches and experience in the field. Each phase is illustrated in terms of a standard template which highlights the key activities to be undertaken and the associated inputs and outputs. Sahebjamnia et al[23] proposed a BCP framework which integrates business continuity and disaster recovery planning as an effective resuming and recovering critical operations of businesses. However, review of literature also suggested that there is no specific standard or final framework for BCP that could be used as a best practice[3,10,27].

This is due to each organization being unique and has different needs in their cycle of operation[21]. The framework proposed by Fani et al[10] can be used as a guide for this study with appropriate modifications to suit the local context. The BCP structure also must be adaptable to changes over time due to the environment and technological advancements.

Material and Methods

This study attempts to provide an operational framework model to improve company continuity and recovery, especially for local SMEs on Sabah's West Coast based on information gathered from field visits. The highlighted case of studies is within the area of Kota Kinabalu (as the main capital of Sabah), Ranau (the tourism hub of Sabah) and Kota Belud (the main agricultural provider in Sabah). These three locations were chosen for their tourist appeal as well as historical data on natural risks. Geohazards are common in the Kota Kinabalu region with floods and landslides being the most regular[4,11,28]. Data acquisition for this operational framework was collected as in figure 2.

This is by recording using photographs or a checklist on the elements that are being disrupted by disaster events. In addition, historical data on disaster events is also being compiled from secondary sources. Data processing was utilized using ArcGIS and QGIS software. These two software have the same concept, just that the ArcGIS provides much better outputs and details. In data analysis, GIS Network Analysis was extensively used in disaster studies[7,31].

The elements accessed were new area, closest facilities and service areas, where these three elements were frequently used in disaster case studies. In terms of data visualization, GIS provides a very powerful medium, so all digitized data could be viewed, edited, stored and manipulated within the platform itself. All of them can be manipulated within their own database management. Therefore, two weeks after the Mount Kinabalu Earthquake in 2015, a team of local scientists from local universities and geological department were dispatched to Kundasang to collect data on local SMEs and investigate the impact of the earthquake on their operations[14,28].

For data collection, this study has adopted mixed methods i.e. qualitative (guided interview with local SMEs operators/owners) and quantitative (guided questionnaires session with local SMEs operators/owners). Structured interviews were carried out involving 59 local SMEs especially in the field of tourism and hospitality including hotels, inns, lodge, resorts and homestays.

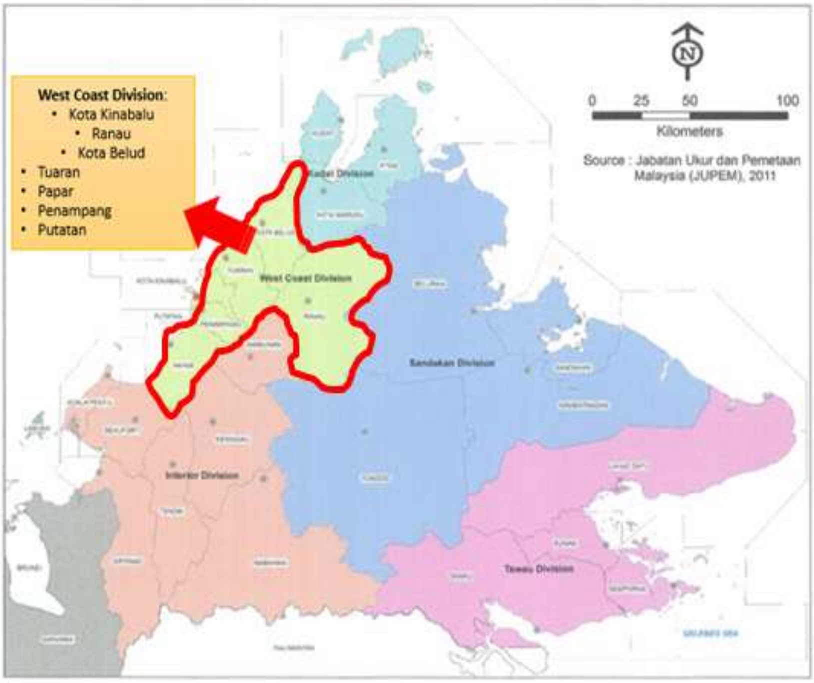

Figure 1: West Coast division of Sabah (Map Source: SSP Report 2010)

Table 1
SME Definition Group according to SMECorp.

Type	SMEs definition
Manufacturing	Sales turnover not exceeding RM50 million OR full-time employees not exceeding 200 workers
Services and other sectors	Sales turnover not exceeding RM20 million OR full-time employees not exceeding 75 workers

Table 2
Number of manufacturing industry by regions (SEDIA Annual Report 2019)

Region	Local SMEs (Registered)	% Each Area
West Coast division	Number	
	265	100%
Kota Kinabalu	153	58%
Kota Belud	57	21%
Ranau	55	21%

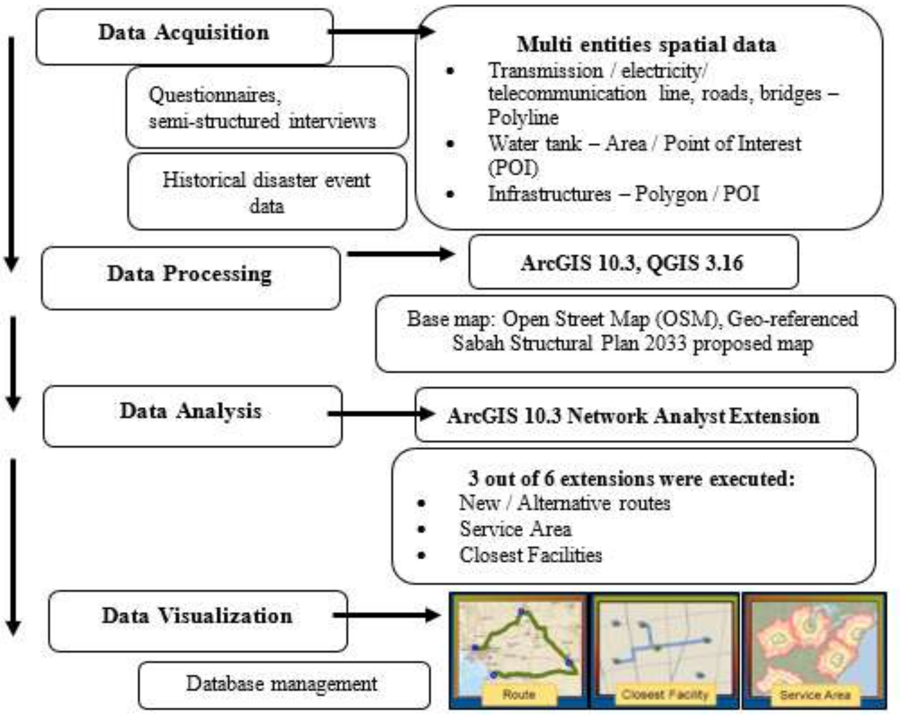

Figure 2: Geospatial Data Flowchart for Geo-BIA

Results and Discussion

Because catastrophes are likely to have a high-intensity impact as well as significant company losses, it is critical to encourage business owners and/or operators to take control of the operational framework. SMEs faced the challenge in terms of financial, strategic orientation of their businesses and their environment of daily operations[5,8]. Therefore, SMEs work as the operational bodies in the proposed operational framework in figure 2. In this operational framework also known as Geospatial-led BIA (Geo-BIA), there are few areas of concern including:

I. Assessment of impact of interrupted businesses;
II. Determination of critical operations;
III. Risk Mapping

As per study areas designed, the GIS network analysis was conducted accordingly. For Kota Belud, the new route element was accessed. This is due to the frequent flooding that occurred in the area affecting the local communities and more than 20 local SMEs located nearby the Kedamaian River, which is always affected by flooding events. It is significant to execute the New Route element. The "worst-case scenarios" were designed with the flooding disrupting the main road (simulation is done between Kota Belud

Hospital to one of the main temporary shelters which is Tun Said Keruak Community Hall).

The algorithm in New Route will compute the new alternative path to avoid the "occurred" disaster event. It might add the distances and travel time compared to the usual route used, but it will give alternatives for SMEs in shifting their common supply chain management into workable routes, even during the disaster event. As for the service area, the "worst-case scenarios" designed were on the clean water supply issues in Ranau and Kota Belud.

These two areas faced the disruption of clean water supply when the disaster event concurrently occurred. For example, the continuous raining leading to landslide events as well as the debris flow which contained the clean water supply. The service area will allocate the nearby Water Treatment Plant (WTP) that could serve the local community as well as serve the SMEs. More than 25 SMEs will get the advantages by utilizing this element because they need continuous clean water supply for their daily business operation.

Lastly, the assessment was done for the closest facility element. The scenario is set to the earthquake disaster event in Kundasang. The closest facility was used to allocate the nearby temporary shelters allocated within the allowed buffering zones from the epicentre incident (earthquake location). Schools were assigned as shelters, so the algorithm will compute the nearest school to reach out during the disaster event. This is beneficial for more than 20 SMEs because they need to know which safest place they should go to protect themselves from the disaster impact.

Moreover, they also need ample time to shift and cover their business operation from the impacts as well. The operational framework of Geo-BIA would complement all these three elements and achieve all four of the concerned areas listed.

From the results, it shows the integration of GIS analysis would elevate the BIA capabilities in assisting the development of Area-BCP[3]. Table 3 highlights the proposed operational framework of Geo-BIA by establishing possible linkages between main components as stated in the literature section and the proposed diagram (Figure 3) with local context/condition in West Coast Sabah and to some extent, linkage to Sendai Framework of Disaster Risk Reduction (SFDRR) 2015-2030[30].

The major component, the BIA, plays a vital role in this architecture in order to access the capabilities of BCP. Transportation, which is heavily reliant on supply chain management, as well as utilities such as energy and water supply disruptions, are three important everyday uses for all SMEs[5]. In this situation, the geospatial solution refers to GIS mapping and analysis in terms of network (point, polygon and polyline) and spatial analysis for the case studies. The scenarios were developed in accordance with the Sabah Structural Plan 2033 (SSP 2033), which emphasised the development of Sabah's west coast[22].

Conclusion

To summarise, this study suggested an operational framework model for disaster-related business continuity planning in Sabah, Malaysia's west coast. Sabah is projected to continue to flourish and develop in lockstep with the country's progress and development. The geospatial solutions provided the most important contribution to the operational framework model. GIS analysis has a lot of promise for vulnerability assessments of interest regions as well as data analysis inside the impacted area.

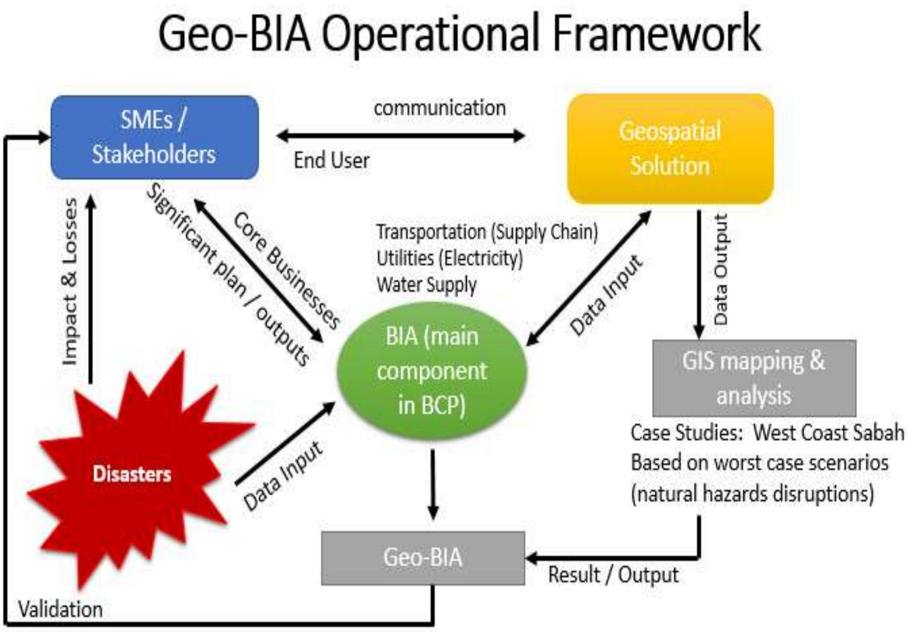

Figure 2: Proposed Geo-BIA Operational Framework

Table 3
Linkage of Geo-BIA Operational Framework with Local Context[22] and SFDRR[30]

		Linking with local condition of West Coast Sabah (SPP 2033)	**Linking with Sendai Framework for DRR (SFDRR 2015-2030)**
Main components of the proposed Geo-BIA operational framework (C)	**Explanations**		
C1: Stakeholders engagement	**Local SMEs -** SMEs group that are affected in the study areas **Academia -** Group that widely do research on the business resiliency among SMEs during disaster disruptions **Public and private partnership** – New contribution in BCP / DRR studies to accommodate the big data innovation.	West coast Sabah has the highest participant in engagement on the action plan (SSP 2033) (Community and private sector = 69 and public sector = 91). It shows that the stakeholders' engagement was important as one of the main players in the operational framework.	**Academia, scientific and research entities and networks** to focus on the disaster risk factors and scenarios, including emerging disaster risks, in the medium and long term; increase research for regional, national and local application.
C2: Establishment of BIA	BIA is the main player in BCP. The phases in BIA require the risk assessment. To assist this Risk assessment phase, the "worst case scenarios" were designed before execute the GIS analyses	West coast Sabah is the main attraction for main businesses as well as for tourism, therefore the BIA process could help the economy of Sabah.	Businesses are encouraged to integrate disaster risk into their management practices.
C3: Integration of geospatial solution	Big data plays important roles in disaster risk resilience. One of them is how to use, apply and manage the geospatial data. Therefore, that is why geospatial data were chosen to be embedded in the BIA phases for Disaster derived BCP.	In SSP 2033, the data management is important in making sure the database is keeping up to date. They already published the book entitled "the journey 10 years of SDC" to elaborate the SSP 2033 achievement. Therefore, with the geospatial data integration, the databases and mapping will be more efficient	**Priority 1** (understanding disaster risk) clearly mentioned: "To develop, periodically update and disseminate, as appropriate, location-based disaster risk information, including risk maps, to decision makers, the general public and communities at risk of exposure to disaster.
C4: Formulation of Disaster derived BCP	Disaster-derived – means that the case studies are depending on the disaster data for the affected areas in Ranau, Kota Belud and Kota Kinabalu. Therefore, the simulation on the worst-case scenarios were conducted in these areas using the geospatial tools.	C4 will contribute in the SSP 2033 particularly; "SSP 2033 aims for Sabah to attain an improved transportation network and infrastructure where social and economic needs are met within a high-quality environment".	**Priority 2**: Strengthening disaster risk governance to manage disaster risk: "To mainstream and integrate disaster risk reduction within and across all sectors and review and promote the coherence and further development, as appropriate, of national and local frameworks of laws, regulations and public policies".

This study proposes an operational framework (Geo-BIA) which embedded GIS analysis for BIA phases. The operational framework also intended to be simple for application on the ground and reliable for local SMEs to utilise when building their own BCP and simple interaction between local communities within the study regions. Validation from local SMEs or well-established enterprises is important once the framework has been built.

In short, this integrated study will aid in achieving SFDRR Target C which is to reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030, as well as SFDRR Target G, which is to increase the availability and access to multi-hazard early warning systems and disaster risk information and assessments to the public by 2030. The implementation of a low-cost, bottom-up approach operational framework model for affected local SMEs in Malaysia's tectonically active region would significantly boost local SMEs motivation to keep their awareness, upgrade their knowledge and skills in maintaining business operations, especially those who are vulnerable to disasters.

Acknowledgement

The authors would like to extend their appreciation to the Malaysian government scholarship (MyPhD) which allowed Mdm. Nur Fadzlina to pursue her Doctor of Philosophy study in Universiti Teknologi Malaysia Kuala Lumpur.

References

1. Asian Disaster Preparedness Centre, UN Office for Disaster Risk Reduction, Disaster Risk Reduction in Malaysia Disaster Risk Reduction Status Report 2020 **(2020)**

2. Auzzir Haigh R. and Amaratunga D., Impacts of Disaster to SMEs in Malaysia, *Procedia Engineering*, **212**, 1131-1138 **(2018)**

3. Baba H., Watanabe T., Nagaishi M. and Matsumoto H., Area Business Continuity Management, a New Opportunity for Building Economic Resilience, *Procedia Economic Finance*, **18**, 296–303 **(2014)**

4. Batmanathan M. and Navakanesh, A Study on the Earthquake Generating Faults in Ranau region, Sabah using Satellite Images and Field Investigation, M.Sc. Thesis, Curtin University **(2018)**

5. Bourletidis B. and Triantafyllopoulos Y., SMEs Survival in Time of Crisis: Strategies, Tactics and Commercial Success Stories, *Procedia - Social Behaviour Science*, **148**, 639–644 **(2014)**

6. Bündnis Entwicklung Hilft, World Risk Report 2019, Druckerei Conrad, Berlin, Bündnis Entwick- lung Hilft and Ruhr University Bochum – Institute for International Law of Peace and Armed Conflict (IFHV), [Online] Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/WorldRiskReport-2019_Online_ english.pdf **(2019)**

7. Das D. et al, Road Network Analysis of Guwahati City using GIS, SN Applied Sciences **(2019)**

8. Eggers F., Masters of disasters? Challenges and opportunities for SMEs in times of crisis, *Journal Business Resilience*, **116**, 199–208 **(2020)**

9. Fabeil N.F., Marzuki K.M., Razli I.A., Majid M.R.A. and Anak Pawan M.T., The Impact of Earthquake on Small Business Performance: Evidence from Small Accommodation Services in Ranau, Sabah, *International Academic Journal Business Management*, **06**, 301-311 **(2019)**

10. Fani S.V. and Subriadi A.P., Business Continuity Plan: Examining Multi-Usable Framework, *Procedia Computer Science*, **161**, 275-282 **(2019)**

11. Floods in Kota Belud after effects of 2015 earthquake, https://www.nst.com.my/news/nation/2017/10/293343/floods-kota-belud-after-effects-2015-earthquake (accessed Jun. 30, 2020) **(2020)**

12. Kamarudin K.H., Razak K.A., Omar Chong N., Abd Wahid S.N. and Wan Mohd Rani W.N.M., From Surviving to Thriving? Evaluating the resilience of rural tourism businesses in disaster-prone area of Sabah, Malaysia, *Disaster Advances*, **12(7)**, 41-48 **(2019)**

13. Kamarudin K.H., Wahid S.N.A. and Omar Chong N., Challenges for Community Based Rural Tourism Continuity and Resilience in Disaster Prone Area: The Case of Mesilou, Sabah, IOP Conference Series, Earth Environment Science, 409 **(2020)**

14. Lehan N.F.A.M., Kamarudin K.H. and Razak K.A., Business Continuity and Resiliency Planning in Disaster Prone Area of Sabah, Malaysia, *Disaster Advances*, **13(7)**, 25-32 **(2020)**

15. Malaysia, Disaster Management Reference Handbook Report, Centre for Excellence in Disaster Management and Humanitarian Assistance **(2019)**

16. Mavrodieva A.V., Budiarti D.S., Yu Z., Pasha F.A. and Shaw R., Governmental Incentivization for SMEs' Engagement in Disaster Resilience in Southeast Asia, *International Journal of Disaster Risk Management*, **1(1)**, 32-50 **(2019)**

17. Mohd Kamal N.A., Razak K.A. and Rambat S., Land Use / Land Cover Assessment in a Seismically Active Region in Kundasang, Sabah, *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences - ISPRS Archives*, **19**, 433-440 **(2019)**

18. Mulok D., Mansur K. and Mori K., The Sabah Development Corridor (SDC), *Persidangan Kebangsaan Ekonomi Malaysia ke-10* (PERKEM 10), **10**, 406–413 **(2015)**

19. NADMA, Cyber Security and Disaster Response and Recovery, [Online] https://www.malaysia.gov.my/portal/content/30606 (Accessed July 31, 2020) **(2020)**

20. Norhisham M.N. and Roslee R., Geohazard Assessment in the Kota Kinabalu area, Sabah, Malaysia, Journal Physic Conference Series, 1358 **(2019)**

21. Omar Chong N., Kamarudin K.H. and Wahid S.N.A., Framework Considerations for Community Resilient Towards Disaster in Malaysia, *Procedia Engineering*, **212**, 105-117 **(2018)**

22. Sabah Structure Plan 2033, Draft Final, Town and Regional Planning Department, Ministry Local Government and Housing **(2008)**

23. Sahebjamnia N., Torabi S.A. and Mansouri S.A., Integrated Business Continuity and Disaster Recovery Planning: Towards Organizational Resilience, *European Journal Operational Resilience*, **242**, 261-273 **(2015)**

24. Samantha G., The Impact of Natural Disasters on Micro, Small and Medium Enterprises (MSMEs): A Case Study on 2016 Flood Event in Western Sri Lanka, *Procedia Engineering*, **212**, 744–751 **(2018)**

25. SMEinfo, SMEinfo | Here's Why SMEs Matter in Malaysia, https://www.smeinfo.com.my/profile-of-smes (accessed Jul. 01, 2020) **(2020)**

26. Tair R. and Dell L., Spring-Water as an Alternative Resource After Earthquake for Villagers, Kota Belud Sabah, *Geological Behavior*, **2(1)**, 05-11 **(2018)**

27. Tammineedi R.L., Business Continuity Management: A Standards-Based Approach, *Inf. Secure. J. A Glob. Perspective*, **19**, 36-50 **(2010)**

28**.** Tongkul F., Active Tectonics in Sabah – Seismicity and Active Faults, *Bulletin of the Geological Society of Malaysia*, **64**, 27–36 **(2017)**

29. UN-ESCAP, The Disaster Riskscape Across Asia-Pacific: Pathways for Resilience, Inclusion and Empowerment, Annual Report **(2019)**

30. United Nation, Sendai Framework for Disaster Risk Reduction 2015-2030, Report **(2015)**

31. Zhai Y., Chen S. and Ouyang O., GIS-based Seismic Hazard Prediction System for Urban Earthquake Disaster Prevention Planning, *Sustainability (Switzerland)*, **11**, 1-12 **(2019)**.

(Received 06th June 2021, accepted 31st August 2021)