GEOSPATIAL APPROACH FOR DISASTER BUSINESS CONTINUITY PLAN FOR MICRO, SMALL AND MEDIUM ENTERPRISE IN MALAYSIA

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DEDICATION

This thesis is dedicated to my family and husband who trusted me and supporting my study journey outmost. It is with Allah SWT's blessing that I am able to fight and endured the hardship until I accomplished this journey, Alhamdulillah.

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ABSTRACT

The increasing number of disasters due to rapid urbanization, population growth, and extreme climate change resulted significant impacts in economic losses, business activities and their continuity. The Micro, Small and Medium Enterprises (MSMEs) undoubtedly serve as the backbone of many economies worldwide. In Malaysia, 98.5% of business establishments are MSMEs oriented, and the sectors contributed to 41% of the country's Growth Domestic Product (GDP) development. Despite the significant contribution of MSMEs to the country's GDP and the livelihood of the community, the absence of an integrated approach and practical framework is still at infancy stage to protect assets and support the MSMEs from direct and indirect impacts of disasters. The growing body of literature on business continuity and MSMEs resilience indicate an increased focus on research works to understand the disaster-based business continuity plan (DBCP) focusing on MSMEs resiliency. Therefore, this study aims to achieve the following objectives, (1) to identify metrics of MSMEs businesses in relation to multi-hazards, (2) to improve Business Impact Analysis (BIA) component in the DBCP framework using the GIS analyses (Geo-BIA) supported by local and expert knowledge, and (3) to develop a comprehensive conceptual DBCP framework emphasizing MSMEs in multi-hazard areas. Through systematic literature review, a conceptual framework of DBCP focusing on MSMEs was co-developed and assessed through a series of fieldwork. Three case study areas in West Coast of Sabah, namely (1) Kota Belud, (2) Ranau (Kundasang), and (3) Kota Kinabalu were accessed. A total of 80 respondents sampled from local MSMEs participated in the guided interview session and questionnaire survey. Assessment to determine metrics for economic, social, and environment was evaluated using the Descriptive and Frequency Analysis and the factors for MSMEs' resilience were analyzed using Relative Importance Index (RII) value and interpretation. The results show that MSMEs resilience to disasters in all three case study areas are strongly linked to MSMEs' local knowledge together with intervention and support from related government agencies, including those with strong fundamentals on BCP development. GIS Network Analysis for disaster event simulation and outputs demonstrated that each case study area is facing different disaster types. The main focus is on infrastructure disruption (e.g., inundated main roads due to flooding, water intake problems, and alternative temporary shelter for affected MSMEs). This study designed the operational framework of Geo-BIA, the first of its kind in Malaysia and serves the main element in developing the DBCP framework. These findings were then integrated into the DBCP conceptual framework, which was further validated through experts' engagement and semi-structured interviews. Multi-sectoral and multi-disciplinary experts in BCP and DRR consists of academicians, practitioners, international and local government officials participated in the validation process. Index Analysis was adopted to determine the suitability of the proposed components of the DBCP framework. This research developed an integrated framework consists of MSMEs' capital of economic, social and environmental in problem-solving phase, together with the Geo- BIA operational framework and key deliverables of DBCP. This practical framework can be used as to accelerate the implementation of BCP in vulnerable areas and to help local MSMEs to rebuild and boost their businesses, even during disaster in Malaysia. This research supports the development of national DRR and resilience strategies, translating a build-back-better concept into practice, and promoting resilient culture, as listed in the UNDRR Sendai Framework for Disaster Risk Reduction 2015-2030.

ABSTRAK

Peningkatan jumlah bencana yang dikaitkan dengan kepesatan aktiviti perbandaran, pertumbuhan penduduk, perubahan iklim secara ekstrem telah membawa kepada dampak yang signifikan dalam kerugian ekonomi, aktiviti perniagaan dan kelangsungan perniagaan. Tanpa diragukan lagi, Perusahaan Mikro, Kecil dan Sederhana (PMKS) berperanan penting sebagai tulang belakang ekonomi di seluruh dunia. Di Malaysia, 98.5% perniagaan yang ditubuhkan adalah berorientasikan PMKS, dan sektor ini menyumbang 41% Keluaran Dalam Negara Kasar (KDNK) negara. Di sebalik sumbangan yang signifikan sektor PMKS terhadap KDNK negara dan kehidupan komuniti, ketiadaan pendekatan yang bersepadu dan kerangka yang praktikal pula berada pada tahap awal untuk melindungi aset dan menyokong PMKS daripada terus terkesan oleh bencana secara langsung mahupun secara tidak langsung. Perkembangan kajian literatur berkenaan kelangsungan perniagaan dan daya tahan PMKS menunjukkan bertambahnya fokus terhadap kerja penyelidikan untuk memahami pelan kelangsungan perniagaan berasaskan bencana (DBCP) khususnya PMKS yang berdaya tahan. Justeru, kajian ini bertujuan untuk mencapai objektif berikut, (1) mengenal pasti metrik daripada pelbagai perniagaan PMKS yang berhubung dengan pelbagai jenis bencana, (2) menambah baik komponen Analisis Impak Perniagaan (BIA) dalam kerangka konseptual DBCP dengan jaringan analisis GIS (Geo-BIA) yang disokong oleh ilmu pengetahuan setempat dan para pakar, dan (3) membangunkan kerangka konseptual DBCP yang komprehensif dengan penekanan terhadap PMKS dalam bidang pelbagai jenis bencana. Menerusi tinjauan literatur sistematik, kerangka konseptual DBCP yang berfokuskan PMKS telah dicadangkan dan kemudiannya telah dinilai menerusi siri kajian lapangan. Tiga kes kawasan kajian di Pantai Barat Sabah telah dikenal pasti untuk penelitian, iaitu (1) Kota Belud, (2) Ranau (Kundasang), dan (3) Kota Kinabalu. Seramai 80 responden yang terdiri daripada pengendali PKS tempatan dipilih sebagai sampel kajian dan terlibat dalam sesi temu bual berpandu dan tinjauan soal selidik. Penilaian untuk menentukan metrik bagi ekonomi, sosial dan persekitaran telah dinilai menggunakan Analisis Deskriptif dan Kekerapan, dan faktor-faktor daya tahan PMKS dianalisis menggunakan nilai Indeks Kepentingan Relatif (RII) dan tafsirannya. Keputusan kajian mendapati daya tahan PMKS terhadap kejadian bencana bagi ketiga-tiga kes kawasan kajian berkait rapat dengan ilmu pengetahuan setempat pengusaha PMKS dan disokong oleh libatsama agensi kerajaan yang berkaitan, termasuklah yang mempunyai asas kukuh ke atas pembangunan BCP. Analisis jaringan GIS untuk simulasi dan hasil peristiwa bencana menunjukkan bahawa setiap kawasan kajian menghadapi jenis bencana yang berbeza. Fokus utama adalah kepada gangguan infrastruktur (jalan utama yang ditenggelami air akibat banjir, masalah perolehan air, dan alternatif perlindungan sementara untuk PMKS yang terjejas). Berpandukan dapatan kajian, sebuah kerangka operasi Geo-BIA telah dibangunkan, sebagai keaslian kajian ini di Malaysia dan sebagai elemen utama dalam membangunkan kerangka DBCP. Kesemua dapatan kemudiannya disepadukan membentuk kerangka konseptual DBCP, dengan proses kesahan kerangka adalah melibatkan pakar secara temu bual separa berstruktur. Pakar dalam pelbagai bidang disiplin dan pelbagai sektor BCP dan DRR terdiri daripada ahli akademik, pengamal, pegawai kerajaan tempatan dan antarabangsa mengambil bahagian dalam proses pengesahan. Analisis Indeks telah diguna pakai untuk menentukan kesesuaian komponen cadangan kerangka DBCP. Cadangan kerangka bersepadu yang dibangunkan adalah terdiri daripada metrik PMKS dari segi ekonomi, sosial dan alam sekitar dalam fasa penyelesaian masalah, bersama-sama dengan kerangka operasi Geo-BIA, dan pemacu utama DBCP. Kerangka konseptual ini boleh digunakan sebagai memacu pembangunan BCP dalam membantu PMKS tempatan untuk meningkatkan dan membangunkan semula perniagaan mereka walaupun sewaktu kejadian bencana di Malaysia. Penyelidikan ini menyokong pembangunan DRR nasional dan strategi daya tahan, sekaligus menterjemahkan konsep bina-kembali-lebih baik ke dalam praktis, dan mempromosikan budaya daya tahan, seperti yang disenaraikan dalam kerangka UNDRR Sendai bagi Pengurangan Risiko Bencana 2015-2030.

TABLE OF CONTENTS

TITLE			PAGE
DECLARATION			**iii**
DEDICATION			**iv**
ACKNOWLEDGEMENT			**v**
ABSTRACT			**vi**
ABSTRAK			**vii**
TABLE OF CONTENTS			**viii**
LIST OF TABLES			**xiii**
LIST OF FIGURES			**xvi**
LIST OF ABBREVIATIONS			**xx**
LIST OF APPENDICES			**xxiii**
CHAPTER 1	**INTRODUCTION**		**1**
1.1	Background of study		1
1.2	Problem Statement		4
	1.2.1	Context	4
	1.2.2	Lack of Awareness on The Importance of BCP Among MSMEs	6
	1.2.3	Missing a Critical Role of Geospatial Technologies in Assisting MSMEs	8
	for Disaster Driven BCP		8
	1.2.4	Absent of Comprehensive Conceptual Framework for Disaster Driven	10
	BCP in Malaysia		10
1.3	Research Questions		12
1.4	Research Goals		12
	1.4.1	Research Objectives	13
1.5	Research Scope		13
	1.5.1	Limitation of Research	16
1.6	Significant of Research		17

1.7 Organization of Thesis 19

CHAPTER 2 LITERATURE REVIEW 23

2.1 Introduction 23

2.2 DRR Framework and Sustainable Development Goals 24

2.3 Disaster management agencies and policies in Malaysia 28

2.3.1 Malaysia National Security Council (MNSC) 29

2.3.2 National Platform on DRR 30

2.3.3 Disaster Risk Management Cycle in Malaysia 31

2.3.4 National Entrepreneurship Policy 2030 (NEP 2030) 33

2.3.5 Shared Prosperity Vision 2030 36

2.4 Business Resiliency 37

2.4.1 Resilience of MSMEs 38

2.4.2 Micro, Small and Medium Enterprises (MSMEs) 42

2.4.3 Impact of disasters to MSMEs 44

2.4.4 MSMEs in Malaysia 45

2.4.5 MSME Roles in Malaysia Economy 47

2.5 Business Continuity Planning 49

2.5.1 BCP evolvement to disaster driven BCP 53

2.5.2 Business Impact Analysis (BIA) 58

2.5.3 Capabilities of geospatial approach for BIA 59

2.5.4 BCPs and MSMEs 64

2.5.5 Best Practices of disaster derived BCP globally 65

2.5.6 BCP studies in Malaysia 76

2.6 Summary 78

CHAPTER 3 RESEARCH METHODOLOGY AND PROCESS 81

3.1 Introduction 81

3.2 Phase One: Preliminary 82

3.2.1 Exploratory study 83

3.2.1.1 Respondents 83
3.2.2 Research Philosophy 86
3.2.3 Research Approach 87
3.2.4 Research Strategy 90
3.2.4.1 Survey research 90
3.2.4.2 Case study 91
3.2.5 Research time dimension 96
3.3 Phase Two: Data Collection 96
3.3.1 Analysis of secondary data 97
3.3.2 Semi-structured Interview 98
3.3.3 Questionnaire survey 99
3.3.4 Fieldwork observation and photograph 101
3.3.5 Field enumerator assistance 103
3.3.6 Geospatial data 104
3.4 Data collection procedures 107
3.4.1 Site Investigation 109
3.4.1.1 Criteria of Study Areas 110
3.4.1.2 Profile of Study Area 117
3.4.2 Pilot Study 126
3.4.3 Actual Field work 127
3.4.4 Limitation and Challenges in data collection process 128
3.4.5 Overcoming the challenges 129
3.5 Phase Three: Analysis, Variability and Reliability 130
3.5.1 Validity and Reliability 132
3.6 Summary 134

CHAPTER 4 DATA ANALYSIS AND FINDINGS 137
4.1 Introduction 137
4.2 Presentation of result: Research Objective 1 (RO1) 138
4.2.1 Population target and response rates 138
4.2.2 General information of the respondents 139
4.2.3 Natural hazard experience 141

4.2.4 MSMEs awareness and preparedness of natural hazard 143
4.2.5 Impact and losses to natural hazard 146
4.2.6 Business resilience and BCPs 148
4.2.7 Economic, Social, and Environment Capitals for Resilience MSMEs 151
4.2.7.1 State of MSMEs: Economic capital 151
4.2.7.2 State of MSMEs: Social Capital 154
4.2.7.3 State of MSMEs: Environmental Capital 157
4.2.8 State of capitals (economic, social and environmental) for MSMEs 161
4.3 Presentation of result: Research Objective 2 164
4.3.1 Geospatial technologies (Software and Analysis 168
4.3.2 GIS Network Analysis 169
4.4 Results and Analysis 171
4.4.1 Context 171
4.4.2 New Routes 172
4.4.2.1 Case Study – Flood in Kota Belud 173
4.4.2.2 Summary 180
4.4.3 Service Area 182
4.4.3.1 Case Study – WTP in Ranau 184
4.4.3.2 Results and Analysis 186
4.4.3.3 Summary 191
4.4.4 Closest Facility 193
4.4.4.1 Case Study - Earthquake – Kundasang 194
4.4.4.2 Results and Analysis 196
4.4.4.3 Summary 201
4.5 Practicality of Geo-BIA with site dependency 204
4.6 Proposed Conceptual Framework of DBCP for MSMEs in Malaysia 208

CHAPTER 5 PROPOSED CONCEPTUAL FRAMEWORK OF DISASTER DERIVED BUSINESS CONTINUITY PLANNING (DBCP) 211

5.1 Introduction 211

5.2 Nature of the framework 212

5.2.1 DBCP inputs preparation 213

5.2.2 DBCP problem solving process 214

5.2.3 DBCP key deliverables and development of industrial policy 214

5.3 Validation of DBCP framework 215

5.3.1 Validation of the proposed DBCP framework through expert interviews 216

5.3.1.1 Design list of questions for framework validation 217

5.3.2 Analysis and Result of Validation of DBCP framework 218

5.3.2.1 Comprehend the effectiveness of DBCP proposed framework 224

5.3.2.2 Benefits of DBCP proposed framework 225

5.4 Finalizing DBCP framework 226

5.5 Limitations and challenges in DBCP framework implementation 228

5.6 Summary 229

CHAPTER 6 CONCLUSION 231

6.2 Research contribution 231

6.2.1 Academic relevance 231

6.2.2 Industrial relevance (for practice) 233

6.3 Recommendations for future research 235

6.4 Summary 236

REFERENCES 239

LIST OF PUBLICATIONS 273

LIST OF TABLES

TABLE NO.	TITLE	PAGE
Table 1.1	Scope of Research.	15
Table 2.1	Level of disaster management in Malaysia.	29
Table 2.2	Business resiliency in various subjects of research.	38
Table 2.3	MSMEs resilience defined in previous studies.	39
Table 2.4	MSMEs Resilience with Risks Assessment.	41
Table 2.5	Global MSMEs losses due to disasters.	43
Table 2.6	Disasters impact to MSMEs.	44
Table 2.7	MSME definition used in Malaysia.	46
Table 2.8	Distribution of MSMEs in Malaysia.	46
Table 2.9	History of MSMEs development in Malaysia.	48
Table 2.10	Evolution of BCP in BCM Development (Bakar, 2018).	51
Table 2.11	Comparison of BCP, Area BCP (disaster driven) and Disaster Management Plan.	56
Table 2.12	GIS and Disaster data management.	62
Table 2.13	Top 10 list of innovations in DRR (Izumi *et al.*, 2019).	63
Table 2.14	Summary of BCPs and MSMEs Studies.	65
Table 2.15	Terms and definition in Business Continuity.	76
Table 2.16	Studies on BCM, BCP, MSMEs related in Malaysia.	77
Table 3.1	Targeted MSME group in each case study areas.	84
Table 3.2	Respondents details for DBCP framework evaluation.	86
Table 3.3	Research Approach (Ragab and Arisha, 2018).	88
Table 3.4	Compilation of MSMEs resilience studies which adopted case study strategies.	92
Table 3.5	Mixed Method Design (Ragab and Arisha, 2018).	94
Table 3.6	Distribution of survey sample according to study areas (n=72).	100
Table 3.7	Selection of study areas criteria.	110

Table 3.8	Comments of assessment criteria for study areas (adapted from NPP-3, NADMA reports, and research fieldwork in 2016,2017, and 2018).	117
Table 3.9	Case study validity and reliability in this research.	133
Table 4.1	Respondent position (n=80).	139
Table 4.2	Industry sector in which the respondent's business operates (n=80).	141
Table 4.3	Number of MSMEs affected by natural hazards in Malaysia (2015-2019).	142
Table 4.4	Assessment of respondents' awareness and preparedness towards natural hazards in case study areas: analysis of mean value and standard deviation (n=80).	143
Table 4.5	MSMEs who experienced loss after a disaster event in all study areas (n=80).	147
Table 4.6	Mean score for MSME business resilience (n=80).	149
Table 4.7	Frequency of MSMEs understanding of BCP (n=80).	149
Table 4.8	Indicators for measuring economic capital.	152
Table 4.9	MSMEs assessment to economical capital (n=80).	152
Table 4.10	Assessment of MSME resilience to economic capital.	153
Table 4.11	Indicators on measuring social capitals.	154
Table 4.12	MSMEs assessment to social capital (n=80).	155
Table 4.13	Assessment of MSMEs resilient based on social capital.	157
Table 4.14	Indicators for measuring environmental capital.	158
Table 4.15	MSMEs assessment to environmental capital (n=80).	159
Table 4.16	Assessment of MSMEs resilient based on environmental capital (n=80).	161
Table 4.17	Core Business Resources (example: Manufacturing company).	166
Table 4.18	Usual condition elements for closest facility.	197
Table 4.19	Result for usual condition in finding new closest facility.	197
Table 4.20	Situation (Earthquake) occurred for closest facility.	200
Table 4.21	Result for new closest facility (Earthquake).	200
Table 5.1	Experts' responses on the contribution of the DBCP framework towards policies.	219

Table 5.2	Experts' validation of communities indicators through index analysis.	220
Table 5.3	Validation of DBCP key drivers by expert through index analysis.	221
Table 5.4	Validation of DBCP key deliverables.	222
Table 5.5	Ranking of elements based on the development process using RII score given by respondents (N =5).	223

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
Figure 1.1	Geo-referencing as the link between economy, social and the environment (Source: (UN-GGIM, 2020)).	8
Figure 1.2	Research Gap – Missing Disaster derived BCP framework and disaster data management.	11
Figure 1.3	Thesis Organization for this study.	21
Figure 2.1	Four priorities for action in Sendai Framework for DRR (Aitsi-Selmi et al., 2015).	25
Figure 2.2	Global Policy Evolution (UNDRR, 2019a).	26
Figure 2.3	Example of national policies in Malaysia.	28
Figure 2.4	Malaysia Disaster management cycle (Centre for Excellence in Disaster Management and Humanitarian Assistance, 2016).	32
Figure 2.5	NEP 2030 main objectives and core elements (Bernama, 2019).	34
Figure 2.6	NEP 2030 – Main objective, strategic thrust, strategies and initiatives related to the study.	35
Figure 2.7	SPV 2030 in line with the aim and objectives for this research.	36
Figure 2.8	Framework for building the resilience of SMEs through DRR (UNDRR, 2020a).	41
Figure 2.9	BCP under BCM planning methodology.	50
Figure 2.10	Main differences in ISO 22301:2019.	52
Figure 2.11	BCP concept Diagram. (Hitoshi, 2015).	53
Figure 2.12	Process of Risks analysis (JICA, 2015a).	57
Figure 2.13	DBCP General proposed design (Hitoshi, 2015; Ono, 2020).	58
Figure 2.14	The five main principles of GSGF.	60
Figure 2.15	Step 3 for Sentinel Asia.	61
Figure 2.16	Steps in developing Area BCP (JICA, 2015b).	67
Figure 2.17	Basic Structure for ABCP (Hitoshi, 2014).	67

Figure 2.18	BIA when Thai flood event were assumed (ADPC, 2017).	69
Figure 2.19	BCP multi-useable Framework by (Fani and Subriadi, 2019).	72
Figure 2.20	Area BCP framework design for the Philippines (JICA, 2014).	73
Figure 2.21	Process of Area BCM in Japan (Cabinet Office, 2014).	75
Figure 3.1	Research Methodology Phases.	82
Figure 3.2	Research Philosophy used in this research.	87
Figure 3.3	Research overall process (Wedawatta, 2013).	95
Figure 3.4	Photography as supporting evidence to the fieldwork observation. (Fieldwork 2015,2016,2017,2018,2019).	102
Figure 3.5	Geospatial data flowchart.	106
Figure 3.6	Flowchart of research design based on fieldwork from 2015 to 2020.	109
Figure 3.7	Distribution of multi hazards in Malaysia for year 2018 (Sources: NDCC, NADMA, 2018).	112
Figure 3.8	Kundasang, Ranau, Sabah (Google Map).	118
Figure 3.9	Local infrastructures cracks within Ranau and Kundasang town.	119
Figure 3.10	Debris flow (clogged log) stuck at Ranau water intake.	120
Figure 3.11	Kota Kinabalu and its district.	121
Figure 3.12	Illustration of Kota Kinabalu as Metropolitan City by 2033 (Source: Town and Regional Planning Department, 2010).	122
Figure 3.13	Kota Belud and its tourism attraction (Google Map).	123
Figure 3.14	Flooding events in Kota Belud (Bernama, BorneoDaily).	125
Figure 3.15	SAIFON installation in Kota Belud in Phase 3 (2019) (Mr Jasmi Hassan, Manager of MSD Innovation Sdn Bhd).	125
Figure 3.16	Relative Important Index (RII) (Wedawatta, 2013).	131
Figure 3.17	Chosen research process and methodology for this study.	135
Figure 4.1	MSMEs economic losses due to disaster by study areas (n=80).	148
Figure 4.2	Summary of capitals relationship for MSMEs resilience to disaster event.	163
Figure 4.3	Applications in GIS Network Analyst of ArcGIS.	170

Figure 4.4	Inaccessible road due to flood event in Kota Belud (BorneoPost,2020).	174
Figure 4.5	Flooding area in Kota Belud.	174
Figure 4.6	Kota Belud district in OSM.	175
Figure 4.7	Road network digitized for Kota Belud.	175
Figure 4.8	Normal route between Kota Belud Hospital and Dewan Masyarakat Tun Said Keruak.	176
Figure 4.9	Shortest path (new route) layer is created.	177
Figure 4.10	Navigation direction windows.	177
Figure 4.11	Flood designed as polygon, place in between two points.	179
Figure 4.12	Network analyst window of new route.	179
Figure 4.13	New route created using GIS network analyst.	180
Figure 4.14	Navigation window for new route.	180
Figure 4.15	Service Area in GIS Network Analyst for ArcGIS.	183
Figure 4.16	WTP affected by logs from Mount Kinabalu in Kampung Bambangan water intake point on Sungai Liwagu (thestar.com.my, 2015).	185
Figure 4.17	Location of WTPs in Ranau.	187
Figure 4.18	Service Area layer generated in ArcGIS environment.	187
Figure 4.19	Result of Service Area for WTP in Kampung Bambangan.	188
Figure 4.20	Villages nearby WTP Kampung Bambangan.	189
Figure 4.21	Service area results for WTPs including proposed WTPs.	190
Figure 4.22	Details on facilities and polygon created for accessibilities to WTPs.	190
Figure 4.23	House destroyed in the Earthquake event 2015.	195
Figure 4.24	Closest facility buffering zone from the incident point.	197
Figure 4.25	Result for closest facility under normal condition.	198
Figure 4.26	Navigation and network analysis window.	198
Figure 4.27	Output of routes in case of Earthquake event.	200
Figure 4.28	Navigation and network analyst window (Earthquake).	201
Figure 4.29	Divisional development strategy for west coast division (Town and Regional Planning Department, 2013).	203

Figure 4.30	PDCA Cycle (Adapted from: (Somasekaram, 2017)).	205
Figure 4.31	Operational Framework of Geo-BIA.	207
Figure 4.32	Proposed DBCP Framework based on literature review, standard BCP/BCM ISO and survey of local MSMEs.	210
Figure 5.1	Validation procedures.	216
Figure 5.2	Final version of DBCP framework after validation by experts.	227

LIST OF ABBREVIATIONS

AADMER	-	ASEAN Agreement on Disaster Management and Emergency Response
ABCP	-	Area Business Continuity Plan
ABCM	-	Area Business Continuity Management
ADB	-	Asian Development Bank
ADInet	-	ASEAN Disaster Information Network
ADRC	-	Asian Disaster Reduction Centre
ADPC	-	Asian Disaster Preparedness Centre
AHA	-	ASEAN coordinating centre for Humanitarian Assistance
APEC	-	Asia-Pacific Economic Cooperation
APM	-	Civil Defence Force
APRSAF	-	Asia-Pacific Regional Space Agency Forum
ARISE	-	Private Sector Alliance for Disaster Resilient Societies
ARMOR	-	ASEAN Risk Monitor and Disaster Management Review
ASEAN	-	Association of Southern Asian Nations
BBB	-	Build Back Better
BCM	-	Business Continuity Management
BCP	-	Business Continuity Plan
BIA	-	Business Impact Analysis
COVID19	-	Coronavirus Disease
CRED	-	Centre for Research in Epidemiology of Disaster
DID	-	Department of Drainage and Irrigation
DMRC	-	Disaster Management and Relief Committee
DRM	-	Disaster Risk Management
DRR	-	Disaster Risk Reduction
EM-DAT	-	Emergency Events Database
EPU	-	Economic Planning Unit
ERM	-	Enterprise Risk Management
ESCAP	-	Economic and Social Commission for Asia and the Pacific

ESRI	-	Environmental Systems Research Institute
FEMA	-	Federal Emergency Management Agency
GEJE	-	Great East Japanese Earthquake
Geo-BIA	-	Geospatial led Business Impact Analysis
GIS	-	Geographical Information Analysis
GNSS	-	Global Navigation Satellite System
GDP	-	Growth Domestic Product
GRAF	-	Global Risk Assessment Framework
GSGF	-	Global Statistical Geospatial Framework
HFA	-	Hyogo Framework for Action
ICT	-	Information and Communication Technology
INFORM	-	Index for Risk Management
IRDR	-	Integrated Research on Disaster Risk
ISO	-	International Organization of Standardization
IT	-	Information Technology
JBPM	-	Sabah fire and Rescue Department
JICA	-	Japan International Cooperation Agency
MCO	-	Movement Control Order
MDG	-	Millennium Development Goal
MITI	-	Malaysia International Trade and Industries
MEDAC	-	Ministry of Entrepreneur Development and Cooperatives
MERCY	-	Malaysian Medical Relief Society
MoSAR	-	Mountain SAR
MNC	-	Multi-National Companies
MNSC	-	Malaysia National Security Council
MSME	-	Micro, Small and Medium Enterprises
MYR	-	Malaysian Ringgit
NADMA	-	National Disaster Management Agency Malaysia
NEP	-	New Economic Policy
NGO	-	Non-Governmental Organization
NPP	-	National Physical Plan
NSC	-	National Security Council
NEP	-	National Entrepreneurship Policy

OSM	-	Open Street Map
PDCA	-	Plan, Do, Check, Act Cycle
PLANMalaysia	-	Federal Department of Town and Country Planning Peninsular Malaysia
POI	-	Point of Interest
PWD	-	Public Work Department
RII	-	Relative Importance Index
RTO	-	Recovery Time Objectives
SAR	-	Search and Rescue
SAIFON	-	Security and Integrated Flood Operation and Network
SEDIA	-	Sabah Economic Development and Investment Authority
SDG	-	Sustainable Development Goal
SDC	-	Sabah Development Centre
SFDRR	-	Sendai Framework for Disaster Risk Reduction
SME	-	Small, Medium Enterprises
SPV	-	Shared Prosperity Vision
SSP	-	Sabah Structural Plan
STEP	-	Science and Technology Expert Panel
TIER	-	Taiwan Institute of Economic Research
UMS	-	University Malaysia Sabah
UN	-	United nation
UNDRR	-	United Nation Disaster Risk Reduction
UN-ESA	-	United Nation of European Space Agency
UNESCO	-	United Nation Educational, Scientific and Cultural Organization
UN-GGIM	-	United National Global Geospatial Information Management
UNISDR	-	United Nation International Strategy for Disaster Reduction
USD	-	United States Dollar

LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix A	Summary of the roles and responsibility of agencies according to Disaster Risk Management	263
Appendix B	SDC and West Coast of Sabah	265
Appendix C	Research Questionnaires	267

CHAPTER 1

INTRODUCTION

1.1 Background of study

Between 1970 and 2020, natural hazards in Asia and the Pacific affected 6.9 billion people and killed more than 2 million, that is 41,373 lives per year, nearly all of them were victims of water-related catastrophes such as floods, droughts, and storms (ESCAP, 2021). The region has not been spared the wrath of natural hazards since the establishment of the Association of Southeast Asian Nations (ASEAN) in 1999. The large-scale, high-impact catastrophes recorded by Indonesia, the Philippines and Thailand have created enormous devastation and significant economic losses. ASEAN is expected to rank as the world's fourth largest economy in 2050. However, if disaster mortality is still high, this future achievement for the region would not be possible (ARMOR, 2020). Malaysia is one of the ASEAN members and is bound to make the country as one of the major regional assets. In terms of catastrophes, despite its proximity to the Pacific Ring of Fire, Malaysia is generally safe from tectonic-related hazards. Despite this, it is frequently threatened by cyclones, floods, landslides, droughts, epidemics, or environmental degradation (ADPC-UNDRR, 2020). Flooding is the annual and most frequent disaster event responsible for a significant number of human lives, damage to infrastructure and epidemics of disease (CFE-DM, 2019). During 1998 until 2018, Malaysia stated 281 people died and over 3 million affected by disasters, which contributed to MYR 8 billion in damages. However, the country saw an increase in risk profile ranking since 2018, as indicated in the World Risk Report 2019, which ranked Malaysia at 71th out of 180 countries, as opposed to 82nd in 2018 (Hilft, 2019). From there, Malaysia start to actively invested in adaption and mitigation efforts in order to improving the disaster management structure, especially in Disaster Risk Reduction (DRR).

DRR is a concept and practice of reducing disaster risks through systematic efforts to analyses and reduce the casual factor of disasters. Examples for DRR activities including in reducing exposure to hazards, lessening vulnerability of people and property, wise management of land and environment and improving preparedness for adverse disaster events (Chmutina and Bosher, 2015). In August 2015, the National Disaster Management Agency (NADMA) were established in Malaysia and has set to be a focal point for disaster management, as a successor to the disaster management division under aegis of National Security Council (NSC). The integration of DRR into the overall national development plan, particularly in the Eleventh Malaysian Plan (RMK-11), from 2016 to 2020, where now shifted into Twelfth Malaysian Plan (RMK-12) covering 2021-2025, has earmarked a transition for the country, from disaster management towards Disaster Risk Management (DRM). NSC has formalised the National Platform and Action Plan on DRR (MyDRR) in 2013 (IRDR, 2018). All of the implementation of action plans for DRM in Malaysia contributing towards the Sendai Framework for DRR 2015- 2030 (SFDRR) which to observe the growth of disaster risk through the recovery, rehabilitation and reconstruction phases that needs to be prepared ahead. This platform will hugely contribute to Malaysia's economic growth, mostly led by Micro, Small and Medium-sized enterprises (MSMEs).

MSMEs are vital to the global economy, yet they are disproportionately vulnerable to disasters. MSMEs account for half of global Growth Domestic Product (GDP) and play a critical role in ensuring the lives of the world's most disadvantaged people. They are, however, extremely vulnerable to calamities, accounting for around 75% of all company losses after a disaster (UNDRR, 2021b). MSMEs range from micro-enterprises such as retailers in street markets to manufacturing facilities with substantial capital investments in equipment and training for the workforce. They are recognized by the Asia-Pacific Economic Commission (APEC) and ASEAN as central to socioeconomic development in South-East Asia, which is the global region most exposed to natural hazards (ARMOR, 2020; UNDRR, 2020). The disproportionate share of risks incurred by MSMEs is due to MSMEs' comparatively poor adoption of DRR treatments compared to bigger enterprises - MSMEs' DRR uptake is 10-20% lower than larger firms'. As a result, MSMEs are more likely to suffer losses as a result of any given catastrophe (UNDRR, 2021b). Their resilience to disasters is therefore

also central to sustainable development. In Malaysia, 98.5% of organizations are MSMEs and this sector contributed to 36.6% of the GDP in 2016 (SMEinfo, 2020).

Despite a compelling overall business case, MSMEs underinvest in DRR, with uptake ranging from 10% to 20% lower than other enterprises, depending on sector and area. The construction and utilities industries had the widest disparity, with MSMEs adopting DRR at a rate of 16 percent lower on average globally. MSMEs in Africa and Asia are the most affected by this disparity, with MSMEs in both areas doing 20% and 17% less DRR than bigger enterprises across all sectors, respectively. According to scholarly work, MSMEs must meet four important requirements in order to implement DRR: access to capital, adoption of resilient business models, effective contracts, and Business Continuity Planning (BCP) (UNDRR, 2021b). However, (Hitoshi *et al.*, 2013) introduced the Area BCP because individual BCP from well-established private and multi-national companies was insufficient for their core business infrastructures to quickly recover due to the disruption of essential resources such as energy, water, transportation and communication within area of disasters. It also reflects that MSME BCPs adoption is minimal, and BCPs of MSMEs that do participate in BCP tend to be too focused on ex post recovery methods (Ono, 2020). Too complicated BCP guidance, a lack of preventative emphasis, and a lack of MSME capability, among other things, appear to be reasons for these realities (UNDRR, 2020a, 2021b).

MSMEs and their lacking of awareness and exposure in preparing the BCPs would be one of the key point that triggered this study. Within BCP, there is one key player which is the Business Impact Analysis (BIA). BIA determined most of the productivity in the company or any MSMEs that needed the inter-operated between the company management, employers, employees, supply chain and many others. In order to implement the effective BIA for the MSMEs, integration of BIA with risk assessment play the significant contributor to utilized and manage the critical business impact (Hassel and Cedergren, 2021). However, in the literatures of BIA development, especially designated for BCPs, it does not have any integration with geospatial technologies, e.g. multi scale remote sensing images, Global Navigation Satellite System (GNSS) for rapid positioning, as well as Geographical Information System

(GIS) databases for data storage, data visualization and data analysis. Geospatial information and technologies have become a ubiquitous part of everyday services and is central to the business models of many of the digital disruptors that have become prominent in the 2010s (UN-GGIM, 2020). Therefore, this study will initiate the embedded geospatial information and technologies to boost up the BIA element within the design of disaster driven BCP. Detail investigation is still needed by incorporating the extensive field data, and advanced processing for GIS data analysis regarding on improving the BIA and later on will contributing in DBCP phase that will be used for MSMEs target group practices in Malaysia.

1.2 Problem Statement

1.2.1 Context

Malaysia were shifted to higher ranking in term of exposure to disasters in 2020 compare to the data from 2019. Malaysia is frequently affected by monsoonal floods, which leading in the hazards list that affected the country. Moreover, exposure is largely dependent on local topography, soil conditions (in the case of landslides) or by regional weather and distance from the coast (ADPC-UNDRR, 2020). All these events had severe impacts on the local businesses and agriculture sustenance, which is leading by MSMEs. For example, 2014 Kelantan flooding in Kuala Krai town, their local economy was paralyzed after certain period of time due to the impact of unusual pattern of monsoonal flood that year. This causing huge destruction and damages in term of sale items and infrastructures (Nayan *et al.*, 2017; Azmi *et al.*, 2021) and according to a press statement by the Ministry of International Trade and Industry (MITI) in 2015, more than 13,000 SMEs were affected (Auzzir *et al.*, 2018). Economic losses suffered by the East coast region was approximately RM 2.9 billion, whereas RM 800 million of government allocation was needed for repairs and reconstruction of critical infrastructure such as schools, hospitals, roads and bridges (Azimi *et al.*, 2019). Other than that, earthquake in Ranau, Sabah in June 2015 causing 18 people died and MYR 6.7 million economic losses due to the 234 days' closure of Sabah parks. The income losses for mountain guide (Malim Gunung) also huge stated as

MYR 2.3 million during that particular moment of closure. Much remains unknown about the real state of small accommodation companies in Ranau as a result of the earthquake, particularly in terms of their operational status and recovery strategy to stay in business (Fabeil *et al.*, 2019). Among the challenges commonly faced by MSMEs as stated by (Nabila *et al.*, 2020) are namely as financial, human resources, marketing strategy, facilities, appliances and layout, and problems with suppliers when disaster strikes. However, there is another challenge that is always overlooked, which is exposure to BCP.

Effectiveness of measures defined in BCPs remains uncertain. The Sendai Framework emphasizes the need of public-private cooperation in strengthening resilience (UNDRR, 2020a). It calls for integrating disaster risk management, including business continuity and practices through disaster-risk-informed investments. Malaysia actively put the Sendai Framework into actions especially when dealt with the disaster affected areas and varies approach in adopting the DRR and disaster risk governance has been strengthened in terms of vision, plans, competence and coordination within and across sectors. However, different circumstances have been observed in the translation of the global efforts into the local exercises of DRR. Major gaps were the lack of study among the local businesses which affected by natural hazards, which is supported by (UNDRR, 2021b) stated that MSMEs lack of expertise and financial resources necessary to implement or provide the overly complex processes and/or deliverables outlined in official BCPs guidance. Besides, when compared to large corporations, MSMEs are less knowledgeable about disaster risk, BCP opportunities and benefits, and, in particular, the role they can play in promoting preventative strategies. By incorporating parts of Enterprise Risk Management (ERM) into BCPs, risk analysis and reduction may be better connected, resulting in cost-effective preventative planning. ERM can be used to support parts of business continuity planning, such as BIA (UNDRR, 2020a, 2021b). As an example, BIA as part of BCP can follow the three steps process outlined in ERM of risk identification, analysis and evaluation, which is the novelty of this study to blend in the geospatial solution into the disaster driven BCP framework. The development of flexible framework, focusing on MSMEs, should be introduced (Fani and Subriadi, 2019; UNDRR, 2021b). Flexible frameworks are required based on varying levels of MSME capacity. Local context, such as the complexity of SME supply chains and

dependence on critical infrastructure, also needs to be considered, as it can affect multiple businesses in the value chain (Bak *et al.*, 2020; UNDRR, 2020a, 2021b).

1.2.2 Lack of Awareness on The Importance of BCP Among MSMEs

In today's business world, organisational resilience is acknowledged as one of the most important assets for the success and long-term viability of small business recovery in every sector (Azmi *et al.*, 2021). (Rom, N.A.M., Hassan, 2020) suggest that government and related agencies to provide assistance to MSMEs on the catastrophic matters and its awareness. MSMEs has the capacity to serve as catalyst for bringing disaster risk information to other social sectors and at the same time supporting risk-informed governance, along helping the government to fulfil its 2030 Agenda obligations, notably the Sustainable Development Goals (SDGs); SFDRR and Paris Agreement on Climate Change (UNDRR, 2021a). Alliance for Disaster Resilience Societies (ARISE) was started by UNDRR in 2015 to support the MSMEs to become a key partner in reducing disaster risk (UNDRR, 2019c). Two from four top priorities of ARISE were covered mainly for MSMEs. The first one is in enhancing the resilience of MSMEs, and also to support resilience infrastructure development. Against this backdrop, series of BCP workshops will support the ARISE initiative, which looks at engaging MSMEs on these important matters.

Despite all the importance to acknowledge importance of BCPs to MSMEs, there is still lack of awareness the importance of BCPs among MSMEs. Report from (Ono, 2014) shows that only 13% of MSMEs respondents have a BCP while 34.8% are in the process of developing one among ASEAN countries. Moving to five years forward, issues with low awareness among MSMEs were still debated. Many MSMEs are unaware of the benefits of digitalization or the solutions available to them. Even when people comprehend the possibilities, a lack of skills or understanding in installing or using technology, especially in poor nations, is a hurdle (UNDRR, 2021b). MSMEs are less knowledgeable of catastrophe risk, BCP possibilities and advantages, and, in particular, the role they may play in supporting preventive efforts (Mukherjee *et al.*, 2020). In the lack of reliable evidence from local authorities, MSMEs may be

hesitant to invest in a BCP, particularly during long-term events such as a pandemic (Mohd Noor *et al.*, 2021). Three main reasons lead with lack of BCP knowledge and expertise, lack of information needed for BCP development and management's low awareness, show that the key to improving the awareness is through the raising of exposure of BCP and MSMEs resilience in all level of management (district, state and national) for every country (UNDRR, 2020a). In addition, study conducted by (Fani and Subriadi, 2019; Azadegan *et al.*, 2020; Fabeil *et al.*, 2020), shows that due to the low percentage of awareness among MSMEs, allowed MSMEs to operate within their capital limitation and impacted their business operation and supply chain management. Bigger firms can use their business networks (such as ARISE) to build peer-to-peer alliances for MSMEs with larger corporations and BCP champions along their value chain, raising knowledge of business continuity planning, ERM, and catastrophe risks. To raise awareness, larger organisations and chosen champions can present their business continuity planning-based risk prevention or disaster recovery success stories (UNDRR, 2021b).

In addition, the innovation is a key driver for long-term growth in MSMEs. The new era with the COVID-19 pandemic outbreaks, defined epoch in history presents many challenges that society and commerce have never been exposed to. In response, geospatial technologies are enabling many innovations that are changing the ways businesses operate and are creating new business opportunities (Kukanja *et al.*, 2020). In times of economic crisis, it is proven that MSMEs become effective to be the dynamist of economic growth post-crisis. As being stated by (Rajabifard Abbas, 2021) in the publication regarding on impact of COVID-19 with the significant use of geospatial technologies, the use of location intelligence and GIS for understanding COVID-19 outbreak and its relationship to infrastructure, population, businesses and other location-based information requires both a clear understanding of the relevant geospatial principles and the relevant aspects of data monitoring, planning and mapping.

1.2.3 Missing a Critical Role of Geospatial Technologies in Assisting MSMEs for Disaster Driven BCP

The integration of information from both statistical (which includes a wide range of socioeconomic and enterprise data) and geospatial (which includes increasingly important environmental and earth observation data) domains has been recognised as important for understanding relationships between and within these three pillars as stated in Figure 1.1 (UN-ESA *et al.*, 2019).

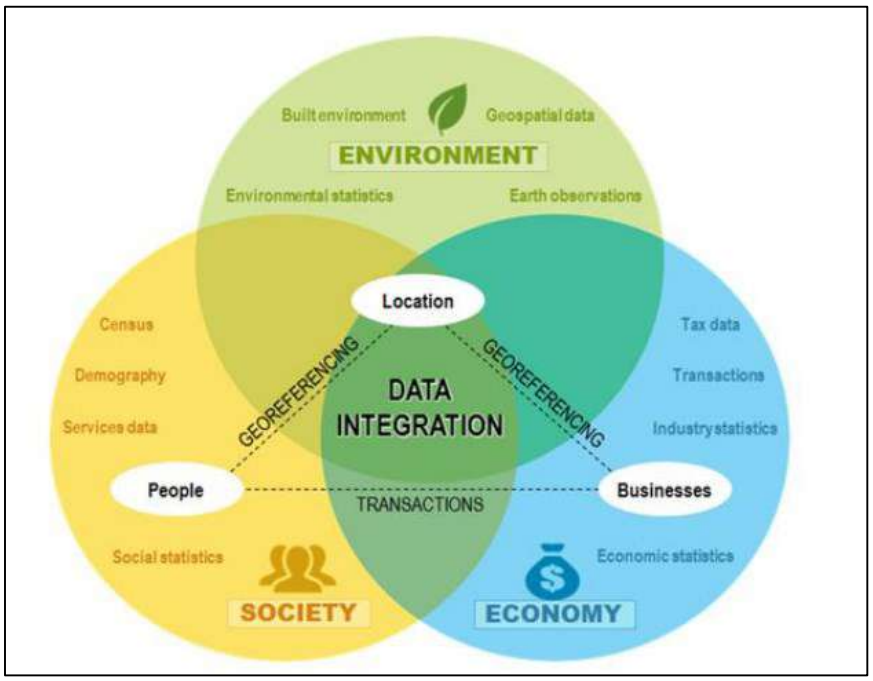

Figure 1.1 Geo-referencing as the link between economy, social and the environment (Source: (UN-GGIM, 2020)).

The missing link between economy, society and environment is data integration. With the link stated on geo-referencing, there were studies relate the importance the using of geospatial technologies, referring disaster field environment such in (Kanthi and Purwanto, 2016; Albano and Sole, 2018; Mohd Kamal *et al.*, 2019; Franch-Pardo *et al.*, 2020). The increasing of intensities of natural hazards in the last few decades, especially in ASEAN region, and they came in an abrupt manner and affecting large disaster areas, thus making it difficult to develop preventive plans for society, which is MSMEs in this study (Dahlberg and Guay, 2015; Rebeeh *et al.*, 2019). Other than that, in Malaysia, there are existing studies on geospatial

technologies with disaster event. In (Norhisham and Roslee, 2019), there are geohazards assessment for landslides and flooding in East Malaysia and the people potentially be affected can be predicted in advanced because of the vulnerable areas in which these events occur are generally known. However, it is still statistically missing a critical role of geospatial technologies among MSMEs. For example, according to studies conducted due to the outbreak of COVID-19, it shows that while the resilience of society overall has decreased, and dependency on globalisation has increased, the potential disruptions caused to society and the economy are resulting in unprecedented impacts (UN-GGIM, 2020). In order to balancing situation, appropriate responses to these issues shows the important role the geospatial industry plays in providing data-driven analysis to support decision-making. Taking into consideration that these negatives effects are also transferred into the local communities in which MSMEs are located, it is crucial to create appropriate mechanisms that will enable these enterprises to build relevant capacities and acquire necessary resources in order to deal with relevant disruptive events (Skouloudis *et al.*, 2020).

There is a study conducted for MSMEs in Malaysia by (Arshad *et al.*, 2018) that using GIS to ease customers in locating MSME business premises. However, the study found out that 70% were in the category of never use GIS or use GIS less than once a week, thus further studies are necessary to understand why there is a slow growth in using GIS for locating business premises or even tourist places which is important for MSMEs. However, the study of MSMEs, who having their businesses in disaster-prone areas, utilization of geospatial technologies is missing. Even though there were studies within disaster field (location), but the impact was not specifically focusing on MSMEs, but rather on the community itself. In Malaysia, the initiatives to introduce the geospatial technologies were vast and critical role in exposing the capabilities of geospatial technologies to MSME established in disaster areas is missing. The use of geospatial analysis in this study adds a new element to the BIA phase, which explains the impacts of a specific event and their intensity. Simultaneously, it would strengthen MSMEs' resilience to natural hazards through effective resilience and adaptation strategies, overcoming the claim made by (UNDRR, 2021b) that MSMEs lack risk assessment capability owing to a lack of tools and personalised risk information and assistance.

1.2.4 Absent of Comprehensive Conceptual Framework for Disaster Driven BCP in Malaysia

By 2025, ASEAN will engage with the private sector to standardise business continuity and disaster recovery strategies across the region. Local economies become more resilient as a result of the mainstreaming of such plans, since the private sector is able to better prepare for and respond to disasters, as well as recover rapidly to resume normal operations (ASEAN, 2020). Stakeholders from the business community should collaborate with policymakers. Larger organisations, for example, can devote resources to putting BCP frameworks to the test. Furthermore, they may assist in the development of a complete typology of BCPs that can be tailored to MSME capability and features such as area, industry, and position in supply and value chains, as well as the types of risks faced (UNDRR, 2020b). However, only 13 per cent of small and medium-sized industries in the region had BCPs and were able to identify and mitigate their financial risks, which is therefore a clear gap in current disaster management and leadership.

There is no specific guidance regarding BCP (e.g. standard or framework) which considered as best practices globally (Fani and Subriadi, 2019). From numerous literatures, implementation of BCP for MSMEs is understudied. Even some of the disaster data losses, mostly government assets, are under-estimated, poorly collected, hardly reached by all-affected communities, and often subject to large and critical infrastructure damage. Therefore, scientific and systematic study, with the support of multi-sectoral agencies, community empowerment, and sophisticated tools and systems are required to carefully understand and develop the aforementioned issues and problems, and possible solutions. From the perspective of disaster resiliency among the communities and businesses stakeholders, the disaster driven BCP framework are constructed to help them to rejuvenate their businesses in a short-time and provides flexibility to MSMEs. In addition, not many BCP studies were conducted in Malaysia that relates to MSMEs especially for rejuvenation of their businesses, mostly focusing on the management and organizational performance indeed, called as Business Continuity Management (BCM) (Nasiren and Asmoni, 2016; Auzzir *et al.*, 2018; Bakar, 2018). Figure 1.2 shows the research gap developed for this study,

showing the missing bridge between MSMEs and disaster driven BCP framework development.

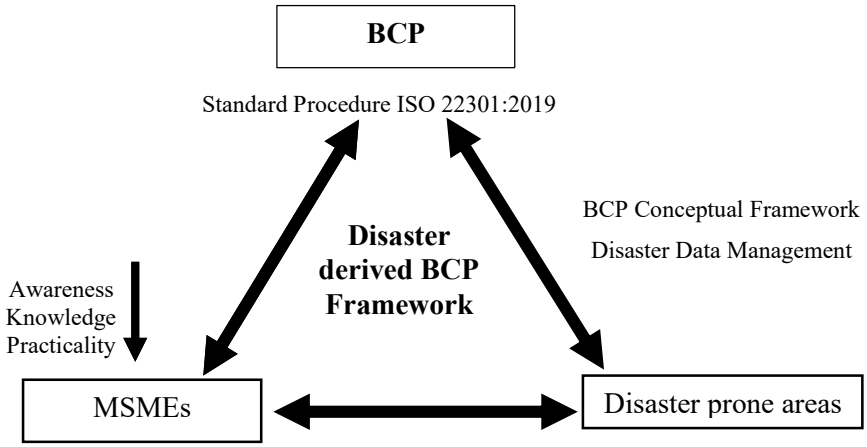

Figure 1.2 Research Gap – Missing Disaster derived BCP framework and disaster data management.

The linkage of MSMEs which resided in disaster prone areas, mostly do not prepared for BCP documentation or might be lacking awareness and knowledge on BCP implementation. Surveys have shown that many financially vulnerable MSMEs have not yet developed a BCP or have no knowledge of BCPs (JICA, 2015b; UNDRR, 2020a, 2021b). Therefore, initiatives from local government in exposing the BCP through preparation of standard guidelines and toolkits amongst others (Ono, 2020). This gap of missing the crucial component of comprehensive framework and an efficient disaster database management for Disaster Derived BCP (DBCP) give a strong justification for this research to be carried out. A comprehensive and holistic approach framework should boost up the practicalities of DBCP when it is being exercises and testing by MSMEs.

1.3 Research Questions

Based on the aforementioned problem statement, the following research questions have been developed;

1. What are the economic, social, and environmental capitals for MSME resilience in the study areas?
2. How to measure the readiness of MSMEs to accept the disaster derive BCP framework and their acceptance level to learn the importance of MSMEs focused BCP?
3. How MSMEs can took place in practices of geospatial technologies as their new knowledge to development of geospatial led-BIA (Geo-BIA)?
4. Which elements in BIA that can be improved for MSMEs in understanding future risk?

How to formulate the disaster derived BCP (DBCP) framework that emphasizing MSMEs and towards achieving target of SFDRR along with economic advancement as stated in National Entrepreneurship Policy (NEP) 2030 and the Shared Prosperity Vision (SPV) 2030?

1.4 Research Goals

The main purpose of this research is to examine the potential of disaster derived BCP framework in monitoring, assessing, and visualize the impact of disasters focusing on local MSMEs. Inputs from the local-context case studies, and businesses types about BCP should contribute significant values in exposing MSMEs to increase their knowledge on proper context of business documentation and management. Other than that, by applying the practicality of geospatial technologies on site which help them in preparing and maintaining their business operation from disaster event. Results from the assessment of key drivers from environment (disaster-prone areas), economy (businesses), and society (local MSMEs) shall be incorporated in formulating comprehensive framework for MSMEs towards contributing to build resilience

MSMEs in Malaysia, in line with local economy policies developed such as NEP 2030 and SPV 2030.

1.4.1 Research Objectives

The specific research objectives are as follows: -

1. To identify the state of MSME resilience capitals comprises the economic, social and environmental components.

2. To improve Business Impact Analysis (BIA) component in DBCP framework using GIS analyses (Geo-BIA) supported by local- and expert knowledge.

3. To develop a comprehensive conceptual DBCP framework emphasizing MSME's in multi-hazard areas.

1.5 Research Scope

This research is based on a thorough review of existing literature on the notion of BCP for impacted local MSMEs. Based on the literatures, the researcher was able to critically examine the indicators to determine if the disaster-derived BCP (DBCP) framework will be flexible enough to be used for all sorts of hazards or whether it will be necessary to adjust parameters in the operational framework of Geo-BIA designated for different kind of businesses in each case study areas. Since this study focuses on three case study areas in Sabah's West Coast, each emphasizing a distinct type of risk and different kind of businesses, it's an intriguing result for the development of the DBCP framework. The result from capitals relationship of economic, social, and environment will be supported by inputs from questionnaire distribution among local MSMEs, as well as several interview sessions with local authorities such as civil defense Malaysia (APM) and local disaster champions. All of these indicators will be

incorporated into the Geo-BIA operational framework and DBCP framework development.

Data collection in this research is based on the list of selection criteria that evolves around three important capitals; society (MSMEs), economic (local businesses type) and environment (disaster-prone areas). This is to complement the selected case studies and to achieve the objectives. There are some limitations, such as the Movement Control Order (MCO) issued by the local government to curb the spreading of Coronavirus (COVID-19) pandemic outbreak. To ensure the research reliability, the selection of local and international expert was being chose to be involved in order to validate the conceptual framework. Quantitative data were obtained through the geospatial tool (GIS) used to develop geospatial assessment and analysis through GIS Network Analysis. Data output is in the numbers of historical disaster event, distance for shortest or alternative path analysis, and the buffering zones for closest facilities can be reached within certain amount of time. The base map or existing data for GIS analysis were digitized as a mock-up data in this operational framework of Geo-BIA. This is due to the limitation in obtaining the data from perspective disaster agencies and data constraint in term of validation for historical disaster events. Qualitative data were collected using a questionnaire and guided interview of affected local businesses. The questionnaire requested the information on respondent's perceptions of local disaster experiences and knowledge on DRR program and activities, and profile of study areas. Guided interview from the local experts will be used as a backup to the outcomes of questionnaires. Data will be processed accordingly and the determination of metrics from different MSME types different type of hazards were interpolated into the flexibility in designing DBCP framework.

The validation process for DBCP framework assessed via online platform (by emails, zoom meeting) with group of experts as well as local informant in the disaster management and BCP. This is due to the restriction to travel within Malaysia states to halt the spreading of COVID-19. With the increasing numbers in the third wave of the pandemic, it is difficult to reach them face-to-face. The inputs, feedbacks, comments and agreement from experts during the validation process including on the Geo-BIA and DBCP conceptual framework. It is important to get the consensus from the experts

for the purposed of confirmation and to make sure that the framework could be improved for future research direction. Moreover, this framework should be easy to understand, user-friendly in term of Geo-BIA practicality thus can be followed well among the local MSMEs and any associated stakeholders. The scope of study is simplified in Table 1.1.

Table 1.1 Scope of Research.

Item	Research Problems	Research Questions	Research Objectives	Methods
1	Lack of awareness on the importance of BCP among MSMEs	RQ1: 1. What are the economic, social, and environmental capitals for MSME resilience in the study areas? RQ2: How to measure the readiness of MSME to accept the disaster derived BCP framework and their acceptance level to learn the importance of MSME focused BCP?	RO1: To identify the state of MSME resilience capitals comprises the economic, social and environmental components.	Data Collection: Literature Review Questionnaires Interview session Data Analysis: Content Analysis Descriptive Analysis Qualitative results
2	Missing a critical role of geospatial technologies in assisting MSMEs for disaster driven BCP	RQ3: How MSMEs can took place in practices of geospatial technologies as their new knowledge to development of geospatial led-BIA (Geo-BIA)? RQ4: Which elements in BIA that can be improve for better practicalities to MSMEs in understanding future risk?	RO2: To improve Business Impact Analysis (BIA) component in DBCP using GIS analyses (Geo-BIA) supported by local- and expert knowledge	Data Collection: Fieldwork Questionnaires Guided Interviews Photograph captured Historical data on disaster event Data Analysis: GIS software (ArcGIS 10.3) with GIS Network Analyst extension QGIS
3.	Absent of comprehensive conceptual framework for disaster driven DBCP in Malaysia	RQ5 : How to formulate the disaster derived BCP (DBCP) framework that emphasizing MSMEs and towards achieving target of SFDRR along with economic advancement as stated in National Entrepreneurship Policy (NEP) 2030 and the Shared Prosperity Vision (SPV) 2030?	RO3: To develop a comprehensive conceptual framework for DBCP emphasizing MSME's in multi-hazard areas.	Data Collection: Guided interview involving MSMEs, local stakeholders and experts Data Analysis: Index Analysis Content analysis and validation of framework

1.5.1 Limitation of Research

There are few difficulties alongside the research journey. The difficulties to obtain the cooperation from respondents during data collection on site were the main limitation. This is due to the time constraints for respondents to participate and contributes in guided interview session and in answering questionnaires, they need a local guider as interpreters because they had problems in understanding the questions, due to the native speaking in their local slang. That is why this study assigned the enumerator team among local researcher based in UMS to help researcher with the data collection process. Most of the respondents were the affected MSMEs due to the disaster event, some of them is the key players in helping to boost up the local economy in affected areas. Other than that, the first challenge is on how to reach out for the affected MSMEs during the initial site visit session. This is because they were located within rural areas, and for one of the study areas (Kota Kinabalu), the time constraint were the biggest obstructions during distribution of questionnaires and semi-structured interviews with the MSMEs due to the location and sparse local MSMEs.

Few interviews with the affected MSMEs shows that they were naturally adapting with the disaster events, and able to survive the loss of jobs due to disasters by doing another field of work scope. They also cut the budget of their businesses by fired some of their employees. These kind of limitation has come to some extent, hampered the data collection process. With the spreading of COVID-19 pandemic for almost two years also affecting the face-to-face data acquisition and fieldwork series could not be done. This is due to the travel restrictions between states in Malaysia and towards the end of the data collection procedures. This also caused some postponement of meeting with the experts for validation process, which dragging the duration of data processing and data collection longer. Other than that, the data processing using geospatial tools needed some time, because all the data inputs need to be done from the scratch. The base map need to be digitized using the Open Street Map (OSM), and the databases need to be constructed with the historical disaster event data collected based on series of literatures. The selection of elements within the GIS Network Analyst extension in ArcGIS software is also decided based on the disaster scenarios

in affected areas. There is constraint in validation of data processing thus Geo-BIA were designed based on mock-up data.

1.6 Significant of Research

The main goal of this research is to develop a comprehensive conceptual DBCP framework emphasizing on MSMEs in Malaysia. This framework works as novelty method for MSMEs focused BCP in Malaysia because it is already being implemented in international level but missing local action among MSME, especially in developing countries (UNDRR, 2021b). Geo-operational BIA's framework (Geo-BIA), which is a new connection for geospatial technology practicality for Malaysian MSMEs also a new novelty in this research where embedding the geospatial technologies into BIA phase within BCPs. The following are the predicted outcomes of the study:

1. The relationship of MSME resilience capitals in formulating flexible DBCP framework, which are the environment (disaster-prone areas), the society (local MSMEs) and the economy (various kind of businesses). These main capitals shall work as the important elements in constructing the DBCP framework focusing on MSMEs, and for better suit in context of Malaysia BCP activities.

2. Identification of appropriate geospatial approach for analysis to be employed in the development of the Geo-BIA operational framework. Because the deliverables resulting from catastrophe scenarios in three case study areas are fresh and distinct, the selected analysis must represent the locality (in term of disaster event), suit different kind of MSME business types, and support the impacted MSMEs.

3. Establishment of operational Geo-BIA and conceptual DBCP framework for MSMEs, directly address the national agenda for DRR activities through the relationship of data integration among environment, social and economy at the same time. The proposed DBCP framework could be used

for local MSMEs, in order to educate the MSMEs on the importance of BCPs and associated stakeholders.

The research can be seen from three different implications to:

1. **Stakeholders,** this study focusing on MSMEs, it is important to prepare:

    a) Conceptual framework of DBCP, which can be used as a practice or working scheme by MSMEs to increase their knowledge and awareness in preparing, documenting or auditing their BCP.

    b) To identify the major issues that affect MSMEs to hazards; and helping them to establish a BCP and encourage MSMEs in Malaysia to participate in DRR programs and initiatives in Malaysia.

    c) This research also focusing on utilizing geospatial technologies in assisting MSMEs, consequently bringing them to participate on practicalities in preparing BCP documentation. Malaysia is chosen because there is no current framework of DBCP to deal with natural hazards at national level which specifically designed for MSMEs group.

2. **Policy maker's** perspective, the proposed DBCP framework can be used to:

    a) Promote BCP practices among MSMEs through future DRR directive.

    b) Identify issues among MSMEs which need participation from various stakeholders including the local government and private companies.

    c) Explore the perceptions of MSMEs in Malaysia on the DRR programs.

In **academic** perspective, the research will discover a novelty in geospatial approach to be embedded in operational Geo-BIA framework for practicalities. It is

also important to improve the proposed DBCP conceptual framework in future research directions.

1.7 Organization of Thesis

Chapter 1 – This chapter introduces the background of study, the lists of research problems and research questions, and also the research objectives, consecutively.

Chapter 2 - This chapter provides a detail review of disaster management agencies and policies, national platform on DRR, disaster risk management cycle in Malaysia, and two national policies related to the economic development in Malaysia. Next is on the business resiliency. The definition of MSMEs and the relationship of MSMEs with resilience is discussed through. Explanation on BCP is being thorough. In addition, the geospatial technologies in managing risks, the existing studies of best practices of BCP, and the relationship of BCPs and MSMEs.

Chapter 3 - This chapter will elaborate on the research methodology applies in this study to develop a constructive methodology based on previous chapter of literature review. This chapter also described the data collection procedure, method for data analysis, data validity and reliability. Moreover, this chapter also elaborated on site investigation, covering on criteria and profile of study areas.

Chapter 4 – This chapter is more into the achievement of Research Objective 1 (RO1) on identify the state of MSME resilience capitals on economic (businesses), social (local MSMEs), and environment (disaster-prone areas) components. Research Objective 2 (RO2) explained in details on development of operational framework Geo-BIA. The selection of elements in network analysis also being done according to disaster scenarios and the suitability to be embedded in BIA phase within the BCP framework.

Chapter 5 - In this chapter, the main focus is on the development of the DBCP conceptual framework to achieve Research Objective 3 (RO3). The selection of each elements as an input to make sure the order in developing the framework is according to the standard ISO 22301: 2019. Besides, the framework development is according to the Plan, Do, Check, Act (PDCA) cycle that is also followed the ISO. Therefore, with the framework construction and validation from the experts, this chapter covered all about DBCP conceptual framework for MSMEs.

Chapter 6 – This chapter provides the conclusion on the achievement of the research objectives, answering all the research problem and research questions, details on the research contribution and recommendation for future research direction.

Flowchart in Figure 1.3 illustrate the organization of this study.

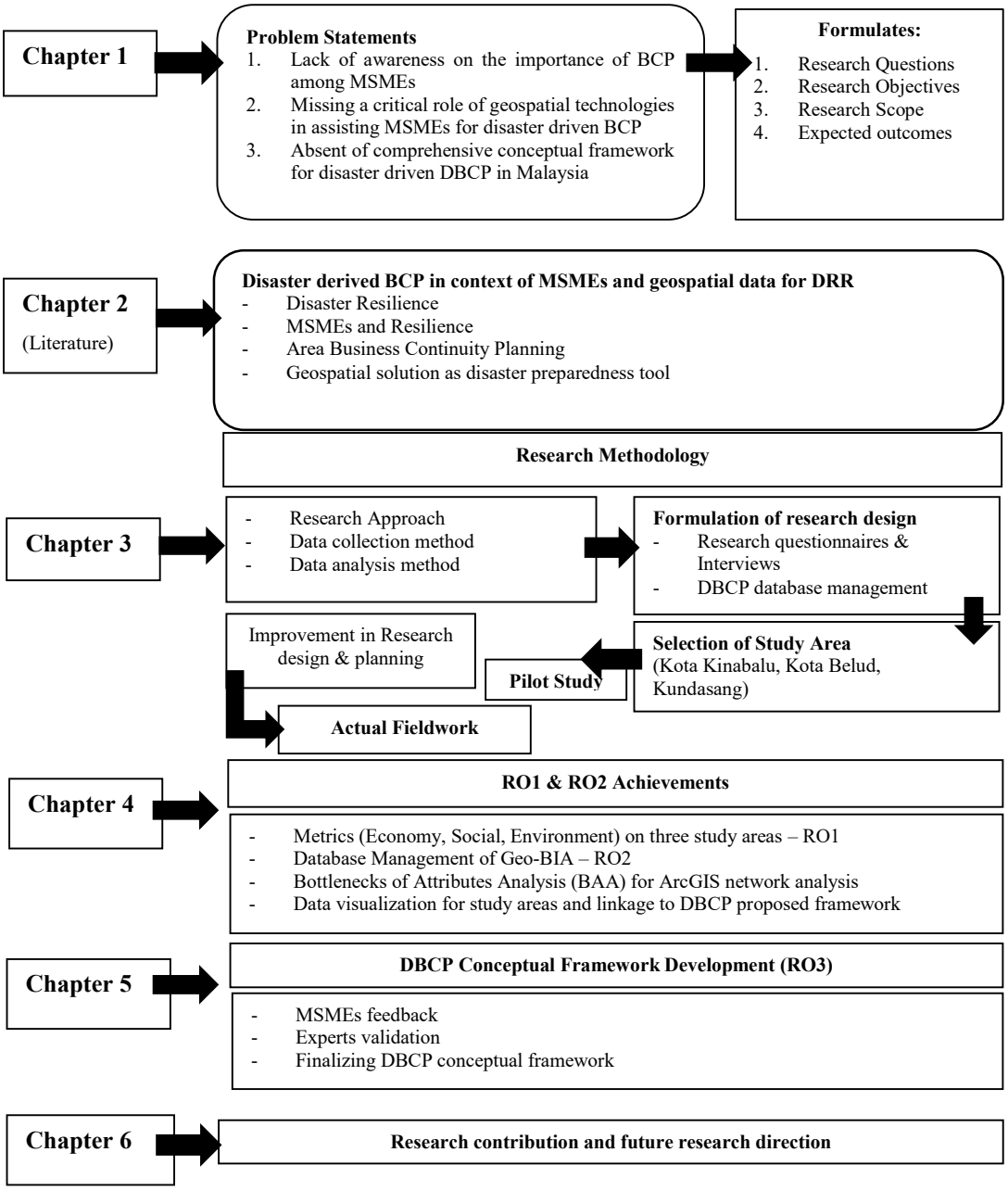

Figure 1.3 Thesis Organization for this study.

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2. **Mohmad Lehan, N. F. A.,** Razak, K. A., & Kamarudin, K. H. (2021). An Operational Framework Model for Geospatial Business Impact Analysis in West Coast of Sabah, Malaysia. *Disaster Advances Journal,* Vol.14 (6), October (2021) **(Q4, IF: 0.330).**

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1. **Mohmad Lehan, N. F. A.,** Razak, K. A., & Kamarudin, K. H. (2020). COVID-19 Pandemic: The New Normal in Business Continuity Plan for Real Estate Firms in Malaysia. International Journal of Real Estate Studies, 14(S2), 138–145.

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2. **Mohmad Lehan, N. F. A.,** Razak, K. A., Kamarudin, K. H., Mohamad, Z**. (2016)**. A Preliminary Study on Disaster Derived Business Continuity Management in Kundasang, Sabah. *7th International Conference and Field Study in Malaysia, 2016*, August 15-17, 2016, Universiti Teknologi Malaysia Johor Bharu. Oral Presentation.

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5. **Mohmad Lehan, N. F. A.,** Razak, K. A., Ramli, Z., and Kamarudin, K. H. (2020). An Operational Framework Model for Disaster Based Business Continuity Planning in the West Coast of Sabah, IOP Conference Series: Materials Science and Engineering.