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DISASTER RESILIENCE SCORECARD FOR OFFICE BUILDING IN MALAYSIA TOWARDS REDUCING FLOOD RISKS

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Abstract

This study is aimed to provide an approach for measuring the resilience of office buildings against flood in Malaysia. Three states were chosen namely Kelantan, Pahang, and Johor as they had been badly affected by the major flood in 2014. From the three states, nine worst-hit districts had been identified, which are Kota Bharu, Pasir Mas, Kuala Krai in Kelantan, Kuantan, Temerloh, and Pekan in Pahang, along with Batu Pahat, Kota Tinggi, and Mersing in Johor. The Disaster Resilience Scorecard for Industrial and Commercial Building is adapted to construct the scorecard. The essential elements were examined with regards to the office buildings within the scope of flood in Malaysia. This study used Survey questionnaire as a method in constructing the scorecard which was distributed among the managers or person in charge of the office buildings management within the study areas. The results from the survey questionnaire reflected the significance of every component in the essentials, thus relevant to be included in the final scorecard.

Keywords: flood; office building resilience; Disaster Resilience Scorecard for Office Building

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INTRODUCTION

2021 has witnessed a major flood event that hit several states in Malaysia such as Selangor, Pahang, Malacca, and Johor. Department of Statistics of Malaysia had announced the total loss of RM6.1 billion due to this flood event and Selangor had been most badly affected state, with the total loss of up to RM3.1 billion, followed by Pahang (RM593.2 million), Malacca (RM85.2 million), Negeri Sembilan (RM77.1 million) and Johor (RM50.1 million). The losses include living quarters, vehicles, business premises, manufacturing, and agriculture sector as well as public assets and infrastructure. Among those public assets were the office buildings that were hit by the massive flood. The phenomenon of massive rainfalls (Abdul Halim et al., 2015) and succeeded flooding did not only make rise of climate change issues and it impacts on the environment, but also raise more local issues on the effects towards ecological, residential property development and price, and the capability of the owners to secure finance and insurance for their properties. Meanwhile, other relevant indicators of flood asperities are the inundated houses, injuries, death of a relative, the degree of damage, along with direct, indirect, tangible, and intangible losses (Alderman et al., 2012).

Malaysia is very vulnerable to flood, particularly during the Northeast Monsoon which frequently affected the states on the East Coast of Peninsular Malaysia such as Kelantan, Pahang, and Johor. Floods have been categorised into three types such as river flooding, flash flooding and coastal flooding (Shafapour Tehrany et al., 2017). In monsoon season, majority of the districts in those states will experience flood, but the degree of the flood varied, subjected to the number of rains received, and other factors such as climate change and global warming. Global warming has caused the over the last century has led to the occurrence of heat extreme which happened once every 1,000 days in the past, to four to five times more often in the recent years (Fischer and Knutti, 2015). Extreme weather seems to be increased and at the same time, affected the water availability, thus influencing the abundance of water. The frequency of flooding in Peninsular Malaysia and the damage caused can be significantly related to the property damage and service disruption. Properties that have been physically destroyed, as stated by Jonkman et al. (2008) will need higher cost of repairing and maintenance to operate which could directly affect the value of the properties. Apart from that, flood could cause disruptions to the amenities and facilities to accommodate the community, mainly the road transport infrastructures (Pregnolato, et al, 2017).

To date, most of the studies on the resilience were focused on residential and community, such the study on the Flood Hazard information map using GIS for residential community resilience (Zulkarnain et al., 2019) and Yusmah et al. (2020) with their study on understanding urban flood vulnerability and resilience.

Hence, this calls for a study to be conducted on the office buildings that have been affected by the flood as they possessed the same risks and losses as the residentials buildings. Additionally, office buildings need to be resilient as they served as places for storing private and confidential documents, and operating the public works, as well as administrating tasks.

LITERATURE REVIEW

The World Risk Index Study published in 2016 put Malaysia in 86th place out of 171 countries which has the highest risk of natural disaster including storms, flood, drought, earthquake, and sea level rise in which the index comprised four elements which are exposure (to natural disasters), susceptibility, coping capacities, and adaptive capacities (Garschagen et al., 2016). Guha-Sapir et al. (2016) stated that floods had brought severe impacts regarding damages with the economic losses related to discrete incidents was ranging from 11 to 600 million US Dollar whilst the total number of affected individuals which required instant relief during emergency period had extend hundreds of thousands. Flood incidents will fundamentally bring detrimental effects on the value of the property (Aliyu et al. 2016), as the flood can damage the buildings and destroy the surroundings (Osti & Nakasu 2016).

According to Arbon (2014), 'resilience is a process of ongoing commitment which develops readiness preceding to a catastrophe which provides positive recovery later'. Djalante et al. (2013) had observed the manner of resilience thinking that managed to change the traditional paradigm of disaster risk reduction towards more integrated and multi-disciplinary, incorporated natural and social sciences with humanities, which permitting it to go beyond response and recovery to preparedness and prevention. There are in depth relative and absolute risk assessment methods available (Ettouney & Alampalli, 2012) apart from the probabilistic or deterministic risk assessment methods (Fenton and Neil 2013). It is possible to use any or all these methods for resilience assessment. Since resilience is based on the 4Rs, according to the American Institute of Architect (2016), the parameters of each of the 4Rs in each asset need to be determined, and the desired methodology (which can be borrowed from any desired risk methodology) must be followed. After that, computing an objective or subjective resilience rating can be achieved in a simple and accurate manner.

Before going deeper into the building resilience, it is best to look at the definition of office building first. As defined by NAPIC, office building or Purpose-Built Office (PBO) is a building in which 75% of the rentable unit is used for office purposes. The net lettable floor area is measured to match the Uniform Method of Measurement of Buildings from the Royal Institution of Surveyors Malaysia (RISM). An office is usually known to be the place where the clerical work is conducted and abundant types of written documents such a

letters, correspondences, files, and record were managed and handled (Chopra D & Gauri, 2015). It is regarded as the place where all various kinds of clerical tasks took place in organising and administrating the organisation's whole matters.

In 2012, a balanced Scorecard for communities specifically designed to evaluate their disaster resilience by utilising an all-hazards strategy was developed by the Torrens Resilience Institute (TRI). The Scorecard evaluates four components of community resilience which are connectedness, risk and vulnerability, procedures that support disaster planning, response, and recovery (PRR), and it resources. Recently, different organisations have constructed frameworks for disaster resilience (Arbon *et al.* 2014), and the detailed discussion on those measures had been reported in a review by the United Nations Development Programme (Winderl 2014). In 2012, the TRI developed the Community Disaster Resilience Scorecard and Toolkit: a balanced tool for communities to assess their disaster resilience using a participatory methodology with facilitated by the local communities (Arbon *et al.* 2012).

For the purpose of this study, the Disaster Resilience Scorecard for Industrial and Commercial Building (building Scorecard) which adapted the Disaster Risk Reduction strategies from the United Nations Office for Disaster Risk Reduction (UNDRR)'s. This scorecard can be used by the owners, managers and operators of office buildings and campuses in Malaysia, from the government and private sectors. The Scorecard provides a set of assessments that allow local governments to assess their disaster resilience, structuring around UNDRR's Ten Essentials for Making Cities Resilient. It also aids in monitoring and reviewing progress and challenges towards implementing the Sendai Framework for Disaster Risk Reduction: 2015-2030 and contributes basic analysis for planning the disaster risk reduction and resilience strategies. It provides the prospective for scoring at the preliminary and detailed assessment levels.

METHODOLOGY

1. The survey questionnaire was developed by adopting the appropriate essentials in the Disaster Resilience Scorecard for Industrial and Commercial Building (building Scorecard) by the UN ARISE. Likert Scale was used, ranging from not important at all to most important to measure the importance of each component in the essentials
2. The Cronbach's Alpha test was conducted to validate the questionnaire
3. The questionnaire was distributed to the building managers or the person in charge of the building management through Google Form as the survey was taken place during the Movement Control Order (MCO) period in Malaysia

4. The responds collected were analysed using the descriptive analysis method by determining the percentage of each component in the essentials
5. Disaster resilience scorecard for office building was constructed based on the importance level of the essentials from the questionnaire.

RESULTS AND FINDINGS

1. Section A- Background of the building

Section A consists of a survey questionnaire that have been distributed to the respondents in the states involved in this study. In the first part of the questionnaire, the questions were related to the background of the buildings in the research areas. From the results, majority of the building aged 10 – 20 years, followed by more than 20 years. Throughout the 20 years, some of the buildings were badly damaged during the major flood that hit the east coast of peninsular Malaysia in 2014. Most of the office building are 2 – 3 storeys high. Hence, the building did not really affect by the flood. Majority of the building in this study were located near the river. Thus, they are more likely to be affected by flood during monsoon season.

Majority of the office buildings carried out all the related work of office which made them eligible for this study and majority of the building are managed by the government. Majority of the office buildings had been hit by flood less than once a year, while only 8% of the building were flooded more than once a year. This indicated that all the buildings were affected by flood, but the degree of the damage varied according to the location of the building. Some of the buildings were badly affected by major flood while some of them only suffers minor damage. The results are as follows:

Table 1: Summary of building background

Component	**Percentage**		
Age of building	**Less than 10 years**	**10 – 20 years old**	**More than 20 years old**
	25%	45%	30%
Height of building	**Single storey**	**2 – 3 storeys**	**More than 3 storeys**
	18%	54%	28%
Frequency of flood	**Less than once a year**	**Once a year**	**More than once a year**
	74%	18%	8%

Component	Percentage	Component
Management of the building	**Government**	**Private**
	53%	47%

2. Section B – Questions Related to Disaster Resilience Scorecard for Office Building

There are seven essentials related to the management of the office building in the survey questionnaire. A total of 80 buildings have undertaken the survey and the results to according each essential is presented in the form of percentage to determine the importance of every component in the essentials towards enhancing the resilience of the office building. The results are presented in the tables below:

1. Essential 1 - Developing and Maintaining the Office Building Resilience in General

Overall, all the five components of the essential were agreed by the respondents to be important aspects in developing and maintaining the office building resilience in general. It also had been reflected in the current practice of the office building management in which all the essentials were adopted in the management of the buildings. Thus, this essential is suitable to be used in developing the disaster resilience scorecard for office building in Malaysian context.

Table 2: The Percentage Level of Importance According to the Components in Essential 1

Components	Level of Importance (%)			
	Less Important	**Slightly Important**	**Important**	**Very Important**
Have the plans to develop the resilience of the building towards disaster whether independently or with the involvement of other agencies	3.3	3.3	37	57
Coordination of the building owner/manager in any disaster management programmes	3.3	5	35	57
Establishing resilient plan by appointing individual/group to coordinate the resilient response & recovery plan with the stakeholder	3.3	6.7	45	45
Coordinating resilient plan and changing relevant information with the stakeholders	3.3	3.3	48	45
Building manager is responsible to report the hazardous materials inside the building and its surrounding	3.3	3.3	38	55

2. Essential 2 - Identifying, Understanding, and Utilizing the Current and Future Risk Scenarios.

Majority of the respondents agreed that all the components in this essential are important in identifying, understanding, and utilizing the current and future risk scenarios. It showed that the essential and all the components inside it are significant in developing the disaster resilience scorecard for office building in Malaysian context.

Table 3: The Percentage Level of Importance According to the Components in Essential 2

Components	Level of Importance (%)				
	Not Important at All	**Not Important**	**Less Important**	**Important**	**Very Important**
Building manager has the access towards worst case scenario and average case scenario from reliable sources	1.7	1.7	8.3	46.7	41.7
The threat and risks analysis have considered the combined and multi hazard risks	1.7	3.3	3.3	46.7	45.0
Aware of the threat level towards the building based on pluvial or riverine flood	1.7	3.3	5.0	35.0	55.0
Aware of the possibilities for the disruption of main power supply caused by flood	1.7	3.3	5.0	35.0	55.0
Aware of the possibilities for the disruption that can affect transportation route caused by flood	1.7	1.7	5.0	36.7	55.0
Aware of the possibilities for the disruption that can affect the telephone line/communication/internet	1.7	3.3	5.0	35.0	55.0

3. Essential 3 - Enhancing Financial Capability for Resilience

There are six components in essential 3 towards enhancing the financial capability for resilience. Majority of the respondents considered all the

components in this essential are important in enhancing the financial capabilities for resilience. Majority of the buildings have practiced the components of this essential in their management, thus emphasizing the importance of this essential in developing the disaster resilience scorecard for office building in Malaysia.

Table 4: The Percentage Level of Importance According to the Components in Essential 3

Components	Level of Importance (%)					
	Not Important at all	**Not Important**	**Less Important**	**Slightly Important**	**Important**	**Very Important**
Building managers truly understand the cost to be borne if flood occurs	-	1.7	-	6.7	40.0	51.7
Having a clear financial plan required during the phase of restoring/rehabilitation after the flood	-	3.3	-	1.7	41.7	53.3
Having all sources of funding that can be used to improve the resilience of the building and planning to acquire them	1.7	1.7	3.3	5.0	53.3	35.0
The critical aspects of building maintenance were covered and allocated in the budget of the operational and maintenance costs	-	1.7	-	3.3	40.0	55.0
This building has insurance coverage for repairing and continuity cost of the organisation	-	3.3	-	6.7	35.0	55.0
Possessing the unexpected fund for the requirement of cash flow & advance payment during the loss adjustment process while waiting for the insurance claim	-	3.3	-	6.7	35.0	55.0

4. Essential 4 - Pursuing the Development of Resilient City to Achieve or Exceed the Resilience Requirements

Essential 4 consists of 5 components in pursuing the development of resilience city to achieve or exceed the resilience requirements. From the result of the survey, majority of the respondents agreed that all the components in this essential are important in achieving the resilience requirements. Conversely, the city and the local community's recovery from a disaster may depend on how effectively the ownership and management of commercial and industrial buildings in its area prepare for and respond to the disaster, and how well they cooperate with the city and each other. As majority of the respondents agreed with all the components in this essential, it will be included in the final scorecard as well.

Table 5: The Percentage Level of Importance According to the Components in Essential 4

Components	Level of Importance (%)			
	Less Important	Slightly Important	Important	Very Important
This building complies to the latest standard codes of building that can be applied to the disaster risks	1.7	3.3	43.3	51.7
This building complies to the local code regulation for the disabled (OKU) towards ensuring the safety of all building users	3.3	5	38.3	53.3
This building participated or registered with any programmes that promote the standard codes for disaster resilient building	1.7	10.0	40.0	48.3
Building manager is involved in the development of resilient building with related agencies	1.7	5.0	41.7	51.7
Building manager has the knowledge on the importance of complying with the codes & standard codes for resilient building	1.7	6.7	36.7	55.0

5. Essential 5 - Empowering Institution's Capacity for Resilience

Majority of the respondents agreed that all the six components in this essential are important in empowering the institution's capacity for resilience. It has been reflected in the current practice of the office buildings studied in this research, thus emphasising the importance of including this essential in the final scorecard.

Table 6: The Percentage Level of Importance According to the Components in Essential 5

Components	Level of Importance (%)				
	Not Important at All	**Less Important**	**Slightly Important**	**Important**	**Very Important**
Building manager has the skills and training to apply the risk scenario plans of the building	1.7	-	6.7	50.0	47.0
Updated building management & operational commission, and the staff were given trainings on disaster risk management	1.7	-	8.3	41.7	48.3
All critical documents/guidelines/procedures & risk plans related to the building, materials, and usage were stored in a safe and easy to access area	1.7	1.7	3.3	46.7	46.7
Building manager collected and analysed the data regularly to inform and update the disaster risk management plans	1.7	1.7	8.3	48.3	40.0
The disaster risk management plans which involved all parties were studied together with the internal stakeholder	1.7	1.7	5.0	45.0	46.7
Ensuring that knowledge transfer can take place in case of management exchange to sustain the resilient plans of the building	1.7	-	3.3	58.3	36.7
Integrating the resilience approaches including the daily operational plans & preventions	1.7	-	3.3	46.7	48.3
Every staff needs to be aware of the possible hazards in the building, be prepared to face the risks, & know how to recover from the threats	1.7	-	3.3	55.0	40.0

6. Essential 6 - Enhancing Infrastructures' Resilience

Essential 6 comprises six components in enhancing the resilience of the infrastructure of the building. Majority of the respondents considered that all the components in this essential are important to enhance the infrastructures'

resilience of the buildings. Most of the building managers are aware of all the components in this essential and included them in their current practices of the building management. Thus, indicated that this essential and its components is significant to be included in the building office resilient scorecard for Malaysia.

Table 7: The Percentage Level of Importance According to the Components in Essential 6

Components	Level of Importance (%)			
	Not Important al All	**Slightly Important**	**Important**	**Very Important**
Building managers have the reference, skills, and trainings to cooperate with the architect & contractor to adopt the resilience consideration towards building design, construction, & retrofits	-	10.0	43.3	46.7
This building has the storm-water management to reduce the damage of flood	1.7	10.0	45.0	43.3
This building has the resilience towards coastal & riverine flood	3.3	10.0	41.7	45.0
This building is designed to put up with the extreme wind conditions	3.3	10.0	36.7	50.0
This building has extra power supply and/or reserved power supply	1.7	11.7	36.7	50.0
There is emergency assistance, response equipment, transport, and related infrastructure that can be used during disaster and placed in strategic locations	1.7	8.3	38.3	51.7

7. Essential 7 - Ensuring Effective Response Towards Disaster

The last essential in the Disaster Resilience Scorecard for Office Building is essential 7 which related with ensuring the effective response towards disaster. There were eight components in this essentials, and majority of the respondents agreed that all the components are important to ensure the effective response towards disaster. This is one of the crucial elements in disaster management as the response during disaster could affect the lives and properties is not taken care effectively. Majority of the office building have adopted all the components in the essentials and are aware of the importance of those components, especially in responding to the disaster, thus emphasizing the importance of including this essential in the final scorecard.

Table 8: The Percentage Level of Importance According to the Components in Essential 7

Components	Level of Importance (%)			
	Not Important at All	**Slightly Important**	**Important**	**Very Important**
Building manager has detailed plans to face disaster – process, procedure, responsibilities, equipment, communication channel, etc.	1.7	6.7	46.7	45
Building manager received data & guidance needed from the related agencies to face disaster threats/risks and able to react during emergency & develop the emergency operational plans of the building	1.7	13.3	46.7	38.3
Building manager and related agencies have the mutual control through plans, equipment, process, and communication	1.7	3.3	53.3	41.7
Safety and emergency equipment are sufficient and complete	-	5.0	53.3	41.7
Building manager and staff can assist the first responder	1.7	8.3	48.3	41.7
Warning system (Alarms, PA system, etc) exist, functioning, and able to spread to all parts of the building	1.7	3.3	40.0	55.0
Building manager practised disaster drills regularly	-	5.0	50.0	45.0
Existing emergency communication methods can last during & after disaster to ensure communication among related parties	-	3.3	53.3	43.3

From the results, all the essentials and their components have been agreed by the respondents as significant to be included in the final scorecard for disaster resilience scorecard for office building in Malaysia.

DISCUSSION

Based on the results from the survey questionnaire, the analysis can be summarized as follows:

Table 9: Summary of Survey Questionnaire Analysis

Essential	Level of importance
Developing and Maintaining the Office Building Resilience in General	>70%
Identifying, Understanding, and utilizing the current and future risk scenarios	>70%
Enhancing Financial Capability for Resilience	>70%
Pursuing the Development of Resilient City to Achieve or Exceed the Resilience Requirements	>70%
Empowering Institution's Capacity for Resilience	>70%
Enhancing Infrastructures' Resilience	>70%
Ensuring Effective Response Towards Disaster	>70%

All the essentials and components suggested in the questionnaire are significant in developing the resilience of the office buildings. It had been agreed by more than 70% of the respondents, thus will be included in the final scorecard. The score from the scorecard can be used to evaluate the status of the building management according to the score in each component within the essentials. The measurement can be interpreted as percentage of involvement among managers and staff of the building in the components stated in the Scorecard or how far have the components have been adopted in the management of the building towards reducing the current and future risks of flood. Each score represent indication of 1 means zero preparation and 5 means perfection. The indicative measurements scale can be classified as follows:

- 5 – Single point of coordination exists with agreed roles and responsibilities
- 4 – Single point exists but with some minor exceptions
- 3 – Single points exists in principle, but with some major omissions, or lack of agreement on some major areas
- 2 – Initial steps taken to create a single point of coordination
- 1 – No single point but plans exist to create one

All the scores will be added up and the total scores will be determined. The measurement of the scorecard can be summarised as the table below:

Table 10: The indication of the score from the disaster resilience scorecard

	Red Zone	**Caution Zone**	**Going Well Zone**
Overall score	**25% (55-56)**	**26-75% (57-167)**	**76-100% (168-220)**
Building resilience	25% (6-7)	26-75% (7-18)	76-100% (19-25)
Current & future risks	25% (7-8)	26-75% (8-22)	76-100% (23-30)
Financial Capacity	25% (7-8)	26-75% (8-22)	76-100% (23-30)
Resilient city	25% (6-7)	26-75% (7-18)	76-100% (19-25)
Empowering institutional capacity	25% (9-10)	26–75% (11-30)	76-100% (31 -40)
Enhancing building resilience	25% (7-8)	26-75% (8-22)	76-100% (23-30)
Effective response	25% (10-11)	26–75% (11-30)	76-100% (31 -40)

Each section is scored at the bottom, and when all parts are done, the points will be added up from each element. Hence, the total score for this is scorecard is 220. The percentage will be determined from the total score and to get through into each element, individual score for the essentials will also be identified. From the individual score for each element, the researchers will be able to point out which essentials that needed the most attention. From there, the appropriate mitigation approaches can be suggested to improve the elements in the essentials in order to enhance the resilience of the office building.

If the overall score is the number 99 or higher, the building is likely to be extremely resilient to any disasters, but if the overall score is below the number 33, the building is much more likely to suffer greatly in a disaster or have great difficulty recovering. If the individual scores in one area tend to be much lower than in the other three, that aspect of resilience should probably be the highest priority for mitigation approach. All scores can be very useful in highlighting those aspects of resilience that needed the most attention from building owners, operators, members, leaders, and decision-makers.

From this scorecard, the current condition of the building can be assessed, and each element will be considered and the essentials with the lowest score, which indicated that they were under the worst conditions can be given more attention to. Thus, this will help the building operators and other related stakeholders to construct the appropriate mitigation approaches according to the

specific needs of the building to reduce the future risks of disaster, such as flood based on the score given in the scorecard.

CONCLUSIONS

The objective of this study is to develop a Disaster Resilience Scorecard for Office Building. This scorecard will be used to assess the current state of the office building in the areas that have been affected by flood and from the result of the scorecard, the appropriate mitigation approaches can be taken by the building management to reduce the risk of flood.

All in all, the survey questionnaire has reflected the importance of all the components in the proposed essentials towards developing The Disaster Resilience Scorecard for Office Building in Malaysia to assess the current state of the office buildings and the level of awareness in managing the building towards reducing disaster risks, specifically for flood. This scorecard will help the building managers and operators to evaluate the current state of their buildings and constructing the mitigation methods that can be adopted in facing the disaster of flood in future.

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