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## **FLOOD VULNERABILITY AND ADAPTATION ASSESSMENT IN PADANG TERAP DISTRICT, KEDAH, MALAYSIA**

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### **Abstract**

Padang Terap, Kedah in Malaysia experienced frequent floods, incurring financial losses to the flood victims and the government for flood mitigation. For an effective mitigation strategy, there is a need for a reliable database on the vulnerability and adaptation levels of flood victims. Therefore, this study is important to provide the data. The objectives of this paper are to analyse the factors that cause flood vulnerability and to determine and assess the existing adaptation to flood in Padang Terap. The research utilised a quantitative approach, through a household survey of 680 respondents. The data were analysed using descriptive and crosstabulation tests. The findings show that topography, distance between houses and rivers, and flood relief centres affect the vulnerability of the flood victims. The vulnerability to flood is higher than the adaptation level, implying that the Padang Terap flood victims are still not adapting to flood and prone to losses incurred related to flood.

**Keywords:** Flood, Vulnerability and Adaptation, Padang Terap, Disaster Risk Management

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## **INTRODUCTION**

The world is currently facing a very significant and alarming climate change phenomenon. Climate change has direct and indirect effects, primarily on humans and ecosystems, including changes to the world's climate (Fita & Abate, 2022; Liu et al., 2017; NRE, 2009). Climate change has negative implications that cannot be avoided, such as typhoons, droughts, rising sea levels, and floods. Looking at the effect of this phenomenon, mitigation actions and adaptation measures are necessary to reduce the adverse effects of climate change (Elhazek et al., 2023; Rusnani, 2010).

In Asia, for example, climate change is causing more floods to occur. Countries such as Thailand, India, Bangladesh, Pakistan, and mainland China face severe flood threats (Ghomian & Yousefian, 2017; Bradshaw et al., 2007). The year 2022 saw the worst floods ever hit Pakistan, killing over 1,700 people and affecting over 33 million more. More than 4 million hectares of crops were damaged and flooded, resulting in 14.6 million people facing a food and agricultural crisis. More than 15.4 million people in Pakistan were expected to be below the poverty line due to the floods. The flood had also caused more than US\$40 billion worth of damage, as estimated by the World Bank (Haq et al., 2022; World Bank, 2022).

Similarly, Thailand experienced the worst flood disaster from August to October 2011. In that terrible event, 283 people were killed, 8.2 million people from 60 areas were affected, and about 6 million acres of land were submerged, of which 1.17 million hectares were rice fields. Rice was destroyed and could not be harvested (Mushonga & Mishi, 2022; Palamanit et al., 2019; McCombs, 2011). Another damage caused by floods in Thailand was the damage to electronic factories such as Honda Automobile Thailand, Mitsubishi Motors, Nikon and Canon, as well as the destruction of the industrial zone in Saharattanakorn with a loss of more than 30 billion Baht. The total losses from floods in Thailand were estimated to be between US \$1.9 billion to US \$2.6 billion (Mushonga & Mishi, 2022; Rızaoğlu, 2021; McCombs, 2011).

Malaysia also experienced the same fate. Floods are natural disasters caused by climatological factors such as rainfall, evaporation, wind movement conditions, temperature, and the influence of the natural conditions of the earth's surface (Zain et al., 2020; Muhammad Barzani et al., 2006; Balek, 1983). A total of 29,800 square kilometres in Malaysia is vulnerable to flooding (Kuok et al., 2021; JPS, 2010). The loss and damage caused by the flood is enormous. For example, the total losses due to floods in 2006 and 2007 were as much as RM1.1 billion and RM776 million for all states in Malaysia. This loss only involved government assets. The government had to spend RM 1.79 billion in 2001 and RM 5.81 billion in 2006 to reduce the rate of destruction and risk due to floods by building flood mitigation and RM 100 million to the Jabatan Pengairan dan

Saliran (JPS) in 2009 to maintain the rivers throughout the country (Rosedi & Ishak, 2023; Mohamed Thajudeen, 2009; RMK 9; 2006; RMK 8, 2001).

One of the states in Malaysia that often experiences frequent flooding is Kedah, which causes very extreme destruction and losses. The total losses experienced from 2000 to 2010 due to the increasingly frequent floods in Kedah were as much as RM 50,920,207.00. Total losses due to floods in Kedah increased from 2000 to 2010, with the highest total losses in 2010 amounting to RM 17,816,000.00 (Tobi et al., 2023; Zahari et al., 2022; JPS, 2000; 2005; 2006; 2007; 2008; 2009; 2010).

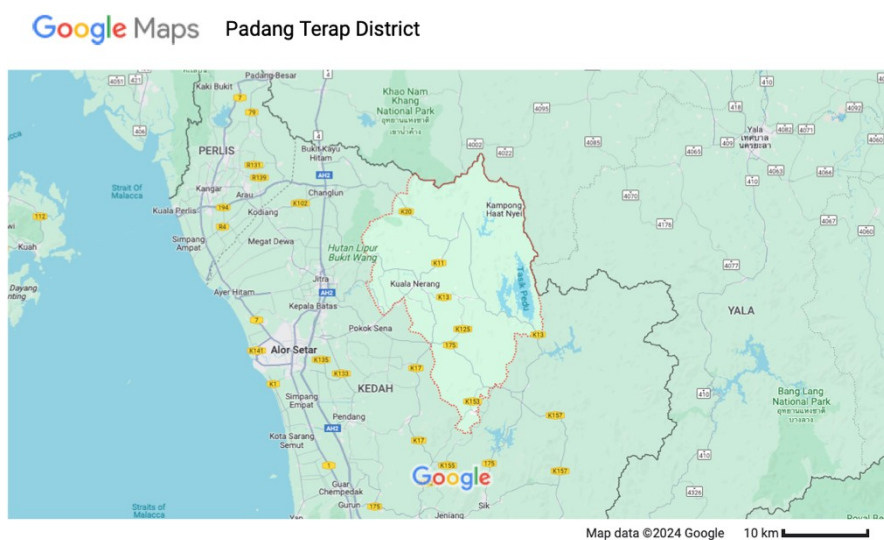
Therefore, identifying an area or community vulnerable to flooding is very important in order to examine the characteristics or conditions of an area prone to flooding. In a more detailed context, the states or factors of a flood-prone community can be determined mainly from the aspect of why they are vulnerable to floods and what adaptations are made to face floods (Abdul Rasam et al., 2023; Omar & Kamarudin, 2023; Noordin et al., 2007). Such research is fundamental and helps to assess the extent of vulnerability experienced by a community and flood-prone areas. It also helps to significantly evaluate whether the adaptation is helpful or not from the risk received due to flooding. Furthermore, it could also help to get an assessment of the vulnerability and adaptation to floods faced by a large area. With that, the weaknesses identified, especially in terms of adaptation to cope with floods, will be able to be improved and, at the same time, will help reduce the vulnerability to floods experienced. Residents, local authorities, and the government must understand the problems related to floods, ways to overcome floods and adapt to floods to be better prepared to face floods, reduce the rate of destruction due to floods, make early preparations for floods, and reduce the level of vulnerability to floods (Omar & Kamarudin, 2023; Sulaiman et al., 2019). If not, when global warming continues and flood disasters become more frequent, severe, and unpredictable, then the magnitude of the floods will increase, making more people and areas to be more vulnerable to the dangers of floods. Destruction and losses experienced by the people will be higher and the financial implications will be worse. This situation will cause the development and economic process of an area and country to be retarded, and the government will have to bear a high financial burden for the repair process.

Therefore, Padang Terap District was chosen for this study because this district is an area that has experienced floods since 1937 until now. Flood incidents in the Padang Terap district have become more frequent from 2000 to 2010. The total losses experienced from 2000 to 2010 for the Padang Terap district were RM 16,615,439.00. The highest total loss in Padang Terap district in 2010 was RM 5,695,000.00 (JPS, 2010).

The losses experienced increase every time there is a flood. Therefore, the amount of aid given to flood victims also increase. For example, monetary assistance of RM 500.00 was given to each family involved in floods throughout

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Malaysia in 2010, amounting to RM 45,076,000.00, of which RM20,405,000.00 was for the state of Kedah (MKN, 2011). This figure shows the high financial implications for the government in dealing with flood disasters. This increase in cost reflects the weak flood adaptation strategy in this area. The people facing the floods are the ones who suffer the most because they are weak and unprepared. Therefore, a flood risk management strategy must change the defenceless flood-prone population to 'stronger' and from less prepared to 'more prepared' to face frequent flood disasters. Therefore, a reasonable approach should focus on adaptation efforts and not just dealing with problems "ad hoc".



**Map 1:** Padang Terap District  
*Source: Google Maps (2024)*



**Photo 1:** Flood in Padang Terap District  
*Source: Authors; FBA Explorer Enterprise (2010)*

Adaptation is the recovery measures taken as a step to adapt to the dangerous effects caused by floods and further reduce the effects of the destruction experienced (Omar & Kamarudin, 2023; Sulaiman et al., 2019; Koshy, 2011; Noordin et al., 2007). As one of the countries heading towards a developed country, Malaysia must have a high and robust adaptation strategy in the face of climate change and global warming that impact flood disasters. Floods are becoming more frequent and have negative financial and physical implications. In addition, knowledge and information about flood-prone areas and residents in an area are also lacking in detail.

## **VULNERABILITY AND ADAPTATION ANALYSIS AND FLOOD RISK ASSESSMENT**

This study was conducted in Padang Terap district, Kedah. Eleven sub-districts or *mukim* in the flood-affected communities were selected for this study. The list of these mukims are Belimbing Kanan, Belimbing Kiri, Padang Terap Kanan, Padang Terap Kiri, Kurung Hitam, Padang Temak, Tekai Kanan, Tekai Kiri, Batang Tunggang Kanan and Batang Tunggang Kiri as well as Pedu.

The approach of this study is a quantitative method using household surveys of flood victims in the Padang Terap district, which involves collecting primary data in the field using a set of structured questionnaires. For this, purposive sampling is used to select a sample from a population based on the purpose of the study more accurately and representative of the characteristics of the actual people being studied, namely flood victims, while reducing errors in the selection of respondents (Zikmund, 2000; Sabitha, 2005).



From 2011 to 2023, the Padang Terap District has experienced persistent flood disaster. These floods primarily affect several sub-districts, including Pedu, Padang Temak, Batang Tunggang Kanan, and Belimbing Kanan. Table 1 provides an overview of the total number of flood victims recorded across the entire Padang Terap District during these years. Notably, the number of flood victims significantly decreased after the 2010 flood. Analyzing data from that year is critical for understanding vulnerability and adaptation to flood disasters in the Padang Terap District, making it a valuable model for further flood-related studies.

**Table 1:** Registered Flood Victims for Padang Terap District, 2011-2023

Year	Total Registered Flood Victims
2011	0
2012	19
2013	0
2014	16
2015	0
2016	0
2017	19
2018	0
2019	0
2020	13
2021	7
2022	23
2023	11

*Source: Jabatan Pengairan dan Saliran (2011); Pejabat Daerah Padang Terap (2012); Pejabat Daerah Padang Terap (2013); Pejabat Daerah Padang Terap (2014); Jabatan Pengairan dan Saliran (2015); Jabatan Pengairan dan Saliran (2016); Pejabat Daerah Padang Terap (2017); Jabatan Pengairan dan Saliran (2018); Jabatan Pengairan dan Saliran (2019); Jabatan Pengairan dan Saliran (2020); Jabatan Pengairan dan Saliran (2021); Jabatan Pengairan dan Saliran (2022); Pejabat Daerah Padang Terap (2024)*

The population for this study is a list of names of flood victims obtained from the JKM of Padang Terap district. Table 2 below shows the sampling for this study. Based on the list, the number of victims registered in the 2010 flood was 1,427 families. The total sample obtained from the study is 680 people: 47.7 per cent of the entire population.

**Table 2: Registered Flood Victims and Number of Respondents**

<b>Mukim (Sub-District)</b>	<b>Total Registered Flood Victims</b>	<b>Total No. of Flood Victims from the Survey</b>
Batang Tunggang Kanan	14	7
Batang Tunggang Kiri	43	19
Belimbing Kanan	514	164
Belimbing Kiri	196	187
Kurung Hitam	201	67
Padang Temak	193	83
Padang Terap Kanan	113	83
Padang Terap Kiri	63	30
Pedu	43	12
Tekai Kiri	24	14
Tekai Kanan	23	14
<b>Total</b>	<b>1427</b>	<b>680</b>

*Source: Jabatan Kebajikan Masyarakat (2010)*

For the analysis of vulnerability and adaptation, the aspect that is emphasised is related to the flood disaster. Disasters that strike bring risks to individuals, communities, and countries (Negera et al., 2022; Ismail et al., 2019; UNDP, 2004). The levels of risk are identified based on natural threats and threats of danger received, as well as the level of vulnerability to a disaster that will strike an area. An example is the level of risk assessed in terms of economics or that involves every element of the economy, such as agriculture and industry, that is destroyed due to a disaster. The relationship between risk, threat, and vulnerability can be written as an equation as follows:

$$\text{RISK} = \text{Threat (Danger)} + \text{Vulnerability}$$

*Source: UNDP (2004); NBSE (2013)*

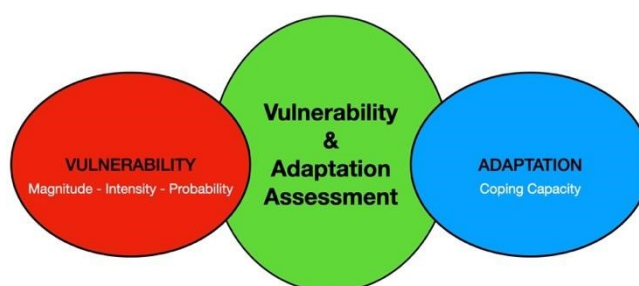
In addition, disaster vulnerability assessment is also determined through the analysis of accepted threats. Next, the assessment is done on vulnerability problems such as physical, social, economic, and environmental elements. Threats and vulnerabilities determine whether an accepted risk is small or large. Adaptation factors or coping capacity also determine how small or large risk is accepted due to a disaster (Ekawati et al., 2022; Rondhi et al., 2019; UNISDR, 2009). Conventionally, risk is expressed by the following equation:

$$\text{RISK} = \text{Threat (Danger)} \times \text{Vulnerability/ Adaptation (Coping Capacity)}$$

*Source: UNDP (2004); CGSS (2013)*

Therefore, vulnerability and adaptation for this study are analysed from two assessments. The first is vulnerability assessment, and the second is adaptation assessment. The diagram below shows the assessment of vulnerability and adaptation and the criteria involved for each assessment.

Vulnerability assessment is related to the criteria of magnitude, intensity, and probability of flooding. The assessment of adaptation involves the criterion of capacity to withstand floods. For magnitude, the evaluation aspect includes the flood level that hit. For intensity, the assessment aspect includes damage to houses and property, theft and accidents, illness and trauma, destruction of crops and livestock, and difficulties experienced before, during, and after the flood, which is divided into intensity and severity.



**Figure 1:** Vulnerability & Adaptation Assessment

*Source: Author's*

Next, for the probability criteria, the evaluation aspect includes the time and the occurrence of floods. The last criterion is survival capacity. The assessment aspect of this criterion includes preparations before, during, and after the flood by individuals and their crops and livestock.

## RESULT AND DISCUSSION

Vulnerability to flooding for this study includes an assessment of the magnitude, intensity, and probability of flooding. The first criterion of vulnerability assessment is magnitude. For this criterion, the measurement refers to the flood level that hit the Padang Terap district. Based on the respondent's body, there are two vulnerability values for the flood level height: 2.00 and 1.00. Therefore, the level of vulnerability for this measure also varies according to the mukim that experiences it and each mukim is classified according to the level of vulnerability.

Based on Table 3, vulnerability assessment for flood level measurements based on the magnitude criterion is 1.55 for the average of the 11 mukims involved. The flood level measurement is assessed from the knee until passing the head of the respondent.

**Table 3: Magnitude Assessment**

VA/ S-D	BKi	BKa	KH	PT	BTKi	BTKa	PTKi	PTKa	TKi	TKa	P
Flood level measurement based on the respondent's body	2.0	2.0	2.0	2.0	1.0	1.0	2.0	2.0	1.0	1.0	1.0

VA = Vulnerability Assessment; S-D = Sub District; BKi = Belimbing Kiri; BKa = Belimbing Kanan; KH = Kurung Hitam; PT = Padang Temak; BTKi = Batang Tunggang Kiri; BTKa = Batang Tunggang Kanan; PTKi = Padang Terap Kiri; PTKa = Padang Terap Kanan; TKi = Tekai Kiri; TKa = Tekai Kanan; P = Pedu

*Source: Author's Calculation*

The second flood assessment of flood vulnerability focuses on the intensity criteria. Vulnerability assessment for these criteria includes damage to homes and property, economic resources and income, disasters and accidents, trauma and disease, hardship, and food. Based on Table 3, the vulnerability value for this criterion is 1.43. Each province that experiences it has a different intensity of vulnerability. Based on Table 4, a total of seven mukims, namely Belimbing Kiri, Belimbing Kanan, Padang Temak, Padang Terap Kanan, Kurung Hitam, Padang Terap Kiri and Batang Tunggang Kanan have a moderate intensity vulnerability level, which is 1.46. Within these mukims, the measure of house and property damage, income affected by floods, trauma due to floods and food difficulties during floods have a high vulnerability value of 2.00. Meanwhile, the measure of crops and livestock destroyed due to floods, disasters, accidents, and diseases has a low vulnerability value of 1.00. Four other mukims, namely Tekai Kiri, Tekai Kanan, Batang Tunggang Kiri and Pedu have a lower level of intensity vulnerability than the other with a value of 1.38. For these mukims, only the measure of house and property damage, income affected due to flood and trauma due to flood has a high vulnerability value, 2.00. The rest, encompassing the measure of crops and livestock destroyed due to floods, calamities, and accidents due to floods, diseases, and food, have a low vulnerability value of 1.00.

**Table 4: Intensity Assessment**

VA/ S-D	BKi	BKa	KH	PT	BTKi	BTKa	PTKi	PTKa	TKi	TKa	P
House damaged	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Estimated damage to homes and property	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Affected daily income	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Crops destroyed	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Livestock destroyed	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Case of theft	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Fatal accident	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Injuries and venomous animal bites	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Trauma	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Floods cause disease	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Existing disease worsen	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Difficulties	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Food difficulties	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0	1.0	1.0	1.0
Average	1.46	1.46	1.46	1.46	1.38	1.46	1.46	1.46	1.38	1.38	1.38

VA = Vulnerability Assessment; S-D = Sub District; BKi = Belimbing Kiri; BKa = Belimbing Kanan; KH = Kurung Hitam; PT = Padang Temak; BTKi = Batang Tunggang Kiri; BTKa = Batang Tunggang Kanan; PTKi = Padang Terap Kiri; PTKa = Padang Terap Kanan; TKi = Tekai Kiri; TKa = Tekai Kanan; P = Pedu

Source: Author's Calculation

The last vulnerability assessment involves the criteria of the probability of flooding. Vulnerability assessment for this criterion includes measures of flood victims' experiences and the nature of floods in the Padang Terap district. Based on Table 5, the vulnerability value for this criterion is 1.58, where each mukim has a different measurement value.



**Table 5: Probability Assessment**

VA/ S-D	BKi	BKa	KH	PT	BTKi	BTKa	PTKi	PTKa	TKi	TKa	P
Been a victim of a flood	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Frequency of floods every five years	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Number of days of flooding	2.0	2.0	2.0	2.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0
Average	1.67	1.67	1.67	1.67	1.33	1.33	1.67	1.33	1.67	1.67	1.67

VA = Vulnerability Assessment; S-D = Sub District; BKi = Belimbing Kiri; BKa = Belimbing Kanan; KH = Kurung Hitam; PT = Padang Temak; BTKi = Batang Tunggang Kiri; BTKa = Batang Tunggang Kanan; PTKi = Padang Terap Kiri; PTKa = Padang Terap Kanan; TKi = Tekai Kiri; TKa = Tekai Kanan; P = Pedu

Source: Author's Calculation

Based on Table 5, a total of eight mukims, namely Belimbing Kiri, Belimbing Kanan, Kurung Hitam, Padang Temak, Padang Terap Kiri, Tekai Kiri, Tekai Kanan and Pedu, have a probability vulnerability level of 1.67. For these mukims, the measure has been a victim of floods, and the number of days of flood events has a high vulnerability value of 2.00. Meanwhile, the measure of flood frequency every five years has a low vulnerability value of 1.00. The remaining three mukims are Batang Tunggang Kiri, Batang Tunggang Kanan and Padang Terap Kanan. For these mukims, the measure of being a flood victim has a high vulnerability value of 2.00. The rest, the measure of the frequency of floods every five years and the number of days of flood events have a low vulnerability value of 1.00.

Next is the assessment of adaptation. The assessment of flood adaptation in the Padang Terap district is evaluated through the criteria of flood resistance capacity. Adaptation assessment for flood resilience criteria includes measures of financial adaptation, crop adaptation, livestock adaptation and general adaptation, such as adaptation before, during and after the flood.

Table 6 is an assessment of the Padang Terap flood adaptation. Overall, the adaptation value obtained is low, which is 1.25. Based on the table, eight evaluations also have a low adaptation value. The assessment covers finances, crops, livestock, and activities to overcome the flood problem. Meanwhile, the assessment of adaptation aspects has a high adaptation value. In addition, there are also among the flood victims who make other preparations to face the flood. However, the other practices also did not help the flood victims reduce the destruction they faced. For example, preparing food, moving goods, buying equipment during floods, and preparing for personal safety.

**Table 6: Adaptation Assessment**

AA/ S-D	BKi	BKa	KH	PT	BTKi	BTKa	PTKi	PTKa	TKi	TKa	P
Financial preparation	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Crops preparation before	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Crops preparation during	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Crops preparation after	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Livestock Preparation before	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Livestock Preparation during	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Livestock Preparation after	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Adaptation before	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Adaptation during	2.0	2.0	2.0	1.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0
Adaptation after	2.0	2.0	2.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0
Activities to overcome the flood problem	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
<b>Average</b>	<b>1.27</b>	<b>1.27</b>	<b>1.27</b>	<b>1.18</b>	<b>1.18</b>	<b>1.18</b>	<b>1.27</b>	<b>1.27</b>	<b>1.27</b>	<b>1.27</b>	<b>1.27</b>

AA = Adaptation Assessment; S-D = Sub District; BKi = Belimbing Kiri; BKa = Belimbing Kanan; KH = Kurung Hitam; PT = Padang Temak; BTKi = Batang Tunggang Kiri; BTKa = Batang Tunggang Kanan; PTKi = Padang Terap Kiri; PTKa = Padang Terap Kanan; TKi = Tekai Kiri; TKa = Tekai Kanan; P = Pedu

Source: Author's Calculation

Overall, from the Magnitude (1.55), Intensity (1.43) and Probability (1.58) criteria evaluation, the overall vulnerability value is 1.52. Meanwhile, the overall adaptation value is 1.25. The difference in the value of vulnerability and adaptation shows that the Padang Terap district is at risk of flooding since the vulnerability experienced is higher than the adaptation.

## CONCLUSION

In conclusion, Padang Terap district urgently requires the establishment of a sustainable disaster risk management system. This system should incorporate an effective early warning mechanism to alert flood victims to relocate to a safer place. Additionally, the government must also improve infrastructure and public facilities including roads, bridges, community halls, flood evacuation centres, clinics, schools, and banks involved in flood-related matters. Sustainable disaster risk management should encompass actions taken before, during and after a disaster. Before a disaster, the things that need to be done are risk research, risk mitigation, and ensuring preparedness for both risk and disaster. Whereas, when a disaster occurs, a swift and prioritised response such as emergency assistance and search-and-rescue operations for disaster victims is essential. Subsequently, the recovery and reconstruction process after a disaster, such as repairing infrastructure, especially houses and public buildings, and fostering innovation in constructing disaster-resistant homes and facilities for reconstruction projects. Low-impact development that can reduce vulnerability in the future should also be prioritised and implemented.

Therefore, a more sustainable disaster risk management system must be standardised and applied in all places where disasters occur. Through this comprehensive sustainable disaster risk management, the involvement of responsible agencies and commitment from the community will help reduce vulnerability to disasters and further reduce the impact of any disaster that occurs in the future.

## CONFLICT OF INTEREST

The author agrees that the conducted research is not related to any personal gain, commercialization, or any form of financial benefit and states that the research also has no conflicting interests with the funder.

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## **URBAN GROWTH IN KANO METROPOLIS NIGERIA- THE MODELS HOW IT IMPACTS THE ENVIRONMENT**

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### **Abstract**

Rapid urban and population growth in the KNMA is distorting environmental quality. The initial data was obtained with the aid of geographical information systems (GIS) and remote sensing (RS) within 35 years (1984 to 2019) with three study periods of 1984, 1998, and 2019. While water pollution samples were taken and analyzed in the laboratory for physicochemical elements. The air pollution parameter consists of carbon monoxides (CO) and carbon dioxides (CO<sub>2</sub>) emission sensed. The Structural Equation Modelling (Smart PLS-SEM) is employed. However, this study solely covers the model development of the urban growth (land use changes, water, and air pollution). The Result uncovers that urban growth in KNMA =  $\alpha + \text{RPG}(\text{P}\beta_1 + \text{P}\beta_2 + \text{P}\beta_3 + \text{P}\beta_4 + \text{P}\beta_5) + \text{GPC}(\text{G}\beta_1 + \text{G}\beta_2 + \text{G}\beta_3 + \text{G}\beta_4) + \text{IEA}(\text{E}\beta_1 + \text{E}\beta_2 + \text{E}\beta_3 + \text{E}\beta_4) + \text{NT}(\text{N}\beta_1 + \text{N}\beta_2 + \text{N}\beta_3)$ , Air Quality Indicator in KNMA =  $\alpha + \text{P}_1 + \text{P}_2 + \text{P}_3 + \text{P}_4 + \text{P}_5 + \text{P}_6 + \text{P}_7 + \text{P}_8 + \text{P}_9$ . Water quality,  $\text{WP} = f(\text{P} + \text{L} + \text{D} + \text{A})$ . This calls for deep and strong study on effective urban management framework applications for the metropolis and it's alike globally. The framework model applications will help in the integration of sustainable land use change principles and techniques, low carbon society development (LCSD) for air pollution mitigating water pollution with its management techniques.

**Keywords:** Urban growth, air pollution, water pollution, theoretical model, Kano metropolis (KNMA)

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## **INTRODUCTION**

Land use classification is a technique employed for land-use study planning. It involves the categorization of the study area into land uses like built-up areas, water bodies, and vegetal cover, among others. Periods of study of the trend of urban expansion are usually divided into desired phases for analysis purposes. Meanwhile, Trinder and Liu (2020) evaluated the period of the study for 30 years and its classification of the land uses was carried out with the aid of Indi frag software and it covers (a) vegetation, (b) buildings, (c) water and soil. Rathayake, Jones, and Soto-Berelov (2020) added human biophysical activities as factors significantly affecting land use land cover changes (LULCC) in Sri Lanka. Landsat series between 1993 to 2018 was utilized for the study. Ustaoglu, and Aydiooglu (2020) commented on the criteria for the study to include (a) Accessibility, (b) Physical features, (c) Water resources, (d) Urban land, (e) Vegetation, and (f) Geology. Liu, Shaker, Jiang (2020) mentioned that the study considered (a) cropland, (b) woodland, (c) shrub, (d) grassland, (e) bare land, (f) water bodies, and (d) impervious surface. The study period is 1990, 1998, 2009, and 2018. Several remote sensing technologies for land use changes have been developed. Yuan (2017) revealed a classification of land uses that employed (a) impervious surface, (b) forest, (c) cropland, and (d) water bodies. The study period undertaken was from 1971 to 2003. Rathayake et al. (2020) depicted human biophysical activities as factors that significantly affect land use land cover changes (LULCC) in Sri Lanka. Landsat series between 1993 to 2018 was utilized for the study.

Land use change indicators in the study of Dempsey, Plantinga, Kline, Lawler, Martinuzzi, et al. (2017), include (a) Built-up area, (b) Forest, (c) Grass and Shrub, and (d) Agriculture. Land use parameters studied by Rathayake et al. (2020) revealed land cover utilized in the study, which include (a) homes, (b) forests, (c) gardens, (d) plantations, paddy peri-urban, (e) shrub, (f) urban, and (g) waterbodies. The study employed a total of 2117 pixels which ranges from 50 as the lowest and 600 as the highest. The study by Conway, Khan, and Esak (2020) indicates that green infrastructure is rapidly receiving multi-disciplinary contributions for policy-making and discussion. There is tremendous research in the United States and European Countries. In Ontario, green infrastructure policy covers definitions of (a) Green infrastructure, (b) Natural heritage system, (c) Green land system, and (d) Low impact development. Urban growth periods of study vary with researchers' interest. Hu et al. (2020) studied and utilized the categories of land use changes indicator, which are (a) Farmland, (b) Woodland, (c) Grassland, (d) Water bodies, (e) Impervious land, and (f) Unused land.

Shih, Mabon, and Puppim de Oliveira (2020) stated that the IPCC classifies land use into, forest land, settlement, wetland, cropland, grassland, and others. Conversion of grassland as revealed by the cropland significantly alters temperature. Parveen, Basheer, and Praveen (2018) revealed that land uses are



categorized under four major phases and categories. Category 1 covers agricultural land, built-up area, grazing land, forest, wetland, wetland, and water bodies. Category 2 which includes built is divided into rural and urban, architecture, grazing land, forest, wetland, grazing/wetland, and water bodies. Besides, category 3 handles built-up areas into eight sub-categories as residential, commercial, transportation and communications, public utilities, recreational, mixed land uses industrial and vacant land. The last category shows that built areas is subdivided based on densities as low, medium, and high densities and included all in the mentioned above. Kaim, Cord, and Volk (2018) opined agricultural management is facing challenges from land use allocation with the sole intention of ecosystem and biodiversity services provision.

### **Land Use Planning**

This is rational coordination, integration, and separation of various categories of land uses which range from residential, commercial, industrial, transportation, and recreational among others with the sole aim of zoning compatible and separating non-conforming land uses for sustainability. This is an integral tool for contemporary spatial planning. It received enormous from scholars like Lima, Chmeli, Guedes et al. (2020) who explained land use planning laws governing occupation vary because of differences in aspiration, ambition, and level of complexity. This is due to disparity in culture, tradition, politics, and geographical location. Principles and practice in land use planning are in scholarly contributions of Graciela (2017) who stated the principles and practice of land use planning have the following considerations, namely (a) Legal and socio-political context, (b) Integration and participation, (c) Scale relevance and vertical integration, (d) Sectoral coordination, (e) Functionality of the land, (f) Best palling policies and practice, and (g) Land use planning care studies. Hersperger, Oliveira, Pagliarin, Palka, and Verburg et al. (2018) argued driving forces of land use planning include, natural, cultural, socio-economic, political, and technological. Additionally, for effective land-use planning, planning and policy cycle that attract the driving forces needs to follow the cyclical nature of land use planning with the following stages, which are ( a) Problem identification, (b) Goal formulations, (c) Relevant data collections, (d) Scientific analysis, (e) Alternative plans productions, (f) Evaluations of the alternative plans, (g) Selections of the best plan base on cost-benefit analysis, ( h) implementations of the selected plans, and ( I) Reviewing of the plans to suit the present and future needs.

Editorial (2019) contributed and considered plans for land development under two broad sub-headings, which are (a) Single developer with the land development model, and (b) Different planning situations for utilities social provisions whereby (1) both developers and local government acquired information, (2) some developers acquired the desire but the government does

not provide it, (3) all developers acquired information but the government does not provide it, and (4) only government provides information. The study by Calbick, Day, and Guoton (2003) assessed practice implementation regarding five innovative planning agencies with regard to land use planning in North America. Wang, Shen, Xiang, and Wang (2018) studied the connection between theory and practice about the characteristics of an urban community resilient. It correlates with resilience strategies and concepts. The study by Allam (2020) discussed ways smart city concepts could be used to promote and standardize data sharing and disseminating data for disaster outbreaks in urban areas. Honey-Roses, Anguelovski, Bohigas, Chiren, Daher, et al. (2020) highlighted that the study concentrates on city design concerning a pandemic. Changes between population lockdown and public space required intensive study for the post-pandemic urban planning and design globally. Steiner (2018) focused on the city of Austin's principles to cover liveable, natural and sustainable, creative, educated, prosperous, mobile, and interconnected, values and respect of people. The study by Kumar (2018) centered on the development of building regulations in the hill town in India with a focus on problems and issues connected to it. It compasses Himalayan hill town natural hazards with careful and very deep thought to comprehend its building regulations for safety. Dempsey, Plantinga, Kline, Lawler. Martinuzzi et al. (2017) added that zoning regulation is the major tool for controlling land use and land cover change. Yan, and Sakairi (2019) mentioned that Geo CPS could be applicable in the following areas, which are (1) Construction equipment and construction industries, (b) Resources management and environmental conservation, (c) Infrastructure and wastewater management, and (d) Mobility accessibility management. Christodoulou and Nakos (1990) showed land use planning involving these comprehensive flow charts.

Lopes, Cavalcante, Vale, and Loureino (2020) revealed that stakeholders divergent interest creates great challenges complex in nature to city planning expertise. This is because of its multidisciplinary and communication gap within the specialists from closely associated disciplines. Wang, Ma, Zhong Hunt, Zhang, et al. (2019) depicted that the study handles integrated land use and transportation forecasting models based on the Baltimore PECAS Demo Model.

### **GIS Application in Land Use Planning**

Modern and contemporary land-use planning employed spatial remote sensing and GIS data in its urban growth and related studies. This is because remote sensing and GIS tools are of high accuracy, wide area coverage, and save both time and resources. Town planners solely focus on spatial data for decision-making. The study by Trinder and Liu (2020) in this context indicates that land use changes are conducted in two cities, which are Wuhan in China and Western Sydney in Australia. The study employed Multiple Endmember Spectral Mixture

Analysis (MESMA) and Super-Resolution Mapping (SRM). The classification is further processed with the aid of Indi frag software to evaluate the exact status of fragmentation. The study relates to the SDG sustainable development goal. Bolous and Geraghty (2020) revealed that GIS technologies could help in the outbreak through public events, site selection, supply chain, resources, locators, and drones. Suleman, Waheed, Sahar, and Aisha (2020) depicted in their study the application of GIS tool identification of affected zones and a proper recommendation to the authority. GIS is applied under the following, are (1) Developing GIS capacity building for controlling, (2) Identifying and revealing epidemic outbreak cases and their court, (3) Mapping for epidemic through spatial segmentation, (4) Arrangement of data considering location, time and peoples involved, (5) Hypothesis test development concerning demand and supply of medical facilities, and (6) Evaluation of supply of materials and its transportation. The study by Patra, Sahoo, Mishra, and Mahapatra (2018) pertaining to geographical information system indicate a significant correlation between land use land cover changes, and anthropogenic activities in the urban setting.

Geographical information systems (GIS) and multi-criteria decision analysis (MCDA) are intensively utilized for urban growth analysis. The work of Ustaoglu, and Aydiooglu (2020) commented that urban suitability is very complex because it desired both environmental and geophysical information and expertise for proactive analysis. GIS and MCDA were the most effective combined tools for these indicators, which are (a) Built-up areas and infrastructure, (b) Vegetation cover blue and green amenities, and (c) Geophysical attributes and access roads. These are employed for land use sustainability studies. Trinder and Liu (2020) explained Landsat is characterized with an intermediate resolution for urban area classification. The study employed Multiple Endmember Spectral Mixture Analysis (MESMA) and Artificial Neural Network (ANN) for the generation of very high resolution. Mouratidis (2020) stated that the study interconnects neighborhood deprivation and neighborhood characteristics together with well-being, using survey geospatial data also from green space, public transport, and local amenities. Rofl, Dielh, Zasada, and Wiggering (2020) added green infrastructure was developed in European Countries with the sole aim of integrating it into policies. Its objectives include (a) Green economy promotion, (b) Social cohesion increasing, (c) Biodiversity conservation, and (d) Climate change adoption. Cost-benefit of megacity evaluation is demonstrated by You, Li, Wang, and Pan (2020) mention that the economic and ecological benefits evaluation of megacities of urban land use is not easily applicable to megacities suburban that therefore, developed population theory. A population economy-space includes factors of land use benefits, population, economy, and space. Benefits of the theory include horizontal benefits, longitudinal benefits, and overall benefits.

## **Land Use**

This is the present or anticipated use of a given piece of land in both rural and urban settings. It is very essential in urban growth study because of its dynamic nature. The dynamism of land use is directly connected with human actions. Iwasaki (2019) studied and categorized residents in the research into clusters, which are (a) Urban professional cluster, (b) Nuclear families with children residing in a rental accommodation (Housing), (c) Area without residents cluster, (d) Blue collar workers cluster, (e) Manufacturing and industrial workers cluster, and (f) Typical farmers cluster. Additionally, Cluster B influences population growth in the study area. It concentrates on sub-urban areas and away from densely populated areas. Trender and Liu (2020) showed the paper handles land use cover changes (LUCC) within urban Wuhan in China and Western Sydney in Australia. The scholars' work dwells under (a) a Comparison of the LUC metric for both Wuhan and Sydney from 1987/8 to 2017, and (b) Land use change in Wuhan and Sydney. Meanwhile, Unger, Bennet, Lemmen, Zeeuw, Zevenbergen, et al. (2020) indicate that land administration and disaster risk management policy transfer should consider (a) Transfer agents (who), (b) Transfer content (what), (c) Transfer process (who), (d) Transfer output (where and when), (e) Transfer outcome (why), and (f) Transfer limitations (why not). Lopes, Cavalcante, Vale, and Loureire, (2020) opined urban planning or urban space planning in Brazil is quite like other similar developing nations cities with an emphasis on Land Use Transportation Integration (LUTI) as a recent transportation sector development. MacDonald and MCKenney (2020) explained that the study covers these subjects' ecology, biology, forestry, environmental science, economics, and, geography with emphasis to its methodology from biodiversity, carbon and remote sensing.

## **METHODOLOGY**

The study solely covers the model development of the urban growth of the studied parameter impacts (land use changes, water, and air pollution). Land Use Change data is obtained with the aid of geographical information system (GIS) and remote sensing (RS) within 35 years (1984 to 2019). The study employed three periods 1984, 1998, and 2019. Water pollution samples were taken from the existing historic ponds in the metropolis and the sample water was analyzed in the laboratory for physicochemical elements. The air pollution parameter in Kano metropolis consists of carbon monoxides (CO) and carbon dioxides (CO<sub>2</sub>) emission sensed with the aid of 707 Crowcon Gasman 19259H gas detector device and SD Card Logger CO<sub>2</sub>/Humidity/Temp/Data Recorder MCH-383SD for both indoor and outdoor. The Structural Equation Modelling (Smart PLS-SEM) is employed for the analysis with references to measuring the magnitude of impacts of each parameter. Three models of urban growth in KNMA theoretical

model, the theoretical model of air pollution, and the theoretical model of water pollution of KNMA. These are mathematically presented.

### STUDY AREA

Kano Metropolis is geographically located within Latitudes  $12^{\circ} 25^1$  to  $12^{\circ} 40^1$  N and Longitude  $8^{\circ} 35^1$  to  $8^{\circ} 45^1$  E. It is the most developing and urbanized city and commercial center of Northern Nigeria. It has an annual growth rate of 3% with a population of (3.5 million, 2010) projected to (4.3 million 2018). It is highly crowded with 1000 people per square kilometer (KM<sup>2</sup>) and its climate is wet and dry based on Koppen’s classifications (Hashim, Gobi, and Ho 2020). Medugu (2010), as Hashim, Gobi, and Ho 2019 stated that the dramatic urbanization processes going on within the Kano metropolis over the past decades is a significant factor. In addition, Kano metropolis is the major commercial active center of Northern Nigerian states. Kano Metropolis is the most industrialized with heavy and light industries. The metropolis is also a commercialized metropolis in Northern Nigeria that attracts immigration of both skilled and skilled labour from and outside the region (Hashim et al, 2019). Figures 1a, 1b, and 1c demonstrates the study area as in Hashim (2021)

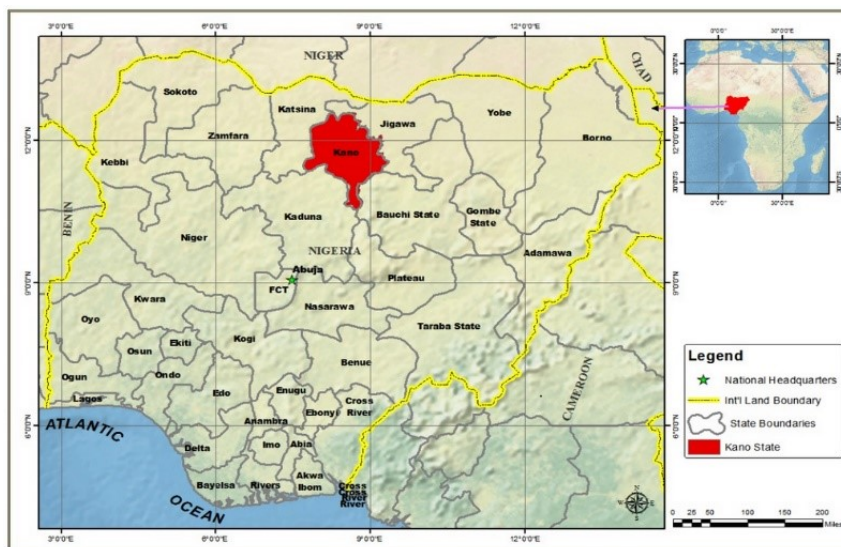


Figure 1a: Showing of Nigeria Showing Kano State

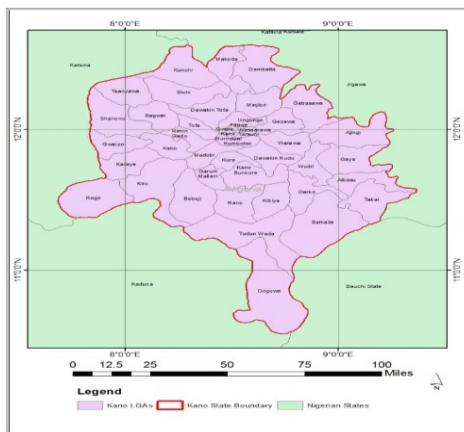


Figure 1b: Showing Kano State

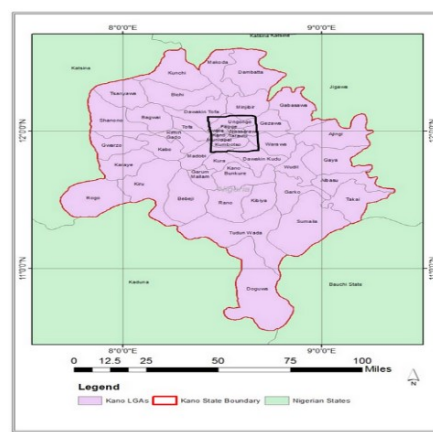


Figure 1c: Showing Kano State Metropolis

## FINDINGS OF THE STUDY

The historic population growth trends of KNMA are recorded from 1820 when the ancient settlement of Kano city was 30,000 to 40,000 thousand dwellers. The population rose to 60, 000 people by 1851 and it significantly rose to 83,000 in 1932 inhabitants as the total population censused by the colonial government. The population as spelt by the colonial government dramatically shifted upward to 250, 000 in 1963. In 1991, the national population census recorded 1.5 million people and by 2006, the population reached 2 million people (Barau et al.2015). This indicates that within the study period which is thirty-five years (35 years), the population closely doubled its initial total values. The study projected the year 2020 population to 2040 which is the plan period of the study. The results of the projection are 6,529,393 people. This implies that if all factors influencing the population growth in the metropolis remain constant, the population will rise relatively in the future.

### Results of Land Uses Pattern

#### Urban Growth in KNMA Theoretical Model

The study revealed that factors responsible for dramatic urban growth in the metropolis could be categorized into three broad headings. These factors caused the speed and direct conversion of the existing agricultural land uses into physical structures ranging from residential land use, commercial land use, and transportation land use to mention but few. The factors are statistically stated as:

$$\text{Urban Growth in KNMA} = \alpha + \text{RPG} (P\beta_1 + P\beta_2 + P\beta_3 + P\beta_4 + P\beta_5) + \text{GPC} (G\beta_1 + G\beta_2 + G\beta_3 + G\beta_4) + \text{IEA} (E\beta_1 + E\beta_2 + E\beta_3 + E\beta_4) + \text{NT} (N\beta_1 + N\beta_2 + N\beta_3)$$

Where RPG= Rapid Population Growth

- Pβ1= Belief of the Residents
- Pβ2= Marriage Type (Polygamous)
- Pβ3= Fertility Rate
- Pβ4= Timely Marriage
- Pβ5= Immigration

Where GPC= Government Policy and Customs

- Gβ1= Land Administrations
- Gβ2= Infrastructural Development
- Gβ3= Land Tenure System
- G β4= Housing Provision/Loan

Where IEA = Intensive Economic Activities

- E β1= Numerous Specialized Markets
- EB2= Industrial Activities
- E β3= Large Job Opportunities
- E β4= Large Market Forces

Where NT= Nature of the Terrain

- Nβ1= Suitable Topography
- N β2= Available Local Building Materials
- N β3= Sufficient Surface and Underground Water Reservoir
- N β3= Regional Geographical Location

### **Theoretical Model of Air Pollution**

Based on the study findings with regards to the rapid populations and its compositions reference to the number of households per house (NHH), number of people per household (NPH), number of rooms per house (NRH), number of rooms rented (NRR) and Monthly rent per room (MRR), the theoretical model is developed. In addition, the research results concerning the amount spent by respondents on energy sources (AMT), Frequency of buying energy sources (FRQ), number of hours respondents used generator (HR –GEN while town services mean of transportation (TWN-SRV), types of energy (TYP ENG) and the purpose for the energy usage (USE ENG), provided bases for the study theoretical framework.

### **Air Quality Indicator in China**

Xu (2017), in the study titled impact ofurbanization on urban quality in China 2017 mathematical arrived. The mathematical relationship is stated below;

$$\text{Air Quality} = \beta_1 + \beta_2(\text{urban\_pop}) + \beta_3(\text{gdp}) + \beta_4(\text{gdp\_capita}) + \beta_5(\text{manufacturing}) + \beta_6(\text{man\_pro}) + \beta_7(\text{coal}) + \beta_8(\text{gas}) + \beta_9(\text{N\_S}) + \beta_{10}(\text{E\_NE}) + \varepsilon \quad (3).$$

The scholar gives emphasis on the urban population, gross domestic products, manufacturing, man production, coal, gas, the difference in geographical location, and the element above in China North South, East, and North East.

### **Energy Demand and Carbon Emission in US Residential Buildings**

Rong (2006), the scholar mathematically arrived at the work impact of urban sprawl US residential energy use. The find of total energy demand concerning population is stated below;

$$\begin{aligned} \text{Total Energy Demand} = & \alpha + B_1 \ln(\text{House Size}) + B_2 \text{House Type} + B_3 \text{House} \\ & \text{Built Year} + B_4 \text{Household Income} + B_5 \text{Householder Race} + B_6 \text{Number of} \\ & \text{Household Adults} + B_7 \text{Number of Household Children} + B_8 \ln(\text{Energy Price}) \\ & + B_9 \\ & \text{HDD} + B_{10} \text{CDD} + \text{Other Controls} + \mu \end{aligned}$$

The scholar gives emphasis to House size (B1), House type(B2), age of house(B3), household income category(B4), Race of the householder(B5), Sum up adult in the household(B6), sum of the children in the household(B7), price of energy(B8), Heating degree per day (B9, cooling degree per day(B10)

### **Theoretical Air Quality Model in KNMA Modified from China and US Studies**

Air Quality Indicator in KNMA =  $\alpha + P_1$  (Number of Households in a House, NHH) +  $P_2$  (Number of People Per House, NPH) +  $P_3$  (Number of Rooms in a House, NRH) +  $P_4$  (Amount Spent for Energy, AMT) +  $P_5$  (Frequencies of Heating and Cooling, FRQ) +  $P_6$  (Time Spent Using Generators, HR-GEN) +  $P_7$  (Town Services Trips Generation, TWN-SRV) +  $P_8$  (Type of Energy Sources Used, TYP-ENG) +  $P_9$  (Purposes for the Uses of Energy, USE ENG).

The study gives-emphasis to the demographic elements and energy demand

Where;

$P_1$  = Number of Households in a House,

$P_2$  = Number of People per House,

$P_3$  = Number of Rooms in a house,

$P_4$  = Amount Spent for Energy,

$P_5$  = Frequencies of Heating and Cooling,

$P_6$  = Time Spent Using Generators,



P7=Town Services Trips Generation,  
P8= Type of Energy Sources Used,  
P9= Purposes for the Uses of Energy(P9).

### **Theoretical Model of Water Pollution of KNMA**

The study uncovers that the existing historic mining ponds in Kano metropolis is because of the interaction of four major parameters. The parameters are very high population, land use type, density, and residential and attitude of the Residents.

The mathematical representation is:

$$WP = f (P+L+D+A)$$

Where:

- P = Population
- L = Land Use Type
- D = Density of Land Use
- A = Attitude of the Residents

### **Results of Land Uses Pattern**

#### **Pattern of Urban Growth in Kano Metropolis Nigeria 1984-2019**

The study uncovers variations in the pattern of urban growth in the area. Each study period has uniqueness and peculiarities regarding factors responsible for urban growth within that specific period. Government attitudes towards infrastructure provision also vary greatly from one administration to another. The economic base of the residents is also a key factor that leads to significant variations in the pattern and form of urban growth in the metropolis.

#### **Nucleated and Concentric Urban Expansion Organic Growth 1984 in KNMA**

The year 1984 is the first period of the study employed for the study for assessment of the trend of land use changes with much emphasis on the conversion of agricultural land into physical structures. Emphasis is on the farmland/open fields, trans-cape/irrigated fields, built-up areas, and water bodies. The study unveiled the understated factors as the characteristics of the determinants that favored this pattern of growth. First, organic/unplanned development, which is mostly seen and visible in very high densities of the traditional walled city (old Kano town or Birnin Kano). In some parts of the ancient city roads constructed in the pre-automobile age are still in existence. The roads are far below planning standards. This makes some areas not vehicular accessible. Second, weak zoning regulations, that is also obvious within high densities within the metropolis. This is also seen in the conversion of residential plots into commercial. This period covers the intensification of commercial activities because of the population growth. Third, irregular plot sizes below

planning standards, whereby the study shows that layouts were basically at the mercy of the farm owners.

### **Nucleated Concentric and Disperse Pattern of Urban Expansion in KNMA 1998**

The study shows the following factors as responsible for the urban growth expansion at this axis. It includes the construction of a dual carriage Zaria Kano Road, which is the major key factor that intensified commercial activities between the states. This also led to immigration to the metropolis thereby leading to a high population increase. This resulted in physical development to accommodate growing populations. The Kano State government's efforts in infrastructure provisions include new road construction, upgrading of the existing ones, and demolishing and connecting roads of substandard roads, especially in the ancient part of the metropolis. The study shows the nucleated concentric and dispersed pattern of urban growth and expansion in the study area.

### **Nucleated Compacted/Concentric and Isolated Pattern of Urban Growth in KNMA 2019**

This study therefore explains and shows the trend of rapid urban growth in the study area between 1984 and 1988 that continued to intensify from 1998 to 2019. The determinant factors responsible for this dramatic growth as depicted by the study include (a) road infrastructural Development from 1998 to 2019, (b) flyovers, through and road upgrading within Central Business Districts, (c) Intensity of commercial activities within neighbouring states, (d) Influx of immigrants from insurgent zones, (e) Rapid population growth, (f) Layout development by the state governments, (g) States creations and economic development, (h) Inter-states linkages, (I) Effective inter-states transport services (Kano Line) that travel across the country, (j) Cities lay-out development, (k) Land values appreciations, (l) Carved out lay-outs from residential to commercial land use, and (m) Conversion of residential land use to commercial. Thomas (2013) in his work in Woodbury discovers these affecting land use land cover changes about rapid urban growth. The factors include economic growth, population growth, policies of the government, and technological growth.

### **RECOMMENDATIONS**

This calls for deep and strong study on the effective urban management framework applications for the metropolis and its alike globally. The framework model applications will help in the integration of sustainable land use change principles and techniques, low carbon society development (LCSD) for air pollution parameters with mitigating water pollution with its management techniques.

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## **ASSESSMENT ON THE FACTORS INFLUENCING INEFFECTIVE COMMUNICATION AMONG STAKEHOLDERS IN INFRASTRUCTURE DEVELOPMENT**

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### **Abstract**

Communication serves as a foundation for the planning and development of infrastructure projects. Because the infrastructure projects are complex and involve multiple stakeholders, ineffective communication could significantly negatively impact the whole development process. Hence, this paper aims to determine the significant factors that lead to ineffective communication among project participants in infrastructure development in Malaysia and explore initiatives to address the problems. The research data were gathered via responses from a questionnaire survey and semi-structured interviews with Grade G7 contractors and consultant engineers who were involved in infrastructure development. The study starts by distributing questionnaires to the target population to determine the significant factors influencing the ineffectiveness of communication among the project participants. At the second stage, 28 industry practitioners were interviewed to gain their deeper insight on the initiatives to address the problems. The result revealed seven significant factors contributing to the communication ineffectiveness in infrastructure development in Malaysia. There were eight initiatives recommended to be taken by project participants to address the problems, namely, to channel the site problems to the right and authorized person/party, encourage a cooperative attitude towards achieving the project goal, avoid confrontational attitudes, provide timely feedback, create a harmonious and effective working environment, promote a no-blame culture, encourage respect for others, and keep written communication at all times. The outcome of the study could mitigate the impacts of ineffective communication in infrastructure planning and development by helping to ensure that all the participants involved are on the same page and aligned with project goals.

**Keywords:** Communication, Development, Infrastructure, Project Participants

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## **INTRODUCTION**

Effective communication is the backbone of successful construction planning and development. It enhances collaboration, minimizes misunderstandings, and ensures that all project stakeholders work together harmoniously towards achieving the project's goals (Ahmed & Othman, 2013; Al-Mayahi et al., 2018; Ling et al., 2013; Mohd Fateh et al., 2023). According to Zhang and Fan (2013), communication skills are the capacity to carry out efficient communication among project participants in order to facilitate the project's implementation. Poor communication among the project participants could result in inefficiencies, errors, and delays in task completion, especially for a large-scale and complicated development like infrastructure projects. In their study, Ismail et al. (2021) found that the frequency of poor communication between the contractor and the engineer in infrastructure projects was only moderately satisfactory. This could be attributed to the construction projects' characteristics, which are fragmented and segmented in nature. In addition, it is also a dynamic sector that operates in frequently changing sets of relationships which are contractually driven. Hence, ineffective communication may lead to poor project planning and performance as well as conflict among project participants. Therefore, this paper aims to determine the significant factors that lead to ineffective communication among project participants in infrastructure development in Malaysia and explore initiatives to address the problems.

## **LITERATURE REVIEW**

The engineers' communication skills are vital as they act as the leaders in the infrastructure project implementation team. In the traditional procurement method, the engineer represents the client and is the leader of the design team. According to Yu and Shen (2013), an engineer's ability to communicate effectively is essential for a successful integration of the participants in the implementation of building projects. In addition, the engineer is in charge of ensuring that a project's planning phase includes a comprehensive task definition, resources, a time schedule, and a list of requirements. To do this, the engineer must conduct clear and effective communications.

On the other hand, good communication skills by the contractor are also critical in this type of procurement method since the designs are prepared by the design team. In ensuring the smoothness of the construction process, a good understanding of the design is paramount. Therefore, a contractor requires good skills in communicating with the design team. Subsequently, the main contractor must ensure the information flows efficiently to the numerous subcontractors' organizations (Rahmat, 2008). In addition, it is vital in infrastructure projects because of the involvement of large numbers of subcontractors compared to general building projects.

There is a provision in both FIDIC Standard Form of Contract and PWD 203A Standard Form of Contract allowing the engineer and superintending officer (S.O.) to delegate their authority to engineer's assistant or S.O.'s representative provided that such delegation is put in writing. Indeed, this provision might lead to conflict if the engineer's assistant or S.O.'s representative has lack of communication skills because all of their authorised instruction must be obeyed by the contractor (Zulkifli et al., 2011). According to Zakaria et al. (2013), under FIDIC Standard Form of Contract, clear and effective communication is important due to different roles of engineer and engineer's assistance. Meanwhile, under PWD 203A, based on the practice in Malaysia, the S.O (in almost all cases) is appointed based on a public post but not based on expertise and experience (Zakaria et al., 2013). This might cause problems in achieving effective communication, thus the delegation of authority to the S.O.'s representative can overcome the problems.

Not limited to the traditional procurement method, the importance of communication skill among the participants is emphasized by researchers in other types of procurement method as seen in Design and Build (Adnan et al., 2008), Joint Venture (Famakin et al., 2012), and Build-Operate-Transfer (Kumaraswamy & Morris, 2002). Therefore, the communication effectiveness of both contractor and engineer, as well as their representatives involved in infrastructure projects, is important to be researched in order to understand how conflict manifests and eventually affects the project's success.

### **Factors Influencing the Communication Effectiveness in Infrastructure Projects**

In literature, the characteristics of infrastructure projects are dominantly associated with complexity in design and construction as well as uncertainty in its implementation would make the participants of the project impossible to strictly comply with what is stipulated in the contract (Ismail et al., 2023). Therefore, the characteristics of infrastructure projects that might affect the communication effectiveness are important to be researched. Apart from project characteristics, the quality of Standard Forms of Contract also plays a major influence on the communication. Since a Standard Forms of Contract is used by the contracting parties to regulate their legal relationship and to provide administrative procedures in project implementation (Chong & Zin, 2010), any flaws or unfair clauses might affect the communication effectiveness among the project participants and eventually might cause dissatisfaction and conflict among them. Similarly, external factors and attitudes of the project participants during project implementation are also reported in the literature as the factors that contribute to good or failed communication in a construction project (Yuslim, 2023; Shehu et al., 2014). Therefore, the determinants of communication



effectiveness in infrastructure projects explained in this study were the characteristics of civil engineering projects, the quality of Standard Form of Contract (SFoC) used, external factors and attitude of individual project participants domain as shown in Table 1.

**Table 1:** Possible Contributing Factors to Ineffective Communication Among Project Participants

Category	Possible contributing factors to ineffective communication among project participants	Reference
Project characteristics	Project type, project size, type of SFoC use, procurement method used, adequacy of design details and specification, project complexity, ground uncertainty, surrounding uncertainty, project scope change, design changes, ease of site access, tight project milestone, technological advancement requirement, multicultural team	Krima et al. (2007); Marique (2013); Ismail (2021); Guo et al. (2016)
External factor	Resources availability, changes in government regulations and laws, bureaucracy of government agencies, weather condition	Yuslim (2023); Yong & Mustaffa (2016); Sambasivan & Soon (2007); Yu & Shen (2013); Shehu et al. (2014)
Quality of SFoC	Fairness of SFoC content, clarity of SFoC content, completeness of SFoC content, trust produced by SFoC content	Shehu et al. (2014); Ahmed & Othman (2013); Gosling et al. (2013)
Attitude of participants	Level of SFoC compliance, level of understanding the content of SFoC, familiarity of procurement method used, Cooperation in solving problems, Competency of engineer	Chan (2003); Rameezdeen & Rodrigo (2010); Ali & Wilkinson (2010); Chong & Zin (2010)

## RESEARCH METHODOLOGY

In order to address the issues related to the communication between the participants in infrastructure projects, this study focused on determining the factors contributing to the effectiveness of communication and then, followed by the initiatives that can be suggested to address them. Hence, the data collection method was conducted in two stages, starting with a survey conducted via questionnaire distribution to determine the significant contributing factors: the next stage was semi-structured interviews were carried out to suggest the initiatives to overcome the communication problems. There were two target population frames, which comprised of professional engineers registered under the Board of Engineer Malaysia (BEM) and Grade G7 contractors registered with the Construction Industry Development Board (CIDB) identified as the respondents. Based on the 4151 eligible target population, the estimated sample size of this study was 255, which was calculated using Raosoft sample size calculator. This sample size calculator has been used by many researchers in the

similar field of study as this research, for example, Desa et al. (2012) and De Araujo et al. (2018), hence showing that the sample size calculation is rational and reliable for this study.

Based on literature reviews carried out, under the four aforementioned domains, 27 factors that might contribute to the communication problems were found as shown in Table 1. Then, the survey was phrased to ask the respondents to rate the level of influence of the 27 factors based on their judgement and working experience in infrastructure projects. These possible influencing factors were presented for assessment to determine which of them has the highest contribution to the communication issues in infrastructure projects in Malaysia. The 5-point Likert scale was used to measure the level of influence of the factors on the communication effectiveness where (5) denotes very high influence, (4) high influence, (3) moderate influence, (2) low influence, and (1) very low influence. This kind of scale is used to calculate the mean score for each factor, which is then used to determine the relative ranking of each factor by assigning a ranking to mean score, with the low mean score assigned low ranks and high scores allocated high ranks (Aziz & Abdel-Hakam, 2016; Shehu et al., 2014).

The data collection process started with sending out 1000 questionnaires to the targeted population. After the result of the questionnaire responses was obtained, the data collection method proceeded with semi-structured interviews. Previously, in the questionnaire forms, the respondents were requested to participate in the subsequent semi-structured interview session for detailed thoughts on the most significant factors and the initiatives to be taken to address the communication issues. 28 of them gave positive feedback and agreed to take part in the interview session. Thus, they were informed on the most significant factors resulted from the questionnaire. Interview questions were developed to guide them during the interview session. Before the interview data were analysed, each interview discussion was transcribed into a text document. Overall, 28 interview audios were transcribed and then analysed manually.

## **ANALYSIS AND DISCUSSION**

### **Questionnaire Result and Analysis**

Prior to distributing the questionnaire, a pilot survey was administered by distributing 60 questionnaires to the target population. 38 responses were received for this preliminary survey. The reliability test was conducted, and the overall Cronbach's coefficient alpha value was 0.802. This verifies that all variables in the study demonstrated internal consistency and the main survey could be administered to the target population. After a period of six weeks, with 29% response rate, a total of 288 responses were received. There were 151 contractor respondents and 137 engineer respondents. As depicted in Table 2, all of the respondents' positions were at the executive level, suggesting that the data

gathered in this study came from reliable sources because the respondents were at the forefront of project execution.

**Table 2: Respondent's Position in Their Organisation**

Respondents position in their organisation	Engineer		Contractor	
	Frequency	(%)	Frequency	(%)
Manager	17	12	19	12.6
Civil Engineer	120	88	20	13
Quantity Surveyor	0	0	112	74.2
Total	137	100	151	100

As portrayed in Table 3, most respondents have extensive experience dealing with infrastructure projects for more than 10 years. 49% of engineer respondents and 46% of contractor respondents have experiences between 6 to 10 years. Very few respondents have experiences between 2 to 5 years with only 8% of the total respondents.

**Table 3: Respondents Experience in Infrastructure Projects**

Year of experience in infrastructure projects	Engineer		Contractor	
	Frequency	(%)	Frequency	(%)
Less than 2 years	0	0	0	0
2 to 5 years	0	0	12	8
6 to 10 years	67	49	69	45.7
More than 10 years	70	51	70	46.4
Total	137	100	151	100

**Table 4: Types of Infrastructure Projects Procured by Respondents**

Types of Infrastructure project	Frequency (No)	Percentage (%)
Road/Highway	259	90
Railway	39	14
Bridge	101	35
Drainage/Canal	36	13
Tunnel	26	9
Port	14	5
Airport	56	19
Dams	17	6

In terms of the type of projects that the respondents have experience being involved with, majority of them (90%) have had experience in managing and constructing road or highway projects. It is followed by projects involving bridges (35%), airports (19%), railways (14%), drainage or canals (13%), tunnels (9%), dams (6%) and ports (5%). As portrayed in Table 4, the subsequent result of the study represented more on the road/highway infrastructure projects.

### Significant Factors Influencing Ineffective Communication in Infrastructure Development Projects

Table 5 portrayed the ranking of the 27 factors that contribute to Ineffective Communication among project participants in infrastructure projects. Based on the result, it was found that out of the 27 factors assessed, only seven of them were significant in causing ineffective communication among project participants rated by all respondents with the mean scores ranging from 4.05 to 4.34. They were familiarity of procurement method used, poor in following condition of contract, scope changes, cooperation in solving problems, competency of project participants, trust produced by SFoC and clarity of SFoC. The factors which were found to have a moderate influence on the communication effectiveness among project participants were project complexity, bureaucracy of government agencies, adequacy of details and specifications, changes in government regulations and laws, weather conditions, changes in initial design, site access, tight project milestone, level of understanding condition of contract, project size, resources availability, ground uncertainty and site surrounding uncertainty. On the other hand, the remaining six factors were found to have low influence.

**Table 5:** The Ranking of Factors that Influenced Ineffective Communication Among Project Participants

Factors influencing poor communication project participants	Overall		Engineer		Contractor		Mann-Whitney U Sig. p
	Mean	Rank	Mean	Rank	Mean	Rank	
Familiarity of procurement method used	4.34	1	4.30	1	4.38	1	0.199
Poor in following condition of contract	4.27	2	4.22	3	4.31	2	0.088
Scope changes	4.26	3	4.25	2	4.26	3	0.746
Cooperation in solving problems	4.07	4	4.03	6	4.10	4	0.039*
Trust produced by SFoC	4.05	5	4.04	5	4.05	5	0.952
Competency of contractor	4.04	6	4.07	4	4.01	7	0.032*
Clarity of SFoC	4.03	7	4.02	7	4.04	6	0.497
Project complexity	3.91	8	3.85	12	3.97	8	0.001*
Bureaucracy of government agencies	3.91	9	3.96	9	3.87	9	0.078
Adequacy of details and specifications	3.88	10	3.99	8	3.78	12	0.001*
Changes in government regulations and laws	3.87	11	3.87	11	3.87	10	0.908
Weather condition	3.87	12	3.96	10	3.79	11	0.000*
Changes in initial design	3.77	13	3.80	13	3.74	13	0.204
Site access	3.26	14	3.28	14	3.25	14	0.560

Factors influencing poor communication project participants	Overall		Engineer		Contractor		Mann-Whitney U Sig. p
	Mean	Rank	Mean	Rank	Mean	Rank	
Tight project milestone	3.21	15	3.26	16	3.16	16	0.054
Level of understanding condition of contract	3.17	16	3.27	15	3.07	19	0.000*
Project size	3.16	17	3.15	19	3.17	15	0.632
Resources availability	3.16	18	3.26	17	3.07	20	0.000*
Ground uncertainty	3.15	19	3.15	20	3.15	17	0.886
Surrounding uncertainty	3.14	20	3.12	21	3.15	18	0.458
Completeness of SFoC	3.05	21	3.17	18	2.93	20	0.000*
Technological advancement	2.85	22	2.99	22	2.72	22	0.000*
Multicultural team	2.76	23	2.73	24	2.79	21	0.197
Fairness of SFoC	2.66	24	2.90	23	2.45	23	0.000*
Procurement method	2.52	25	2.66	25	2.40	24	0.000*
Project type	2.35	26	2.43	26	2.28	25	0.014*
Type of SFoC	2.31	27	2.41	27	2.21	26	0.000*

Based on the p-values of each of the seven critical factors contributing to ineffective communication among project participants depicted in Table 5, there was no significant difference in the opinion of both types of respondents on these factors except for cooperation in solving problems and competency of project participants. With the p-value of 0.039 and 0.032 respectively, the cooperation in solving problems and competency of project participants were found to have a higher influence on communication project participants perceived by contractor respondents compared to engineer respondents. Overall, this can be concluded that, out of 27 factors assessed, only seven factors were found to be of significant influence on ineffective communication among project participants namely familiarity with the procurement method used, changes in project scope, poor in following condition of contract, cooperation in solving problems, competency of project participants, clarity of Standard Form of Contract (SFoC) and trust produced by SFoC.

### **Semi-Structured Interview Result and Analysis**

The purposive sampling strategy was adopted to select the semi-structured interview participants. Sekaran and Bougie (2010) mentioned that purposive sampling is narrowed to a specific group of people who can deliver the needed information. The participants are selected based on the characteristics of the population that fulfil the criteria set by the researcher. Hence, the suitable participants for this study were the engineers and the contractors. The analysis of the interviews focused on in-depth discussion of the seven significant factors contributing to the communication effectiveness obtained from the questionnaire analysis.

### ***Participants' background***

There were 28 participants who volunteered to take part, including 12 engineers and 16 contractors. All of the participants have had more than five years of experience in dealing with infrastructure development projects in Malaysia, where most of them have exceeded ten years of experience. Both engineers and contractor participants' positions were at the executive level and directly involved in the project implementation.

**Table 6:** Participants of the Interview

Engineer Participants			Contractor Participants		
ID	Respondent position	Experience (years)	ID	Respondent position	Experience (years)
E1	Resident Engineer	9	C1	Senior Contract Manager	15
E2	Resident Engineer	20	C2	Project Manager	10
E3	Road Engineer	12	C3	Project Engineer	12
E4	Project Coordinator	12	C4	Project Manager	12
E5	Project Engineer	10	C5	Project Engineer	10
E6	Principal Engineer	9	C6	Senior Quantity Surveyor	10
E7	District Engineer	18	C7	Planning Engineer	16
E8	Bridge Engineer	13	C8	Senior Quantity Surveyor	9
E9	Road Engineer	16	C9	Site Quantity Surveyor	8
E10	Road Engineer	10	C10	Site Engineer	6
E11	District Engineer	18	C11	Project Manager	13
E12	Project Engineer	6	C12	Project Manager	9
			C13	Site Engineer	10
			C14	Quantity Surveyor	5
			C15	Site Engineer	7
			C16	Site Engineer	8

### ***Initiatives for improvement of ineffective communication among infrastructure development project participants***

There were eight initiatives recommended to be taken by project participants for the improvement of communication among project participants. The initiative recommended by the majority of participants was the engineer to provide timely response to the contractor's inquiry. Timely feedback by the engineer on any contractor's inquiry is very important to ensure good communication between them. Time is the essence in civil engineering projects and the contractor's work progress must be in line with the work program, thus unnecessary delay from the engineer in regards with contractor's inquiry which may lead to dissatisfaction, and this affects the progress on site. The initiative can also be made by the Resident Engineer (RE) by visiting the construction site regularly in order to meet

site staff for discussions as well as to give a timely response. The next initiative recommended to address the communication ineffectiveness was to channel the site problems to the right and authorized person/party. The majority of the respondents highlighted that by channelling the site or construction problems to the right and authorised party, dispute and poor communication between project participants, particularly between engineer and contractor can be avoided. They stressed out that in case any problems occur on site, the contractor must always discuss the problem immediately with the resident engineer or representatives.

The other initiatives suggested were to encourage cooperation towards achieving project goal, create a harmonious and effective working environment, avoid confrontational attitude, no blame culture, encourage respect for others and keep written communication at all times. Infrastructure projects involve many key participants with different roles and responsibility in project implementation. Hence, in the event of any problems in the construction site, each of them must be aware of each other's roles by channelling the problems to the right parties. It could be a provocative action that could affect communication if the problem was channelled to the wrong party. Similarly, a confrontational attitude must be avoided. Hence social integration is needed among key participants to prevent them from being fragmented and unable to work together effectively. Each of the key participants also should encourage cooperation towards achieving the project goal. With good cooperation among them, it could lead to effective communication. Holding regular meetings, joint evaluation and technical collaboration throughout the construction process requires interaction and sharing of knowledge to a substantial extent. Hence, they learn a lot from each other, resulting in broader competence for all participants and facilitating future collaboration.

Creating a harmonious and effective working environment on site could also enhance good communication among the project participants. Under the premise of a friendly atmosphere, the existence of trust helps bilateral members reach the agreement, which contributes to the formation of cooperation and transparent communication among them. On the other hand, communication among the project participants could be strengthened by encouraging respect for others by realizing that everyone has a similarly important role to play in ensuring the accomplishment of the project goal. By understanding and adhering to the condition of contract in completing tasks, each key participant could be encouraged to perform their proper function by securing the parties. From this perspective, the contract may be analysed as a tool to generate trust and encourage a 'no blame' culture in the project. Therefore, it is suggested that all key participants keep written communication at all times. By following all procedures and keeping all transactions in written form, it would ensure authorisation of

instructions or approvals and prevent them from the ‘blame game’, frustration and conflict.

## CONCLUSION

In addressing the communication ineffectiveness among the project participants in the infrastructure development in Malaysia, this study applied both quantitative and qualitative approach via a survey using questionnaires and semi-structured interviews. The findings revealed that seven factors that significantly contribute to the ineffectiveness of communication, namely familiarity with the procurement method used, changes in project scope, poor compliance with conditions of contract, cooperation in solving problems, competency of project participants, clarity of the SFoC and trust produced by the SFoC. Based on the significant contributing factors revealed, this study suggested eight initiatives that must be implemented by all project participants to address the ineffectiveness of communication in infrastructure development projects. Those initiatives were to channel the site problems to the right and authorized person/party, encourage a cooperative attitude towards achieving the project goal, avoid confrontational attitudes, provide timely feedback, create a harmonious and effective working environment, promote a no-blame culture, encourage respect for others, and keep written communication at all times. The outcome of this study highlighted the determinants that are common in construction development projects but very significant in triggering communication problems among the project participants. Understanding the determinants is important, and the initiatives suggested by the study would be useful for the client, consultant, and contractor in planning the protective measures to avoid problems during project implementation.

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## **INDUSTRIALISED BUILDING SYSTEM MODULAR SYSTEM (IBSMS): ADDRESSING MERITS AND CHALLENGES FOR SUSTAINABLE DEVELOPMENT SUCCESS**

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### **Abstract**

In response to the current demand for an innovative construction design that offers shorter construction periods and cost-saving benefits, Malaysians are increasingly seeking alternative solutions for sustainable development. The Industrialised Building System Modular System (IBSMS) emerges as a promising sustainable approach for home design and has developed as a transformative approach in the construction industry, holding massive potential for sustainable development. Nevertheless, certain merits and challenges must be addressed to promote the widespread adoption and implementation of sustainable development within the Malaysian construction industry. To provides a complete analysis of the merits and challenges associated with IBSMS, a questionnaire survey was conducted with the aim of shedding light on its role in fostering the success of sustainable development. The survey targeted G7 contractor companies in Selangor, resulting in 77 valid responses. The data obtained from the survey underwent descriptive analysis. The survey findings revealed that the most significant challenges hindering IBSMS adoption were the shortage of construction professionals experienced in working with modular systems, logistical complexities, cost implications, complex compliance implementation procedures, and resistance to change. Addressing the complex balance between these merits and challenges is crucial for policymakers, construction professionals, and researchers in unlocking the full potential of IBSMS in sustainable development and advancing construction in Malaysia.

**Keywords:** Sustainable Development, Industrialised Building System Modular System, Merits, Challenges

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## **INTRODUCTION**

In an era marked by rapid development, resource scarcity, and environmental concerns, the construction industry faces an urgent need to embrace innovative approaches aligned with the principles of sustainability. In recent years, IBSMS has gained attention as a construction method that holds the potential for improving efficiency and quality in the Malaysian construction industry. Unlike the traditional construction paradigm, characterised by on-site assembly of buildings using labour-intensive and often wasteful methods, IBSMS, with its emphasis on off-site fabrication, assembly line production, and modular components, presents a compelling alternative that offers various advantages for the construction industry and broader societal goals. However, despite its promising advantages, the widespread adoption of IBSMS in Malaysia faces significant challenges. These challenges hinder the effective implementation of the system and limit its progress in comparison to other countries.

This research aims to investigate the merits and challenges associated with IBSMS in the context of sustainable development within the state of Selangor, Malaysia. Therefore, it is essential to conduct a questionnaire survey among registered contractor companies in Selangor to identify and understand the merits and challenges associated with IBSMS. The primary purpose is to provide insights that will guide its successful integration into sustainable construction practices in the Malaysian construction industry. By gaining insights into these benefits and challenges, appropriate measures and strategies can be developed to overcome them, ultimately enhancing the implementation of IBSMS, and leading to improved innovative construction practices and outcomes in Malaysia.

## **LITERATURE REVIEW**

### **Industrialised Building System Modular System (IBSMS)**

Construction industry is a significant contributor to the economy of developed countries, including Malaysia. Unfortunately, the Malaysian construction industry has recently faced challenges related to productivity, wastage, performance, and an over-reliance on foreign labour (Rahman et al., 2012). Since Industrialised Building System (IBS) is already established in the Malaysian construction industry, it is vital to adapt IBSMS to the IBS approach. The IBSMS has been improved to address current and future demands challenges. In addition, it holds a great potential to eliminate the current IBS limitations and drive the industry towards improved views, rapid progress, and sustainability. 14% of experts agreed that IBSMS is suitable for future construction planning in Malaysia (Aziz et al., 2019).

The adoption of IBSMS in the construction industry has become increasingly prevalent. Nevertheless, this adoption process is not without its challenges. Successful implementation of IBSMS in construction projects requires addressing key obstacles, including additional transportation and logistics considerations, extensive coordination and organisational requirements, a lack of experience and skills among construction professionals, public and expert perception issues, complex inspection, and code compliance requirements, as well as higher financial risks. These obstacles significantly impact the integration and effectiveness of IBSMS in construction practices.

To comprehensively understand and address these challenges, conducting a literature review is essential. This review based on existing research and scholarly works, aims to provide an in-depth exploration and understanding of the obstacles associated with IBSMS adoption in construction practices (Wuni, Shen, & Mahmud, 2022). The insights gained from this review will contribute to the advancement of research and practice in the construction field, facilitating the successful integration of IBSMS in the Malaysian construction industry.

#### ***Transportation & Logistics Considerations***

One particular challenge in adopting IBSMS in construction practices is the transportation of modular units. This process typically involves the use of large trucks and trailers, necessitating careful logistics coordination. Modular units come in various specifications, with widths ranging from 8 ft to 14 ft, lengths reaching up to 70 ft, and heights between 11 ft and 13 ft. Smooth transportation and logistics require the implementation of specific control measures, such as staging areas, traffic officer control, and parking restrictions. Ensuring the timely and efficient transportation of oversized components to distant locations is vital to prevent delays, mitigate additional costs, and avoid adding complexity to the project schedule. Moreover, the transportation of modular units is subject to the regulations set by a country's road department (Musa et al., 2016).

#### ***Coordination & Organisational Requirements***

Subsequently, effective communication is essential for successfully delivering construction projects, especially with the growing housing demands in the industry (Mohd Fateh et al., 2023). Besides, the fragmented nature of IBSMS presents a considerable challenge in coordinating and ensuring a continuous transition between various work processes. This complexity can result in potential cost overruns and technical difficulties. Therefore, the need for extensive coordination and organisation is also crucial to mitigate these challenges and ensure the successful implementation of IBSMS. To achieve efficiency in project scheduling and cost-effectiveness (Lim et al., 2022), proper coordination among different stakeholders involved, effective planning, and

well-defined processes are necessary. This emphasises the importance of maintaining clear and effective communication channels throughout the project's execution (Al-Mayahi et al., 2018), as it plays a pivotal role in facilitating collaboration and overcoming challenges posed by the modular system's complexities.

### ***Construction Professionals Experience & Skills***

Another significant challenge in adopting IBSMS is the lack of experience and skills among stakeholders and construction professionals in Malaysia. They seem to lack familiarity with IBSMS, which may result in knowledge gaps and potential complications. This lack of familiarity is partly attributed to a limited understanding of the design, applicability, and accomplishment of building practitioners (Navaratnam et al., 2019). Consequently, this issue hinders the proper implementation of the system, leading to improper work procedures and unattained benefits. Additionally, a shortage of modular expertise and skills within the construction industry has also been noted (Aziz et al., 2019). The substandard quality of modular construction in Malaysian projects arises from issues like improper manufacturing, unskilled labour, and inadequacies among architects, engineers, and contractors.

### ***Public & Construction Expert Perception***

Furthermore, the adoption of IBSMS also faces substantial challenges due to negative perceptions from the public and even construction experts (Rahman, 2014). Generally, these unfavourable views often reduce public demand for this construction method, driven by concerns and doubts about its quality and performance. Stereotypes that associate the modular system with cheapness and limited construction options further hinder its widespread acceptance. Despite being recognised as one of the modern methods of construction, the development and adoption of modular construction remain limited to a few developed countries, with a generally low adoption rate in the construction industry (Lim et al., 2022).

### ***Building Codes, Standards & Regulations***

In Malaysia, the construction of modular buildings is regulated by guidelines and regulations established by the Malaysian Construction Industry Development Board (CIDB) and other relevant authorities. These guidelines cover various aspects, including design, construction methods, materials, and quality control measures, tailored to the specific requirements of the Malaysian context (CIDB, 2019). While Malaysian standards and regulations for modular construction may differ from those in other countries, such as the HUD-Code used in the United States, the primary objective remains consistent: ensuring that modular

construction adheres to the necessary implementation procedures standards for structural integrity, safety, and functionality (Said et al., 2014).

One notable challenge encountered when adopting IBSMS in Malaysia is the complexity of the inspection process for modular buildings. Due to the unique characteristics of modular construction, such as non-conventional connections and different procedures, a comprehensive and meticulous inspection of every aspect of the building is required. This complexity, combined with challenges related to building regulations and planning permission procedures, can hinder the process of obtaining building-occupancy approval (Hyams et al., 2018).

### ***Finance Risks***

In addition to the challenges mentioned earlier, another significant obstacle in adopting IBSMS in construction practices is the higher risk to finance. While the system offers cost savings through reduced on-site activity, there are substantial upfront costs associated with automation, including the establishment of fabrication plants, allocation of machinery, equipment, formwork, and transportation fees. Experts argue that the design and engineering aspects of IBSMS can contribute to overall cost increases (Navaratnam et al., 2019). Additional expenses arise from the need for additional design and engineering hours, approximately 10% more than conventional methods, and the use of extra materials, requiring about 30% more structural steel for module transportation (Egege, 2018). These costs can add up to approximately 0.5% of the total construction cost. As a result of these financial considerations, lenders may perceive funding IBS modular projects as risky. The potential bankruptcy of module manufacturers poses a concern for lenders, who may face the risk of losing their investment (Abdelmageed, Abdelkhalek, & Zayed, 2020). Therefore, the higher risk to finance further compounds the challenges encountered in the adoption of IBSMS in the Malaysian construction industry.

## **RESEARCH METHODOLOGY**

The study adopts a quantitative analysis approach, employing a carefully designed structured questionnaire as the primary tool for data collection. The questionnaires underwent meticulous design, incorporating insights from an extensive literature review that included sources such as journals, reports, and seminar papers from Malaysia and other countries. Validation of the questionnaire by experts in the construction field ensured its clarity, relevance, and appropriateness, guaranteeing its quality and applicability.

Selangor was chosen as the research location due to its top rank in project awards for 2021 and 2022, as reported by the CIDB (2022). Additionally,

Selangor is a rapidly developing region in Malaysia with a wealth of building and infrastructure projects, providing ample opportunities for future well-planned and extensive construction endeavours. The study focused on G7 contractors selected based on their eligibility, investment capabilities, experience, and advanced technology, which positioned them as leaders in the IBS market. These contractors' companies, operating in the selected area, are approved, and licensed by the Malaysian CIDB, enabling their engagement with professionals and specialists for larger civil engineering and housing construction projects.

To create an accurate sampling frame, a comprehensive list of potential participants was compiled from diverse sources, including construction industry associations, governmental databases, and academic institutions, primarily within the regions of Gombak, Kuala Langat, and Sepang. The research employed a simple random sampling method to select respondents from the target population, with a primary focus on individuals who are construction experts knowledgeable about IBSMS and its implications. Out of the 4,669 companies registered under CIDB in Selangor, the study specifically targeted the Gombak (29.9%), Kuala Langat (37.7%), and Sepang (32.5%) areas, comprising approximately 95 companies. Using the sampling approach outlined by Krejcie and Morgan (1970), the research selected 77 respondents from registered contractor companies.

## **ANALYSIS AND DISCUSSION**

The research questionnaires were distributed to the respondents via Google Forms, resulting in a 100% response rate, indicating a reliable dataset for further analysis. The collected data was analysed using SPSS version 28 software. In this study, the majority of respondents fell into the age group of 31 to 35 years (28.6%), followed by those aged 36 years and above (26%), 26 to 30 years (24.7%), and 18 to 25 years (20.8%). The majority of respondents were from Kuala Langat (37.7%), while others were from Sepang (32.5%) and Gombak (29.9%). Regarding their job positions, the primary role was Quantity Surveyor (28.6%), followed by other positions, such as Site Manager, Contractor, Project Manager, Project Coordinator, and Safety Officer (23.4%). Architects accounted for 16.9% of respondents, Administration Personnel constituted 16.9%, and Engineers represented 14.3%. Majority of the respondents had 6 to 10 years of experience (36.4%). Respondents with 1 to 5 years and 11 to 15 years of experience each made up 20.8%, while those with 16 to 20 years of experience comprised 16.9%. Only 5.2% of respondents had over 20 years of experience.

### **Implementation of IBSMS**

The findings of this study indicate that a significant proportion of survey respondents, specifically, 41.6%, have worked on at least five modular projects



over their careers, indicating limited exposure to modular construction. Besides, 39% of respondents reported handling 6 to 10 modular projects throughout their professional experience, suggesting a moderate level of involvement in IBSMS implementation. Furthermore, the findings demonstrate that only a small percentage of respondents (16.8%) handled 11 to 15 modular projects, and an even smaller portion (2.6%) managed more than 15 projects, indicating limited involvement in IBSMS projects. Based on the findings, it can be inferred that IBSMS projects are increasingly being adopted in the industry. Within the last 12 months, most respondents (68.8%) had not participated in any modular projects, but over the last five years, a significant portion of the respondents (68.8%) had been involved in modular projects, indicating a growing interest in and adoption of the IBSMS construction methods.

### **Merits in Implementing IBSMS**

Essentially, the summary of the literature review highlights the cruciality in addressing the merits to promote IBSMS projects in future development. As shown in Table 1, merits incorporate a range of factors, from increased construction efficiency and quality to minimised waste and reduced environmental impact.

**Table 1: Merits to promote IBSMS.**

Author	Findings	Benefits
Aziz et al., 2019; Boafo et al., 2016	80% of construction activity will be done in factory	Faster
Kamali & Hewage, 2016; Lawson et al., 2012	The number of visits by delivery vehicles to the site reduced by 70% and the bulk of transport activity has been shifted to the factory	Minimise site disruption and traffic
Musa et al., 2016; Navaratnam et al., 2019	Modular building can be movable, dismantled, refurbished, and relocated for use in another location and for new purposes	Flexible
CIDB, 2019; Said et al., 2014	Reducing the environmental and human health concerns associated with demolition, such as dust production and noise	Environmentally friendly
Abdelmageed et al., 2020; Musa et al., 2016	The programme consists of strict quality control combined with testing protocol and independent inspection that promote superior quality of construction	High quality
Lawson et al., 2012; Peñaloza et al., 2017	IBSMS reduces on-site accidents by 80%	Significantly safer with enhanced security

By identifying the benefits, the industry can facilitate the widespread implementation of modular construction methods, leading to improved efficiency and effectiveness in the construction process. Table 2 presents the analysis of mean scores and rankings obtained from the 77 respondents.

**Table 2:** Merits of implementation of IBSMS in Malaysia’s construction industry.

Category	Mean	Rank
High quality	4.18	1
Faster	3.96	2
Environmentally friendly	3.75	3
Significantly safer with enhanced security	3.73	4
Minimise site disruption and traffic	3.60	5
Flexible	3.57	6

Evidently, the results show that a significant number of respondents emphasised the high quality achievable in the modular system, ranking it first with a mean score of 4.18. They also recognised the faster procedure of modular construction, ranking it second with a mean score of 3.96. Subsequently, environmentally friendly, and significantly safer with enhanced security were ranked third and fourth, with mean scores of 3.75 and 3.73, respectively. On the contrary, the results reveal that site disruption and traffic minimisation, as well as flexibility of the modular system, were ranked fifth and sixth, with mean scores of 3.60, and 3.57. Apparently, the results suggests that the respondents highly value the quality and speed advantages of the modular system, while the perception of its flexibility and potential for minimising site disruption and traffic is relatively lower. This suggests a need to address perceived challenges and better promote the benefits of modular construction in Malaysia's construction industry. The lower ranking and mean scores in this aspect could be due to a lack of exposure to successful implementations or a need for more evidence and case studies to showcase these advantages. Consequently, the findings emphasise the need for addressing the perceived challenges associated with modular construction. These challenges could include misconceptions about its limitations, concerns about integration with existing construction practices, or the need for clear guidelines and standards for modular projects.

### **Challenges in Implementing IBSMS**

The final section of the questionnaires aims to assess the obstacles related to IBSMS, as identified by previous researchers. Table 3 highlights significant challenges, including a lack of construction professionals experienced with modular systems, logistics complexities, cost implications, complex compliance

implementation requirements, and resistance to change. These challenges require strategies for the successful integration of IBSMS in Malaysia.

**Table 3:** Significant challenges of IBSMS implementation.

Author	Description	Challenges
Musa et al., 2016; Rahman, 2014; Xu et al., 2020	Modular units need to be transported by large trucks and trailers and imposed with additional overhead of logistics coordination	Transportation and logistics consideration
Rahman, 2014; Xu et al., 2020	Coordination and transition challenges	Extensive coordination and organisation
Aziz et al., 2019; Navaratnam et al., 2019	Lack of modular expertise and skills in the construction industry	Lack of experience and skills
Paliwal, 2019; Rahman, 2014; Subramanya et al., 2020	The concept of IBS modular system is viewed negatively by public and even to some experts in the construction industry	Negative public and expert perception
Xu et al., 2020	The complex structure of the system involving non-conventional connections, indeed demands more inspection effort	Complex inspection and code compliances
Abdelmageed et al., 2020; Egege, 2018; Navaratnam et al., 2019	Some experts believed that the design and engineering of IBS modular system can add up to the overall cost	Higher risk to finance

Table 4 presents the findings on the critical challenges encountered when implementing the IBSMS in the Malaysian construction industry.

**Table 4:** Challenges in adopting IBSMS in Malaysia's construction industry.

Category	Mean	Rank
Lack of experience and skills	4.23	1
Additional transportation and logistics consideration	3.99	2
Higher risk to finance	3.96	3
Complex inspection and code compliance	3.86	4
Extensive coordination and organisation	3.36	5
Undesirable public and expert perception	2.97	6

Likewise, the present analysis has identified the top six challenges, as deemed by industry professionals, in adopting IBSMS as the most challenging. Among these challenges, the lack of experience and skills among construction professionals emerged as the highest-ranked concern, with a mean score of 4.23. The respondents strongly agreed that this aspect poses the most significant challenge in adopting IBSMS in Malaysia. Following closely, additional

transportation and logistics considerations were ranked second, with a mean score of 3.99. The respondents identified this as another critical challenge impacting the adoption of IBSMS. The third and fourth ranks were assigned to the challenges of higher risk to finance and complex inspection and code compliance, with mean scores of 3.96 and 3.86, respectively. These challenges were recognised as important factors that need to be addressed for the successful implementation of IBSMS in the Malaysian construction industry. On the other hand, extensive coordination, and organisation, as well as undesirable public and expert perception, were rated as the least challenging aspects in adopting IBSMS. These factors obtained the fifth and sixth ranks, with mean scores of 3.36 and 2.97, respectively. Although they were perceived as less challenging, they still warrant attention to ensure the smooth adoption and integration of IBSMS in the Malaysian construction industry.

## **CONCLUSION**

This research has revealed that IBSMS holds significant promise for advancing sustainable development in the construction industry. Through a comprehensive literature review exploration and a structured questionnaire survey of merits and challenges, drawing upon the experiences and perceptions of construction professionals and stakeholders in Gombak, Kuala Langat, and Sepang, within the state of Selangor, Malaysia, it has highlighted the potential benefits of IBSMS, including a range of factors, from increased construction efficiency, quality to minimise material waste and reduced environmental impact by energy efficiency, and enhanced occupational safety. These merits not only align with the principles of sustainable development but also point out the potential of IBSMS to transform the construction industry, making it eco-friendlier and more efficient. At the same time, however, this study also pinpointed significant challenges, such as initial cost considerations and resistance to change, that require strategic planning and policy support to facilitate the widespread adoption of IBSMS. Addressing these barriers could encourage more extensive engagement with IBSMS projects and pave the way for greater efficiency and cost-effectiveness in the construction industry. Among the challenges identified in this research, lack of experience and skills among construction professionals emerged as the most significant obstacle. This finding emphasises the importance of investing in training and capacity-building programmes to equip construction professionals with the necessary expertise to implement modular construction practices effectively.

In conclusion, addressing these challenges is crucial to unlocking the full potential of the modular system and promoting the successful integration of IBSMS in the Malaysian construction industry. While the significance of undesirable public and expert perceptions was relatively low, stakeholders should

still make efforts to enhance awareness and understanding of the benefits and capabilities of the modular system. Active engagement with stakeholders, encompassing the public and industry experts, enables the dispelling of misconceptions, thus paving the way for increased acceptance and adoption of modular construction methods. To mitigate these challenges, it is imperative for construction professionals and stakeholders to take proactive measures such as promoting collaboration and knowledge sharing among industry professionals, encouraging innovative approaches to modular construction, and fostering a supportive regulatory environment that facilitates the adoption of modular techniques. By addressing these challenges head-on and leveraging the benefits offered by the modular system, the construction industry in Malaysia can experience significant advancements. The successful implementation of the modular system can yield a range of advantages, including improved efficiency, reduced construction timelines, enhanced sustainability, and increased cost-effectiveness.

In summary, this study has illuminated the challenges impeding the adoption of the modular system in the Malaysian construction industry. By recognising these challenges and implementing appropriate strategies, stakeholders can overcome barriers and capitalise on the extensive potential of modular construction. The findings will not only benefit individual projects but also contribute to the overall growth and sustainability development of the construction industry in Malaysia.

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## **VIRTUAL REALITY (VR) GEOGRAPHIC INFORMATION SYSTEM (GIS) MODEL TO PROMOTE RURAL TOURISM PRODUCT IN PERAK TENGAH DISTRICT**

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### **Abstract**

Perak Tengah District is not stated as an important tourism cluster in Perak. Nevertheless, Perak Tengah has tourism resources that need to be highlighted as an alternative for rural tourism. The main issue is that Perak Tengah district's tourism resources have not been effectively advertised or utilised, nor have there been any formal digital tourism marketing activities been put into place. The mixed method study was used to identify potential rural tourism products and to obtain the opinion of local operators on how to market the tourism products. The evaluation of rural tourism in terms of goods and destinations in Perak Tengah Districts is the main emphasis of this paper. The findings show that marketing and promotion have emphasised on strengthening local business environments and cultivating strong stakeholder ties. The adoption of Virtual Reality Geographical Information System (VRGIS) model by Perak Tengah District in developing the tourism roadmap or 'Peta Pelancongan' is to encourage communication and data exchange which are the essential elements for its success. For future research, the extension of developing a comprehensive application for rural tourism products in Perak Tengah District should be considered.

**Keywords:** Geographic Information System (GIS), Rural Tourism, Tourism Marketing, Tourism Product, Virtual Reality (VR)

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## **INTRODUCTION**

Each state in Malaysia has created its own methods for marketing tourism-related goods, services, and attractions as a result of the country's growing domestic tourism industry. The local economy and the distinctiveness of some locations are, however, threatened by serious problems. Three key issues regarding tourism marketing and promotion are addressed in the study. In the current Geographic Information System (GIS) database, there are first and foremost gaps in the collection and management of tourism data (Harun & Mat Zin, 2018). Due to incomplete information provided to tourists and the general public regarding local attractions, effective promotion and marketing are hampered. In order to improve tourism advertising and presentation, new technology like Virtual Reality (VR) should be embraced. Even while some companies have started using digital platforms like TripAdvisor, the full potential of virtual reality and smart tourism has yet to be realised because smaller operators cannot afford to do so (Israel et al., 2019).

Finally, insufficient cooperation among tourist stakeholders makes it harder to promote tourism products effectively. Tourism products, particularly those in rural areas, are undermarketed due to a lack of cooperation and communication. Utilising VR and GIS technologies, the study's goal is to create a promotion system for travel-related goods in the Perak Tengah District (Perkins et al., 2020). Exploring a VR-GIS framework for tourism databases, identifying crucial elements for VR promotion, and suggesting an application architecture for Perak Tengah are some of the goals of the study. The theoretical contribution of the paper, which offers a fresh integrated VR-GIS framework for domestic travel in Malaysia, is what gives it its significance. This strategy may boost domestic tourism and revenue. In other words, the study can help local tourism authorities and business owners promote rural tourism and strengthen local economies. Academics, governmental, and industrial cooperation will advance knowledge and produce worthwhile results that will advance societal goals and meet government objectives.

## **LITERATURE REVIEW**

This study focuses on the use of virtual reality (VR) in Malaysian tourist planning, management, and marketing using Geographical Information Systems (GIS). The report suggests a structure where local governments, businesses, and tourism organisations work together to gather and manage data. According to Muhammad Soffian et al. (2021), the GIS is used to construct attributes for research regions, such as location, place names, the category of tourism products, and addresses. Through the use of platforms like Esri's CityEngine, 3D

procedural modelling can be used to integrate VR and GIS (Sameeh El Halabi et al., 2019).

Despite the potential of virtual reality tourism, there hasn't been much study of this strategy in Malaysian tourism over the previous five years. The potential market for cultural heritage in tourism has, however, been recognised by studies carried out in European nations, such as Arnold's research (2005) on virtual tourism in cultural heritage. A few less well-known studies in Malaysia have concentrated on virtual reality or internet methods. For instance, Sharib (2009) used the Online Virtual Malaysia Walkthrough (MAWA) to investigate the utilisation of digital products and pictures. To display complicated data and offer access to Malaysia's remote and inaccessible cultural and natural heritage places, MAWA employs a team of experts in 3D graphics, instructional design, multimedia, and internet development. To study the significance of perceived immersion and physical visitor value in VR tourism, Vishwakarma et al. (2020) used a quantitative approach and the Value-Based Adoption Model (VAM). High Dynamic Range Imaging (HDRI) photography was used by Hashim & Jusof (2010) to document historical sites and analyse photographs.

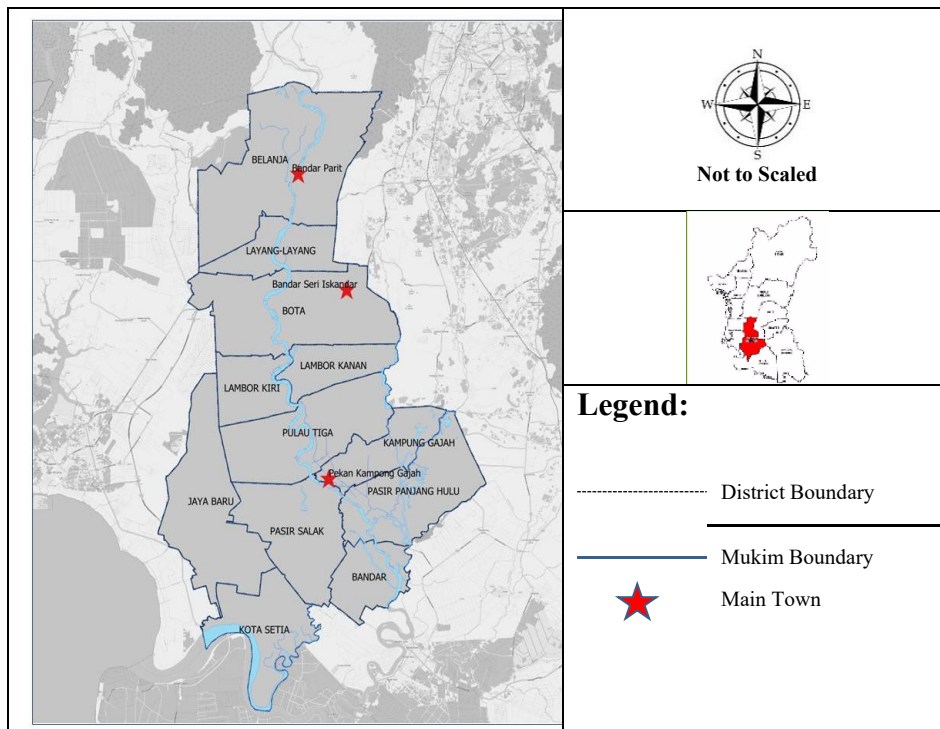
Similar to this, Schiopu et al. (2021) combined perceived attractiveness elements using the Technology Acceptance Model (TAM) to create an alluring tourism mapping system. Harun and Mat Zin (2018) evaluated the potential of cultural heritage as a new tourism destination through a qualitative study that included observation, resource inventories, focus groups, and interviews. Rahmat et al. (2023) improved data collection and analysis by combining qualitative and quantitative methodologies, leading to the production of insightful findings. It is important to note that further proof is required of academics using their research on Malaysian VR tourism and using Geographic Information Systems (GIS) to create VR tourism models. Internet accessibility was identified by Rijal et al. (2023) as the largest obstacle to the use of information technology for tourism promotion. Therefore, traditional and modern technology should be applied in marketing campaigns for travel destinations.

The use of VRGIS in the tourism industry incorporates data from tourism planning, evaluation, and identification of important success elements. To comprehend the elements influencing technology acceptance, the research uses the Technology Acceptance Model (TAM) and the Technology, Organisation, and Environment (TOE) framework. Technology adoption is significantly predicted by perceived usefulness and simplicity of use (Chatterjee et al., 2021; Venkatesh et al., 2016). Business marketing and collaboration support issues have an impact on how well technology is accepted.

## RESEARCH METHODOLOGY

### Study Area

The district of Perak Tengah is situated in the middle of the state of Perak. The Perak Tengah district is surrounded by the districts of Kuala Kangsar to the north, Kinta, Kampar, and Batang Padang to the east, Hilir Perak to the south, and Manjung to the west. The two biggest localities are Seri Iskandar, a significant town managed by the Perak Tengah District Council, and Bota, the largest settlement in the region. The Perak Tengah District has a total of twelve mukims. Mukim Belanja, Mukim Bota, Mukim Lambor Kanan, Mukim Lambor Kiri, Mukim Kampung Gajah, Mukim Pasir Salak, and Mukim Pulau Tiga are the only tourist attractions in the research area. However, some mukim, like Mukim Layang - Layang, Mukim Jaya Baharu, Mukim Bandar, Mukim Pasir Panjang Hulu, and Mukim Kota Setia, do not have any tourism-related goods. The main industry in these areas is agriculture. It is, therefore, expected that the necessary data may be successfully gathered. Figure 1 depicts the study area and the location of the main towns in the Perak Tengah District.



**Figure 1:** Study Area: The District of Perak Tengah  
*Source: Perak Tengah District Councils (2018)*

## Research Method

A mixed method approach was employed to collect data for the study. The qualitative approach used was an observation survey, while the quantitative approach used was a questionnaire survey, which was utilised to obtain the local business owners' perspectives on marketing tourism products.

## Data Collection

The rural tourism products included in the study are restaurants, hotels and hostels, parks, tourism facilities, and historical areas and buildings. The list of tourism products was obtained from the Tourism Unit at Perak Tengah Local District and searched through Google Earth 2019 by setting more than 10 reviews. The first list provided has a total of 229 potential rural tourism products from all categories. The observation surveys had to be conducted first to ensure the existence and validity of the data on rural tourism products.

A questionnaire survey was conducted among the local tourism product operators after the verification of the listed rural tourism products. The objective of the survey was to determine the local operators' marketing methods for promoting their products.

## ANALYSIS AND DISCUSSION

### Verification and Validation of Rural Tourism Products

Based on the observation, there were 229 coordinate locations for commodities related to tourism, which were arranged into five main groups, which include Accommodation (56 units), Food and Beverages (85 units), Education and Institution (37 units), Places and Attractions (23 units), and Trade and Services (28 units). However, during the observation survey, it was found that the number of validated rural tourism products were as follows: Accommodation (17 units),

Food and Beverages (46 units), Education and Institution (40 units), Places and Attraction (31 units), and Trade and Services (35) units (Table 1).

**Table 1:** Listed Rural Tourism Products in Perak Tengah District

Num	Groups of Tourism Product	Listed Rural Tourism Products	Validated Rural Tourism Products
1	Accommodation	56	17
2	Food and Beverages	85	46
3	Education & Institution	37	40
4	Place and Attraction	23	31
5	Trade and Services	28	35
	<b>Total</b>	<b>229</b>	<b>169</b>

From the listed rural tourism products, it was found that there are several mukims in the Perak Tengah Districts that sell a range of tourism

products. There are 132 units each at Mukim Bota, 31 units at Mukim Kampung Gajah, and 15 units at Mukim Belanja. However, some mukims have at least two types of tourism products. For example, Mukim Lambor Kanan has 13 units without accommodation, Mukim Lambor Kiri has two units of food and drinks and one unit of educational institution, Mukim Pasir Salak has 14 units without trade and services, and Mukim Pulau Tiga has four attraction places and heritage sites and four units of accommodation. There are also some mukims that only offer one specific type of tourism product, such as Mukim Bandar with one educational institution, Mukim Kota Setia with five food and beverage establishments, and Mukim Layang - Layang with one educational institution. However, as shown by Mukim Pasir Panjang Hulu and Mukim Jaya Baru, there is no unique tourism product which has been created. Refer to Table 2.

**Table 2:** Listed Rural Tourism Products by Mukim in Perak Tengah District

Area / Mukim	Listed Rural Tourism Products	Validated Rural Tourism Products
BP1-Belanja	21	22
BP2-Layang-Layang	1	1
<b>BP3-Bota</b>	<b>132</b>	<b>99</b>
<b>BP4-Lambor Kanan</b>	<b>13</b>	<b>7</b>
BP5-Lambor Kiri	3	3
<b>BP6-Pulau Tiga</b>	<b>8</b>	<b>3</b>
<b>BP7-Kg. Gajah</b>	<b>31</b>	<b>28</b>
BP8-Pasir Panjang Ulu	0	0
<b>BP9-Pasir Salak</b>	<b>14</b>	<b>4</b>
BP10-Bandar	1	2
<b>BP11-Kota Setia</b>	<b>5</b>	<b>0</b>
BP12-Jaya Baharu	0	0
<b>Total</b>	<b>229</b>	<b>169</b>

After the verification and validation from the survey, the actual numbers of tourism products found at the sites are not the same as the list provided. This is because the preliminary data of 229 coordinate locations were obtained from google earth in 2019, which was before the Covid-19 outbreak. After the Covid-19 epidemic subsided, many of these places were closed and no longer in operation. A total of 169 tourism products were used as the final data to be analysed further. Refer to Table 2 above.

### Elements of Perak Tengah Districts' Rural Tourism Products

The observation survey of rural tourism products was broken down into five categories based on the product's fundamental characteristics. Some of the factors at work include signage, accessibility, surrounding conditions, parking provisions and support facilities like restrooms and prayer rooms. Overall, it was discovered that rural tourism products have a moderate level of service. Based on the average mean, the highest element of rural tourism products, as shown in Table 3, is accessibility with  $M=4.33$  and is considered to be at a good level. While the lowest element is supporting facilities with  $M=3.52$  and is considered at moderate level. The findings show that the supporting facilities need to be improved. Meanwhile the details of the highest and lowest provision of each element at the rural tourism products are shown in Table 3.

**Table 3:** Elements of Rural Tourism Products in Perak Tengah Districts

Num	Elements	Item	%	Total	Mean	Rank
1	Signage	<b>Very Clear</b>	<b>38.6</b>	<b>65</b>	3.76	3
		Clear	29.3	50		
		Moderate Clear	13.8	24		
		<b>Not Clear</b>	<b>6.5</b>	<b>11</b>		
		Not Very Clear	11.8	20		
		<b>Total</b>	<b>100</b>	<b>169</b>		
2	Accessibility	<b>Very Easy to Reach</b>	<b>56.5</b>	<b>95</b>	4.43	1
		Easy to Reach	32.5	55		
		Moderate to Reach	7.7	13		
		Hard to Reach	3.3	5		
		<b>Very Hard to Reach</b>	<b>0</b>	<b>0</b>		
		<b>Total</b>	<b>100</b>	<b>169</b>		
3	Surrounding Condition	<b>Very Good</b>	<b>56.3</b>	<b>95</b>	4.33	2
		Good	22.5	38		
		Moderate	19.2	32		
		Bad	2	4		
		<b>Very Bad</b>	<b>0</b>	<b>0</b>		
		<b>Total</b>	<b>100</b>	<b>169</b>		
4	Parking Provision	Very Adequate	19.9	34	3.66	4
		<b>Adequate</b>	<b>38.2</b>	<b>65</b>		
		Moderate	30.5	51		
		Not Adequate	10.2	17		
		<b>Very Not Adequate</b>	<b>1.2</b>	<b>2</b>		
		<b>Total</b>	<b>100</b>	<b>169</b>		
5	Supporting Facilities	Very Adequate	13.8	24	3.52	5
		<b>Adequate</b>	<b>40.7</b>	<b>69</b>		
		Moderate	33.3	56		
		Not Adequate	8.1	14		

Num	Elements	Item	%	Total	Mean	Rank
		<b>Very Not Adequate</b>	<b>4.1</b>	<b>7</b>		
		<b>Total</b>	<b>100</b>	<b>169</b>		

Signages at tourist attractions are essential to guide the visitors and act as maps for them. Thus, the elements of signage which are important include accessibility, readability, and clarity. Additionally, guides and signs are necessary for some distant tourist spots located in off-the-beaten-path Promoting Perak Tengah as a tourist destination requires keeping tourist hotspots in good condition. Finally, support facilities, including parking lots, prayer rooms, and restrooms, are essential for visitors' convenience.

In order to obtain a pattern of promotion among local operators of rural tourism products, a total of 73 respondents were selected from a total of 169 rural tourism products. Based on 5 groups of tourism, only 4 groups are applicable for local tourism products which are Accommodation (10), Food and Beverages (38), Place and Attraction (11) and Trade and Services (17). Out of the 73 respondents, 60.3% were males (44) and 39.7% were females (29). The highest number of respondents were in the age range of between 35 – 44 years old while the lowest number were in the age range of 65 years old and above. Refer to Table 4.

**Table 4:** Respondent Profile Background

Variable	Sub-Variables	Frequency	%
Gender	Male	44	60.3
	Female	29	39.7
	<b>Total</b>	<b>73</b>	<b>100</b>
Age	18 -24 Years Old	5	6.8
	25 -34 Years Old	23	31.5
	<b>35 - 44 Years Old</b>	<b>28</b>	<b>38.4</b>
	45 -54 Years Old	8	11
	55 - 64 Years Old	6	8.2
	<b>65 Years Old and Above</b>	<b>3</b>	<b>4.1</b>
	<b>Total</b>	<b>73</b>	<b>100</b>

Based on the questionnaire survey conducted among local operators for the purpose of obtaining information of their preference in promoting and marketing their products, the majority or 64.7% (66) of them are using website and social media and very few of them, 8.8% (9) are using radio and mass media. It shows that people nowadays prefer using technology instead of conventional methods. Refer to Table 5.

It was found that 30.1% (22) of the local operators carried out their promotion and marketing every day. Meanwhile, 26% (19) carried out their promotion and marketing 2-3 times per week, 21.9% (16) did it once a week and the remaining 21% (16) did not specify the frequency of their promotional activities. This shows that the local operators are aware of the importance of promotion and marketing. Refer to Table 6.

**Table 5:** Promotion and Marketing Type by Local Operator

Type of Promotion and Marketing of Tourism used	Frequency	%
Paper based - Brochure, newspaper, and flyers	12	11.8
Websites and social media	66	64.7
Radio and Mass Media	9	8.8
Collaboration within Travel Agencies and Local Operator	15	14.7
<b>Total</b>	<b>102</b>	<b>100</b>

**Table 6:** Promotion and Marketing Type by Local Operator

Frequency of Promotion	Frequency	%
<b>Everyday</b>	<b>22</b>	<b>30.1</b>
2-3 Times per week	19	26
1 Time per week	16	21.9
Others	16	21.9
<b>Total</b>	<b>73</b>	<b>100</b>

## **PROPOSED VIRTUAL REALITY (VR) USING GEOGRAPHIC INFORMATION SYSTEM (GIS) MODEL FOR RURAL TOURISM PRODUCTS IN PERAK TENGAH DISTRICT**

The VR is an interactive map in the GIS application we created to show the icons, locations, brief information, categories, photos and videos of rural tourism products. Utilising the QGIS 3.26 programme, the validated rural tourism products data gathered from the observation survey are documented as coordinate points. These interactive maps are also linked with Google Street so that the location of the rural tourism products is shown in 3D. There are five categories of rural tourism products which are accommodation (56 units), food and beverages (85 units), education and institutions (37 units), places and attractions (23 units), and trade and services (28 units). This paper discusses only one category of rural tourism products, which is food and beverages. An example of the QGIS data attribute of food and beverages is shown in Figure 2.



fid	id	Nama	Alamat	Jenis	Waktu	Tarikan	No Tel	BP	Gambar	Video	Rating	Hari	A
1	1078	D Parit Cafe	NULL	Food & Bevera...	12.00 pm – 9.00...	Mee Hailam	60104632204	Belanja	1078_D'Parit Ca...	NULL	NULL	NULL	NULL
2	1079	Mee Hailam Pe...	NULL	Food & Bevera...	10.00 a.m – 5.00...	Mee Hailam	60122487455	Belanja	NULL	NULL	NULL	NULL	NULL
3	1080	Kedai Shamyut...	NULL	Food & Bevera...	8.00 a.m – 3.00 ...	Sarapan Pagi d...	NULL	Belanja	1080_Kedai Sha...	1080_Kedai Sha...	3	NULL	NULL
4	1089	Restoran Rizzul...	NULL	Food & Bevera...	10.00 a.m – 5.00...	Makanan Tenga...	NULL	Bota	1089_Rizquillah	1089_Rizquillah ...	NULL	NULL	SIBC
5	1090	Restoran Redan...	No 90	Food & Bevera...	10.30 a.m – 5.00...	Makanan Tenga...	60195479661	Bota	1090_Redang P...	1090_Redang P...	NULL	NULL	SIBC
6	1092	D'krabi Tomya...	No 308	Food & Bevera...	5.00 p.m – 11.0...	Makanan Mala...	60116525273	Bota	1092_D'Krabi To...	1092_D'Krabi To...	NULL	NULL	SIBC
7	1093	MASTERGRILL	No 380 & 381, 14	Food & Bevera...	4.30 p.m – 12.0...	Makanan Barat	60199999062	Bota	NULL	NULL	NULL	NULL	SIBC
8	1094	Botalleft Restaur...	No 255	Food & Bevera...	4.30 p.m – 12.0...	Makanan Mela...	60133397782	Bota	NULL	NULL	NULL	NULL	SIBC
9	1095	Stalista Street's ...	No 254	Food & Bevera...	4.00 p.m – 12.0...	Makanan Mela...	60162380547	Bota	1095_Stalista Str...	1095_Stalista Str...	NULL	NULL	SIBC
10	1097	Restoran Seri Ik...	No 499	Food & Bevera...	8.00 a.m – 6.00 ...	Makanan Mela...	60125414770	Bota	1097_Restoran ...	1097_Restoran ...	NULL	NULL	SIBC
11	1098	Mokti's Gula A...	486, Persiaran S...	Food & Bevera...	10.00 a.m – 6.00...	Aiskrim Gula A...	60194467641	Bota	1098_Mokti's G...	1098_Mokti's G...	NULL	NULL	SIBC
12	1101	Che'ou Cafe. R...	No 411 & 410	Food & Bevera...	3.00 p.m – 11.0...	Makanan Ala T...	60194334310	Bota	1101_Che'ou C...	1101_Che'ou C...	NULL	NULL	SIBC

**Figure 2:** Food and Beverages in QGIS 3.26

As the first step, an extension of the use of the VR rural tourism product for promotional purposes, the 2D QGIS map was used to publish promotional materials on the website. A tourism website was launched by the research team in collaboration with the Perak Tengah District Council. The tourism website is part of the smart city initiatives by Perak Tengah District Council. This initiative not only can help the local council but also tourism operators to promote their tourism products which are available in the Perak Tengah District. Figure 4 shows an example of tourism roadmap or ‘Peta Pelancongan’ smart city initiative of QGIS 2D Map for Food and Beverages published in the tourism website. By clicking the tourism categories, then clicking the tourism product icon, all the information related to the product, photos and videos will be displayed on the screen. The data in QGIS will be updated from time to time to make sure that the tourism website is always up-to-date. The tourism roadmap or ‘Peta Pelancongan’ website is still under construction and is not yet open for public access. This ‘Peta Pelancongan’ is also linked with the Google Street so that the location of the rural tourism products can be seen in 3D.

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 Virtual Reality (VR) Geographic Information System (GIS) Model to Promote Rural Tourism Product in Perak Tengah District

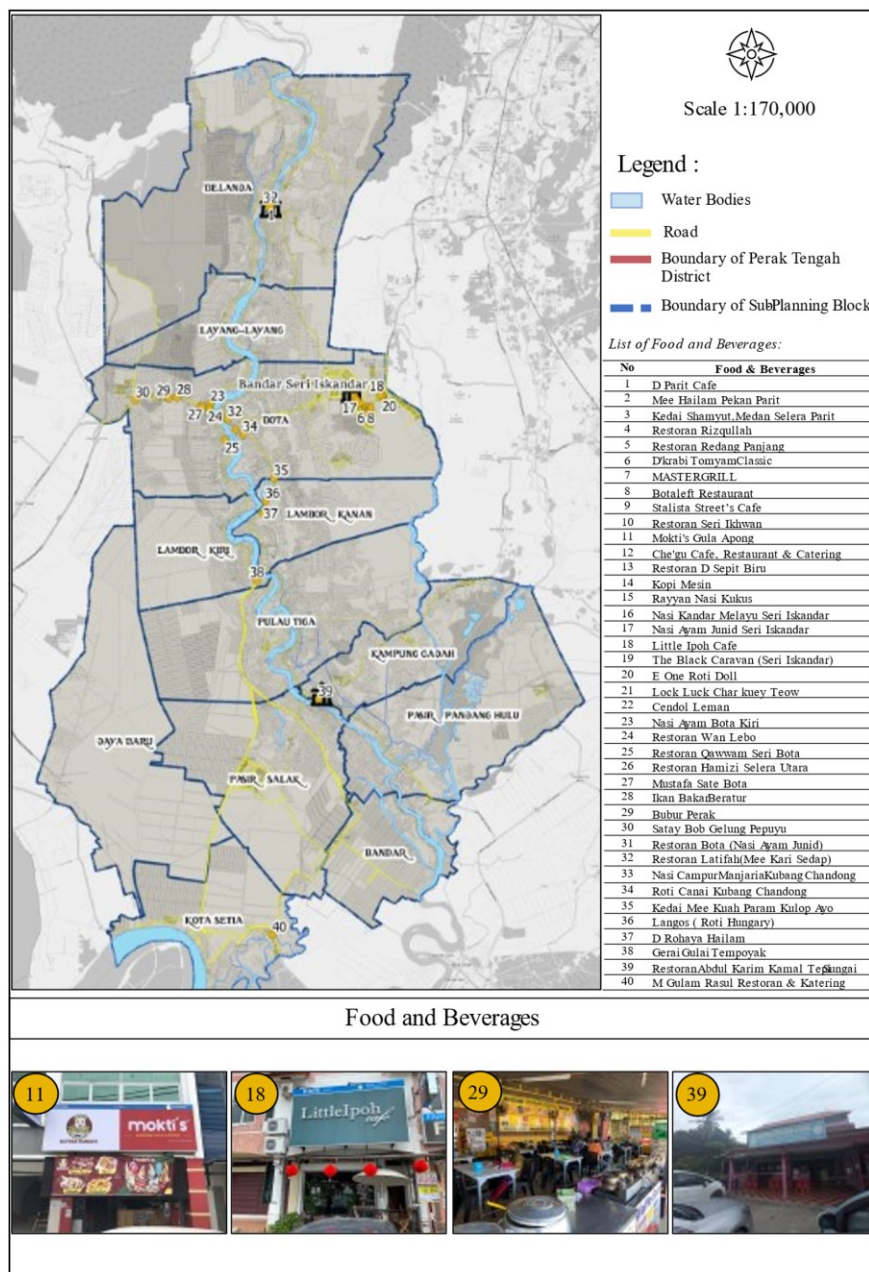
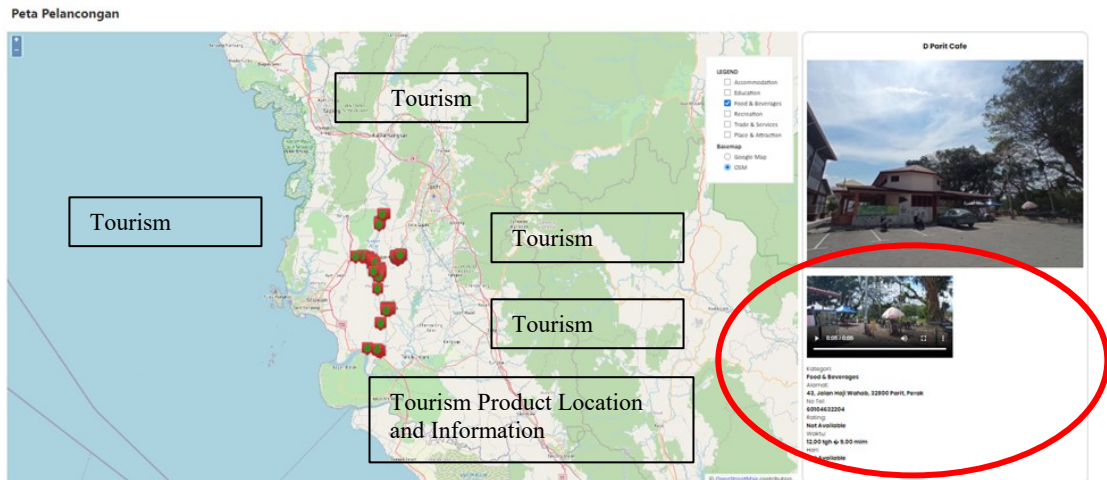


Figure 3: Example of QGIS data and 2D Map for Food and Beverages



**Figure 4:** Example of QGIS 2D Map for Food and Beverages Publish in Tourism Website and also Linked with 3D Google Street

## CONCLUSION

According to the distribution of rural tourism products in Perak Tengah District there are five categories of tourism products available in the area which are 1) place and attraction, 2) accommodation, 3) trade and services, 4) education and institution, and 5) food and beverages with 169 validated rural tourism products. It can be concluded that based on the five provision elements, which are signages, accessibility, surrounding conditions, parking provision and support facilities, most of the rural tourism products are rated between moderate to good levels. The element which received the highest ranking is accessibility. With regard to the opinion of 73 rural product operators on the promotional and marketing channel preference, the majority of them prefer to use the website and social media.

Since many local operators are using websites and social media to promote their products, the researchers' proposed framework of incorporating VR in local tourism promotional activities in collaboration with Perak Tengah District Council is timely. The collaboration entails the researcher providing the QGIS 2D mapping data to the Perak Tengah District Council while the council is responsible in establishing the tourism roadmap called 'Peta Pelancongan'. The 'Peta Pelancongan' is an integrated website that has all the information about the rural tourism products in Perak Tengah District and is also linked with Google Street so that the rural products can be seen in 3D. The website will be opened for public access soon. For future research, it is proposed that the website be made accessible through an application that provides easier access to the website, for example, using a mobile phone.

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## **LESSONS LEARNED FROM COVID-19 PANDEMICS IN MALAYSIA'S FACILITIES MANAGEMENT ORGANISATION**

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### **Abstract**

The COVID-19 pandemic necessitates a significant response from the construction industry. The increasing recognition of the virus's transmission has demanded the enhancement of quality in multiple domains. The primary responsibility of Facilities Management (FM) is to guarantee the operational effectiveness, comfort, security, environmental friendliness, and productivity of the constructed surroundings. This paper seeks to examine the lessons learned from measures implemented by FM organisations during the COVID-19 pandemic. This research employs a quantitative methodology approach. The questionnaires were disseminated to 317 FM firms in Selangor with a response rate of 36%. The results found that most facilities managers had an ample understanding of FM organisation management throughout the pandemic. It is of utmost importance to comprehensively ascertain the lessons learned in FM during the COVID-19 pandemic and proactively equip and strategize themselves to handle future pandemics and disruptions by cultivating the capacity and resilience to respond to environmental shocks. The implementation of the plan is of utmost importance as it serves as a guiding principle for future actions. The endeavour and the knowledge gained from past pandemics have shaped an industry proposition for a fair and impartial approach to addressing future pandemics in Malaysia.

**Keywords:** Facilities Management, Covid-19, Lessons learned

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## **INTRODUCTION**

Covid-19, a global pandemic, has created significant disruption worldwide, leading to lockdowns in various nations, including Malaysia. These measures were implemented to prevent the spread of the virus. The Malaysian government has implemented the Movement Control Order (MCO) as an approach to address the lockdown situation, commencing on 18th March 2020 (Esa et al., 2020) which has had a significant influence on various industries in Malaysia, particularly the construction sector.

Besides, the COVID-19 pandemic has resulted in extensive disruption to enterprises, daily activities, and operations, especially those related to FM. In addition to healthcare personnel, FM professionals and operatives are also part of the crucial workforce at the forefront of the pandemic. They are responsible for meeting the increased demand to maintain a clean, healthy, safe, and sustainable environment (Ling & Tam, 2022).

The objective of this paper is to examine the lessons learned from measures implemented by FM organisations during the COVID-19 pandemic. The outcome of this paper will identify the best strategies based on lesson learned from the covid-19 pandemics for the future reference of FM organisations.

## **LITERATURE REVIEW**

### **FM during COVID-19 outbreak**

A study carried out by Mehmood et al., (2023) presents a thorough analysis of the difficulties Malaysia encountered during the pandemic, with a focus on public hospital FM. The research concentrates on enhancing facility administration to guarantee hospitals are prepared to handle COVID-19 situations. It incorporates a critical synthesis of data and information on COVID-19 and service management to offer insights applicable to both the current pandemic and upcoming health emergencies. This research is important because it is one of the first to compile information on FM related to the COVID-19 pandemic in Malaysia. It also provides helpful suggestions for how healthcare management could be handled in underdeveloped nations during such emergencies.

### **Lessons Learned from Covid-19 Pandemics in Malaysia's Facility Management Organisation**

#### ***Preparedness and contingency planning***

A single epidemic preparedness is sufficient. However, the covid-19 pandemic has clearly shown that Malaysia was not adequately prepared. To effectively address future pandemics, it is crucial to implement robust preparedness and contingency planning in accordance with established best practices. According to Leibniz (2021), establishing a robust global communication infrastructure can greatly improve countries' capacity to identify and promptly address ongoing

outbreaks, pandemics, and epidemics. Therefore, it is crucial to maintain existing pandemic preparation plans that clearly define specific roles and duties, communication strategies, and processes for distributing resources. Regularly evaluating and modifying these plans based on knowledge acquired from previous epidemics is crucial.

An effective strategy will provide regular updates of risk assessments and inventory resources to mitigate the risk of shortages and ensure prompt action. Historically, previous pandemic outbreaks have experienced a shortage of personal protective equipment (PPE), leading to disruptions in the provision of follow-up care for patients. Consequently, engaging in early planning allows for the mitigation of future difficulties. Malaysian NGOs played a significant role during the crisis by actively mobilising resources to manufacture and distribute personal protective equipment (PPE) to support the frontline workers. As a result of various circumstances that arose during the previous pandemic, some organisations have experienced delays in initiating corporate and community initiatives aimed at reducing the transmission of the virus (Shaharuddin et al., 2021).

#### ***Enhanced hygiene and cleaning protocols***

FM was obligated to significantly increase the frequency of cleaning, with a specific focus on heavily used locations. Amidst the COVID-19 pandemic, there was a heightened emphasis on the significance of maintaining environmental hygiene. Consistently reviewing cleaning techniques, even in non-pandemic times, can preserve elevated standards of cleanliness. It will be crucial in the future to allocate resources towards training cleaning staff and using advanced hygiene technologies.

The COVID-19 disaster has emphasized the importance of thorough preparedness and contingency planning for future pandemics and similar crises. Dhama et al., (2021) stated that the Environmental Protection Agency (EPA) of the United States has recommended several effective substances for use against covid-19. The use of post disinfection methods and employing safe and ecologically friendly disinfectants are crucial to prevent the emergence of health risks. Due to the extensive utilization of EPA-approved disinfectants in response to COVID-19, there was a high demand for professional cleaning services. Besides, by strategically distributing hand sanitizer stations across the workplace to accommodate a larger number of personnel, this efficient disinfection method efficiently stops the spread of germs (Macleod et al., 2023).

Implementing flexible cleaning contracts is a valuable technique for managing cleaning services. These contracts allow for alterations to be made based on current health conditions and occupancy levels. Safi et al., (2022) state that the provision of cleaning and disinfection services to unemployed individuals



during the COVID-19 pandemic has created prospects for a rapid and enduring economic revival.

### ***Flexible work environment***

Amidst the COVID-19 pandemic, methods to maintain physical distance have been implemented to reduce the spread of the virus. While these precautions are crucial for protecting public health, they come with a variety of issues. An important issue with this aspect concerns the modification and reorganisation of physical settings to effectively promote and sustain sufficient physical distancing. The current matter concerns the efficient administration of occupancy restrictions in shared spaces, such as elevators, toilets, and restrooms. This location poses a significant concern as it has the potential to rapidly propagate a virus.

According to Liu et al., (2020) during the early stage of the pandemic, there may be a situation where the government either does not adopt or only partially implements preventive measures and quarantine protocols. This can also happen when there are restrictions on remote work. Furthermore, there is a deficiency in the implementation of signage and floor markers to provide guidance for individuals. To alleviate anxiety, companies should implement navigational signals, signage, and posters to prompt individuals to maintain the necessary physical distance. By utilising subtle cues and guiding individuals to explore their workplace in new ways, floor decals, markings, and graphics can effectively shape behaviour.

### ***Space utilization and management***

Mitigating the impact of COVID-19 on urban green spaces and parks is a growing concern among academics and professionals (Razali & Shukor, 2022). The epidemic has shown the immense value of flexible spaces. It is recommended to reconfigure facilities in a way that allows for quick and efficient setup of areas for social distancing or isolation. By utilising the knowledge acquired throughout this timeframe, it is possible to shape future workplace policies, resulting in improved overall safety and efficiency. Implementing efficient space management strategies helps create physical distance, reducing the risk of employees contracting COVID-19. Efficient utilisation of space could potentially prevent the transmission of the virus. This will have a substantial impact, as the control of space use has been highly beneficial prior to the COVID-19 pandemic (Syed Abdul Aziz et al., 2020).

Employing technology to monitor places in real-time can streamline the management of building occupancy and enhance rules for social distancing. The monitoring of space utilisation and management can be made easier through the use of IWMS (Integrated Workplace Management System) or CAFM (Computer Aided FM) software. Integrating software with sensors enables the efficient

utilisation of space. Therefore, intelligent building technology is deployed. The data collected on the real usage of a space by occupancy sensors is used to guide challenging decisions (Morley, 2023).

### ***Improve Indoor Air Quality (IAQ)***

The significance of indoor air quality (IAQ) has escalated, particularly considering the COVID-19 pandemic. Effective maintenance management is essential for keeping a hygienic and secure indoor environment. An important advancement in maintenance management with regards to IAQ is the implementation of sophisticated air filtration devices. These systems have the capability to eliminate airborne pollutants, such as viruses, from the air inside buildings. Consistent maintenance of these systems guarantees their optimal performance and efficacy in enhancing indoor air quality (IAQ) (Mata et al., 2022). The COVID-19 pandemic has highlighted the importance of indoor air quality in the spread of illnesses. To prevent this danger, it is crucial to prioritise the incorporation of ventilation and air filtration technologies in future facility designs and improvements to current infrastructure by employing effective maintenance strategies and utilising state-of-the-art technologies, the indoor air quality (IAQ) can reduce the risk of diseases being transmitted through the air. (Hamad, 2021).

### ***Health monitoring and reporting***

To address future pandemics in Malaysia, it is crucial to implement proactive health monitoring and reporting systems as a key component of a comprehensive approach. Clear and open health screening and reporting procedures need to be created and shared. In addition, this includes procedures that protect privacy when conducting contact tracking within facilities. According to Dar et al., (2020), proficient contact tracing can enable societies to lift lock-down measures even prior to the availability of vaccines. The goal of mobile contact tracing is to expedite the manual interview-based contact tracing process to contain an outbreak effectively and expeditiously.

The utilisation of information technology in the medical domain has recently been seeing rapid growth. The ability to make informed decisions in the fields of planning, administration, health care, and policy relies heavily on the acquisition of dependable information (Yeong et al., 2021). Health informatics can assume a leading role in tackling a wide range of concerns associated with possible pandemics.

Partnerships with health authorities have the capacity to accelerate the sharing of information and the response to new health hazards. Korri (2023) suggests that implementing policies to consistently improve the performance of the healthcare system and achieve its full potential. Malaysia is committed to

achieving Health for All through the implementation of Universal Health Coverage (UHC). The accomplishments achieved so far have been driven by the continuous multisectoral activities and unwavering political dedication, which will continue to propel progress.

### ***Supply chain resilience***

During the COVID-19 pandemic, depending on external sources for crucial supplies posed a vulnerability. This issue can be alleviated by establishing supply chains that are more resistant and by maintaining strategic stockpiles of essential resources. The use of supply chain resilience helps a country ensure a consistent supply of imports under unexpected situations. For instance, stockpiling all crucial resources such as key medical supplies, personal protective equipment (PPE), and pharmaceuticals is done to guarantee a prompt reaction in the event of a pandemic. Formulate agreements with suppliers to ensure a dependable network for the distribution of goods. Accenture, (2023) state that manufacturing organizations can promptly tackle the issue of suboptimal manufacturing by utilizing the available data to perform a retrospective analysis of the fluctuating supply and demand.

To anticipate future demand and ensure the smooth operation of an organization, contemporary forecasting methods establish a connection between sales needs, operational capabilities, the availability of raw materials and components, and projected future demand (Frank McKay, 2023). Nevertheless, organizations want more than just these interdisciplinary understandings confined to their internal operations, considering the intricacy of contemporary worldwide supply networks.

### ***Technology and innovation***

Raising awareness of green technology and its societal applications can improve understanding and prevent negative environmental effects (Abdullah, et al., 2024). The utilization of technology for FM was crucial during the outbreak such as contactless entrance, digital occupancy tracking, online reservation systems for shared venues, and mobile health screening applications. New technologies, such as the internet of things (IoT) and artificial intelligence (AI), are crucially involved in several areas, including healthcare, economics, and education, to monitor and reduce the effects of the COVID-19 pandemic.

Mondal & Mitra, (2022) define the Internet of Things (IoT) as a technology that involves equipping physical objects with sensors, software, and network connectivity. This enables these objects to perceive their surroundings, analyse and interpret real-time data, and communicate and share information with each other through a wireless network.

Furthermore, it is necessary for ventilation technologies to incorporate HVAC systems with sensors and monitoring tools to enhance ventilation, regulate humidity levels, and ensure that air quality meets industry standards. (Santos et al., 2020).

Mukherjeereduce, (2021) asserted that the utilization of contactless services reduces interpersonal contact, hence mitigating the transmission of the virus. IoT sensors can be utilized to monitor the levels of hand sanitizer, assuring a continuous and readily available supply at the stations.

### ***Communication and training***

During periods of health crisis, timely, effective, and transparent communication methods are essential. Staff and guests rely on accurate information concerning facility operations and safety measures. Research has demonstrated that transformational leadership, training and development, and communication have a good effect on employee engagement. This research offered significant theoretical contributions by investigating the aforementioned factors as integral components of the reciprocal interaction between employers and employees, and their impact on employee engagement during the COVID-19 pandemic (Mustaffa et al., 2022).

Organizational culture should encompass routine training sessions on health and safety protocols, which should also cover potential outbreak situations. According to Yeong et al., (2021) risk assessment and hazard identification methods are crucial elements of workplace health and safety measures. If an organization fails to properly identify risks, it runs the risk of not recognizing potential dangers within its premises that could put its employees and anyone nearby at risk.

### ***Psychological support and employee Well-being***

The COVID-19 lockdown is anticipated to have a substantial effect on the psychological well-being of employees. This impact is likely to be influenced by various aspects, including as perceived workplace stress, the response of the organization, conflicts between work and home responsibilities, and the level of flexibility provided (Al-Jubari et al., 2022). The challenge of establishing a healthy work-life balance is intensified during a pandemic when employees are required to work remotely from their homes.

Kundi et al., (2020) found that affective commitment in employees may serve as a mediating element in the relationship between job performance and psychological well-being. Effective psychological support for employment enhances job performance. By prioritizing and implementing strategies in these specific areas, employers can effectively promote the psychological well-being

of their employees both during and after the COVID-19 pandemic by fostering a work environment that is healthier and more supportive.

### **RESEARCH METHODOLOGY**

This research aims to investigate lessons learned from covid-19 outbreaks in FM organization in Malaysia for future strategies improvements. The scope of the research includes the 317 FM firms in Selangor, retrieved from CIDB website 2023. The author selected a sizable sample with a 36% response rate to gain an understanding of the whole issue. As a method for collecting quantitative data, the research employs a questionnaire survey. Then, the data were analysed using a 5-point Likert scale to measure their agreement on each statement related to the issues. The analysis is then conveyed using charts and tables.

### **ANALYSIS AND DISCUSSION**

This section has been specifically developed to achieve the objective of this research, which is to ascertain the FM measures for future outbreaks based on lessons learned. The survey consists of thirteen (13) questions that require participants to rate their agreement on a Likert scale from 1 to 5, where 1 represents "Strongly Disagree" and 5 represents "Strongly Agree".

**Table 1:** Lesson Learned for Future FM Strategies Towards Covid-19 Outbreaks

<b>Lesson Learned: Strategies Towards covid-19 Outbreaks</b>	<b>Ranking</b>	<b>Mean Value</b>	<b>Standard Deviation (SD)</b>
Improved indoor air quality for future facilities and improved existing infrastructure.	1	4.22	0.82
Design spaces and buildings to allow rapid changes in layout for areas of social distancing or isolation.	2	4.21	0.79
Implement a flexible work environment for employees and enhanced protective measures.	3	4.20	0.82
Enhance new technologies and innovations to solve unprecedented crises.	4	4.15	0.86
Contingency planning incomprehensive pandemic preparedness plan.	5	4.15	0.82
A support system for employee mental health and well-being when working remotely.	6	4.14	0.85
Recommendations for good communication and training to facilitate safety measures and facility operations.	7	4.14	0.80
Provides a more resilient supply chain and maintains strategic stockpiles.	8	4.11	0.77
Good network with health authorities for information and quick response.	9	4.08	0.85
Enhanced hygiene and cleaning protocol by investing in training for staff and technology.	10	4.08	0.84

Lesson Learned: Strategies Towards covid-19 Outbreaks	Ranking	Mean Value	Standard Deviation (SD)
Establish clear protocols for health screening.	11	4.04	0.91
Update preparedness regularly to avoid shortages and ensure a quick response.	12	4.01	0.90
Improve the IT infrastructure and policies required to support a smooth transition from face-to-face to remote operations.	13	3.99	0.86

Table 1 presents the lesson learned from the knowledge gained from past experiences for the purpose of developing future strategies in response to a pandemic. The highest mean value is that of the *Improved indoor air quality for future facilities and improved existing infrastructure*, which is 4.22, (SD:0.82). The statement by Mata et al., (2022) provides support for the existence of instances that can enhance indoor air quality. For instance, regularly maintaining the systems to ensure their appropriate functioning and efficacy in improving indoor air quality (IAQ). The mean value for the statement *design spaces and buildings to allow rapid changes in layout for areas of social distancing or isolation* is 4.21, (SD:0.79). This is the second highest mean value. The utilisation management has been highly beneficial prior to the COVID-19 pandemic. The research additionally discovered that implementing a one-meter distance between individuals will effectively halt the transmission of the disease. *Implement a flexible work environment for employees and enhanced protective measures*, has been rated as the third highest mean value of 4.20 (SD:0.82). Hamingson, (2023) asserted that the adoption of a remote working strategy enables organisations to achieve cost savings by eliminating the necessity for costly office space or satellite offices. Moreover, this strategy grants employees the autonomy to select their own schedules and operate remotely from any place. Additionally, it facilitates the mitigation of virus transmission to all regions.

The third lowest ranked for lessons learned strategies towards covid-19 is to *Establish clear protocols for health screening* with an average value of 4.04 (SD:0.91). Malaysia is committed to achieving Health for All by implementing policies outlined by Korri, (2023) to enhance the functionality of the healthcare system and completely achieve Universal Health Coverage (UHC). This allows health authorities to enhance their ability to expedite the transmission of information and respond to emerging health risks. Consequently, proactive health monitoring and reporting systems are crucial component of a comprehensive plan. The key takeaway is the importance to continually *Update preparedness regularly to avoid shortages and ensure a quick response*. This second to last ranking has a mean value of 4.01 (SD: 0.90). Hazell et al., (2019) have provided evidence that SODIS (solar disinfection and disinfection) is beneficial in combating various viral diseases. Currently, this cleaning robot stands as the sole

recipient of third-party safety certification. Consistently demonstrating preparedness will be essential for optimal readiness in the face of future pandemics. The lowest mean value of 3.99 (with a standard deviation of 0.86) is that of *Improve the IT infrastructure and policies required to support a smooth transition from face-to-face to remote operations*. Alghamdi & Alghamdi, (2022) have recognised the utilisation of digital technology as a crucial measure in mitigating the transmission of the coronavirus. This includes employing digital tools for providing aid, medical consultations, healthcare services, and monitoring the spread of the virus. Amidst the COVID-19 pandemic, digital technology was employed to mitigate the transmission of the virus, and its implementation has aided in curbing the infection's spread.

## **CONCLUSION**

The research provides a thorough examination of how FM organisations in Malaysia adjusted to the challenges presented by the COVID-19 pandemic. The statement emphasises the significance of thorough preparation for unexpected events, seamless incorporation of technology, and prioritisation of employee welfare. It also highlights the imperative for FM organisations to improve their crisis management capabilities, strengthen supply chain resilience, and prioritise safety and health measures. The research concludes that the knowledge gained from the pandemic is extremely helpful for better preparing and responding to future crises, not just in the FM sector but also in various other industries.

However, it is important to recognise that every paper has its own set of limitations. The research utilises a quantitative approach, employing surveys that were given to FM firms in Selangor. This method may not adequately encompass the qualitative dimensions of FM concerns and solutions amidst the pandemic.

To streamline further investigation, the researchers propose the following recommendations:

- The incorporation of several geographical regions in the research will offer a broad outlook on the ways for lessons learned during pandemics.
- Employing various methodologies, including the integration of mixed-method research that combines qualitative and quantitative approaches, can lead to more profound insights.
- Examining stakeholders is essential for understanding the perspectives of diverse individuals involved in a particular context, from workers to senior executives. This thorough investigation expands the range and complexity of available information, therefore providing a comprehensive knowledge of the industry's readiness towards pandemics.

The research findings assert that the pandemic had significant impacts on FM in Malaysia, which calls for a reassessment of practices and policies in the future.

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## **MEGA PROJECTS AS A BIG PUSH FOR RURAL DEVELOPMENT AND TRANSFORMATION: A CASE STUDY OF TANJUNG KUPANG, JOHOR**

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### **Abstract**

Mega projects are currently seen as a catalyst for Malaysia's development as they can provide various benefits both in the city and the countryside. However, if the desired progress does not consider the socio-economic aspects of the community, the development will ignore their quality of life. Therefore, the impact of a mega project development in the Tanjung Kupang subdistrict became a research medium. This study examines the impact of a mega project development on the rural communities of the Tanjung Kupang subdistrict. A quantitative approach method was adopted, employing a questionnaire survey involving 61 heads of households as the study sample. Descriptive and inferential statistics were used to analyse the data collected. The findings identified several factors that greatly affected the socio-economic level of Tanjung Kupang rural communities, such as employment, income, and development location. The findings also indicate that the mega project in Tanjung Kupang has had an impact on the rural community in the subdistrict in terms of increased side income (4.48), increased communication and infrastructure networks (4.43), loss of income from agricultural source activities (4.33), and competition of foreign workers with local people (4.23). Therefore, this study may serve as a reference for assessing the impact of a mega project and giving awareness to the construction sector on the importance of social community involvement in any development planning.

**Keywords:** Mega Project, Rural Community, Rural Development, Socio-economic

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## **INTRODUCTION**

In recent years, there has been a resurgence of interest in researching rural development and transformation to understand how mega projects influence urbanisation in rural areas. Projects have undeniably delivered various benefits to both urban and rural communities; they contribute to economic growth and improve infrastructure, thus enhancing the overall standard of living (Preston & Ngah, 2012; Ahmad et al., 2022). As a result, the significant disparity between urban and rural communities has been reduced. Malaysia has set ambitious strategic directions in its development plan, aiming to become a developed and competitive nation. The 12<sup>th</sup> Malaysia Plan (2021–2025) emphasises the promotion of high-impact development through industries and strategic activities as catalysts for economic growth (Rashid et al., 2023). The National Rural Physical Planning Policy 2030 recognises the importance of high-impact development in rural areas. The focus is empowering the rural economy and generating profitable and sustainable income opportunities for the rural community (PLANMalaysia, 2017).

The tenth pillar of the National Rural Development Policy 2030 emphasises the significance of housing, regional development, and rural settlement planning in alignment with the Sustainable Development Goals (SDGs). This includes prioritising the equality of quality of life and well-being between urban and rural areas, as well as within rural areas, by strengthening the roles of various development sectors (Ministry of Rural Development, 2018). Overall, research on rural development and the influence of mega projects on rural urbanisation has underscored the importance of strategic planning and sustainable development to create balanced growth and bridge the gaps between different communities in Malaysia.

The acceleration of local economic development and physical transformation through mega projects has had a profound impact on rural life, bringing about various changes. On one hand, these mega projects have acted as catalysts, creating opportunities for rural communities and stakeholders. They have led to the creation of local jobs, improved income levels, and facilitated better access for local products and services to both internal and external markets. These positive aspects have contributed to the overall upliftment of rural areas (Rashid et al., 2019a; Sieng & Kamarudin, 2021). However, along with the benefits, mega projects have also introduced new challenges and risks. One significant concern is the potential for an imbalanced development focus, where the needs of rural communities might be overlooked in favour of prioritising the interests of investors and clients associated with the mega projects. Such imbalances can lead to neglecting the socio-economic needs of the local population, raising questions about the sustainability and inclusivity of the development (Masamuddin & Rashid, 2022).

This article specifically examines the impacts of mega projects on the development and transformation of rural communities in Tanjung Kupang, Johor, shedding light on the complexities of this evolving rural-urban landscape. By considering both the positive advancements and potential challenges, it aims to provide a comprehensive understanding of the implications of mega projects on rural areas and their inhabitants.

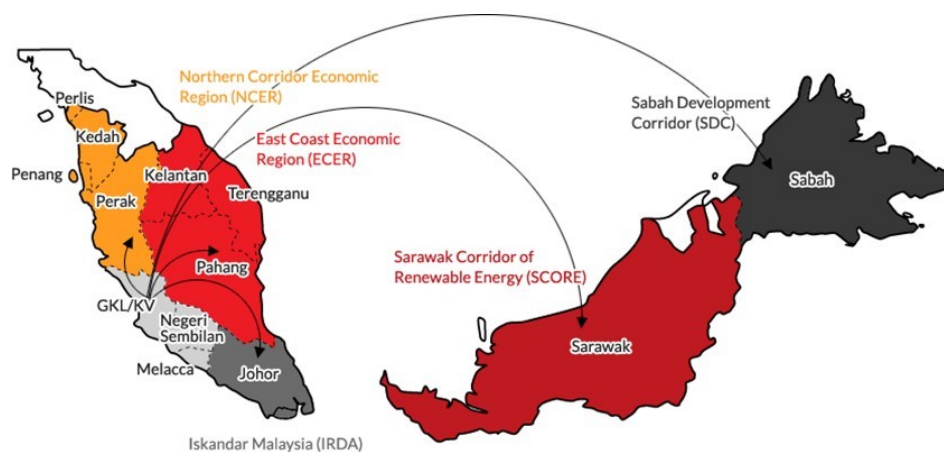
## **LITERATURE REVIEW**

### **Regional Development in Malaysia**

Under the New Economic Policy (NEP) (1971–1990), regional development planning was formulated to become one of the channels to achieve the goal of poverty eradication and the restructuring of society in terms of social, economic and spatial components before the racial riot in Mei 1969. Among the strategies adopted by the Malaysian government was to introduce new land development in border areas. Apart from the main goal of poverty eradication and social restructuring, the Regional Development Authority (RDA) was given the following mandates: to correct economic and structural imbalances between regions, utilise the resource strength of underdeveloped states towards national economic development, strengthen agricultural and industrial development in less developed areas, shifting new development and growth to less developed areas and finally, urbanising rural agricultural areas (Quazi, 1987; Ngah, 2010; Sieng & Kamarudin, 2021; Masamuddin & Rashid, 2022).

Even after NEP ended in 1990, the focus towards regional development and transformation of rural and less developed regions remained as central attention to both the federal and state governments. During the 9<sup>th</sup> Malaysia Plan (MP) (2006–2010), the idea of corridor development as a vehicle to achieve balanced growth was proposed and launched in 2006. In the Mid-Term Review of the 9<sup>th</sup> MP, five economic corridors were announced including the Northern Regional Economic Corridor (NCER) covering the states of Perlis, Kedah, Penang and Perak in the north of Peninsular Malaysia, Iskandar Malaysia (IM) in the south of Johor, the East Coast Economic Region (ECER) covering Kelantan, Terengganu, Pahang and Mersing district in Johor. The remaining two corridors were located in East Malaysia i.e., the Sarawak Corridor of Renewable Energy (SCORE), and the Sabah Development Corridor (SDC) (Krimi et al., 2010; Ngah, 2011) (Figure 1).

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**Figure 1:** Regional Development Corridors in Malaysia  
 Source: Economic Planning Unit (2021)

Committed investment from all corridors is encouraging despite the investments having been much lower and much work needed to lure the investors. Comparing the five investment corridors, the IM region is far ahead in terms of cumulative investment, and this can be expected as IM is close to Singapore and its developments are concentrated in several areas in Nusajaya, near the existing conurbation of Johor Bahru (Ngah, 2011; Sieng & Kamarudin, 2021). IM is also supported by vast and strategic land area and abundant resources and infrastructure, which, in turn, have boosted nine economic sectors namely Electricity and Electronics, Petroleum and Oleo-Chemical, Food and Agri-processing, Logistics, Tourism, Creative Industry, Healthcare, Education and Finance business.

### Mega Projects as a Big Push for Rural Development

In simple terms, a mega project is a large-scale investment project. Siemiatycki (2017) defined mega projects as initiatives that are physical, very expensive, and for public interest. This type of project can reach more than a thousand million value of investment and attract public attention because of their enormous impact on society, the environment, and the development budget. Tanyanyiwa (2018) and Müller-Mahn et al. (2021) highlighted two main drivers for mega project development. First, for recognition that mega infrastructure projects are essential for the economic development of the country. Therefore, the Malaysian government has continuously developed infrastructure to cater for the growing demand for upgraded infrastructure resulting from economic growth and transformation. The second driver of mega project development is to meet socio-economic needs, including promoting the development of less developed regions

and rural areas in the country. Improvement and provision of infrastructure and public amenities caused by mega projects might increase the accessibility of regional development to the market to bring more balanced national development and overcome economic disparities (Rashid et al., 2019b).

Over the years, many mega projects have been developed. The 869-kilometre North-South Expressway (PLUS) from Johor Baru (south of Peninsular Malaysia) to Padang Besar (on the Thailand border in the north) is a dual-lane road project. PLUS highway is an example of major improvements to the country's road network. Many intercity highways have been developed by the private sector as mega projects and are toll roads (Solak, 2022). A more recent example is the Pan Borneo Highway (PBH) which stretches for 1,073 kilometres from Miri to Sematan, Kuching, and is equipped with four road lanes, including an overtaking lane at every kilometre to deal with frequent accident areas and improve accessibility (Rose & Imau, 2020).

Not only that, Malaysia has also developed mega projects for port areas, such as Tanjung Pelepas Port (PTP) in Johor. PTP is Malaysia's premier transshipment port, equipped with the latest facilities, equipment, and information technology systems that integrate all port users. In the Iskandar Malaysia region, there is also a mega project called Rapid Pengerang (Pengerang Integrated Petroleum Complex) which was planned under the National Major Economy of Malaysia Region (NKEA) (Rabe et al., 2014; Ngah & Saad, 2015). The overall development should generate a total investment of approximately RM 120 billion and is expected to increase the country's gross national income (GNI) by an additional RM 20 billion by 2020 (Rezayee et al., 2020). This project is also expected to create 50,000 new jobs during its construction and 4,000 jobs upon its completion.

The development of Forest City is also one of the mega projects in the Iskandar Malaysia region aimed at creating a smart eco-city that targets foreign investors, particularly from Singapore and China. Known for its artificial islands, Forest City aims to provide an integrated industrial activity hence providing employment opportunities and transforming the socio-economic status of the surrounding rural communities (Moser, 2020). Most of the mega projects were developed in the greenfield development in the rural areas. The direct and indirect benefits or impacts on the rural areas and their communities can be visualised into a spillover development coming from these mega projects, such as employment opportunities, establishment of new businesses, physical infrastructures and amenities, and accessibility improvements. These impacts were the catalyst for the rural developments.

### Rural Socio-economic as Indicator for Rural Development

Razali and Rashid (2021) proposed two components to measure rural communities' socio-economic performance in development. Concerning the presence of a mega project, the focus of this article is on economic components (income and employment) and social components (health and education) (Rashid et al., 2019a; Yusoff et al., 2021) (Table 1). Figure 2 depicts the conceptual framework for examining the impact of mega projects on the socio-economic of rural communities.

**Table 1: Socio-economic Variables of Rural Community**

Variable	Indicators	Sources / References
1. Education	Education level	Ngah & Kamarudin (2015); Rashid et al. (2019b); Gustin & Abd Rahim (2020); Yusoff et.al. (2021)
2. Health	Health level	Rashid et al. (2019b); Gustin, & Abd. Rahim (2020); Rose & Imau (2020); Yusoff et.al. (2021)
	Ability to carry out the job	Gustin & Abd Rahim (2020); Razali & Rashid. (2021); Rashid et al. (2020); Yusoff et.al. (2021)
3. Income	Total household income	Rabe et al. (2014); Ngah & Kamarudin (2015); Tanyanyiwa (2018); Rashid et al. (2023)
	Side income	Rabe et al. (2014); Rezayee et al. (2020); Razali & Rashid (2021); Rashid et al. (2023)
4. Employment	Types of job	Ngah & Saad (2015); Tanyanyiwa (2018); Rashid et al. (2019a); Vorodam et al. (2022)

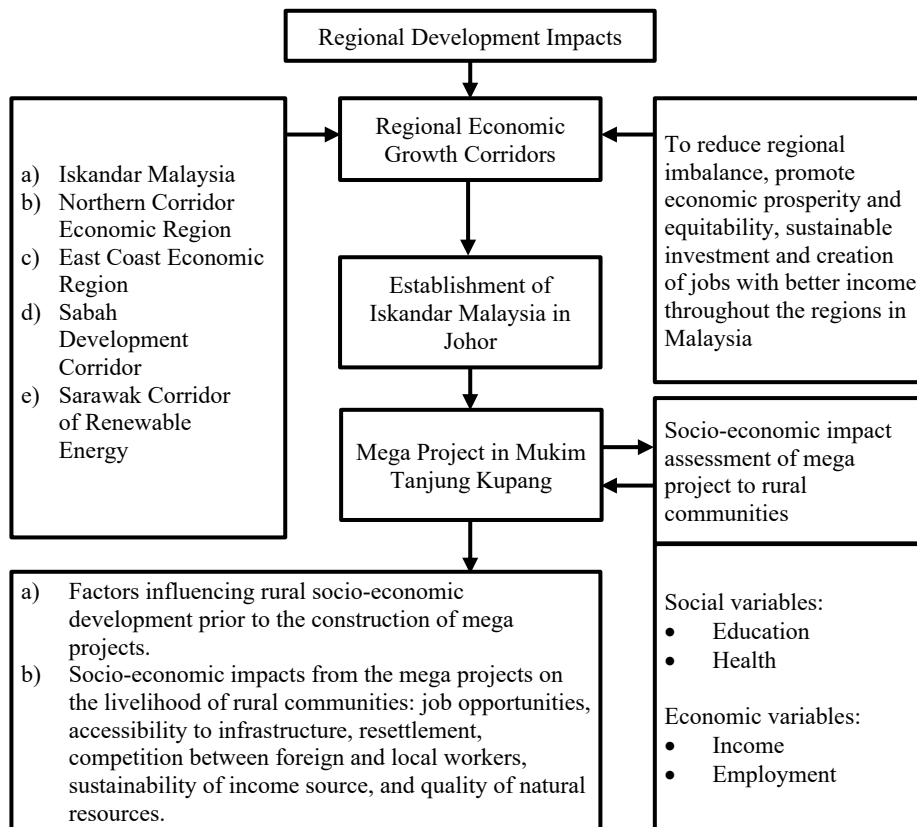
Based on Table 1 and Figure 2, the social and economic components of rural communities are divided into four variables: education, health, household income, and employment. Detailed descriptions of each component are as follows:

- a) Education: The rural communities' socio-economy is measured based on educational variables, which could relate to the economic background of individuals or family groups. Past studies have demonstrated the strong influence of education and household income level. A higher household income is said to be able to affect education, such as having a good level of education for an individual or family (Gustin & Abd Rahim, 2020; Yusoff et al., 2021).
- b) Health: A person's health level affects their income level. An individual with a stable income is closely related to his/her ability to obtain good health services, such as at a private clinic or hospital. A person's health affects his/her ability to work (Gustin & Abd Rahim, 2020; Yusoff et al., 2021).
- c) Income: This indicator refers to households in the socio-economic background that will be focused on in this research. Several factors influence socio-economic backgrounds and the income variable, including



the ability to support one’s own family and the monthly income rate (Razali & Rashid, 2021; Rashid et al., 2023).

- d) **Employment:** This indicator refers to the type of household job, the job sector, and the ability to carry out a given task/job effectively. This variable is important for measuring a family’s level of income in an area (Razali & Rashid, 2021; Rashid et al., 2023).



**Figure 2: Proposed Conceptual Framework**  
*Source: Author (2023)*

## RESEARCH METHODOLOGY

### Study Method

The quantitative method is suitable for impact-related studies (Brannen, 2017). This study employed the quantitative method to collect opinions on the impact of mega project development on rural communities. The head of each household was selected as the sample size using a stratified sampling method. A total of 61 respondents were selected from 545 families in two villages, namely Kampung

Pok (44 respondents) and Kampung Tiram Duku (17 respondents), which are located in proximity to two mega projects nearby, namely Forest City and Tanjung Pelepas Port.

The data gathered through the questionnaire survey included background information on rural households and views on the impact of mega project development on rural communities. The impacts were assessed using a Likert scale appropriate for the impact study (Alabi & Jelili, 2023). Descriptive analysis using a mean score analysis and inferential analysis (t-test analysis) were performed. The mean score analysis was used to examine the impact of the mega project developments on rural communities in terms of six identified impacts: job opportunities, accessibility to infrastructure, resettlement, competition between foreign and local workers, sustainability of income source, and quality of natural resources. Meanwhile, the t-test analysis determined whether there was a significant correlation between the impact of mega projects (as independent variables) and the four socio-economic components of rural communities: education, health, income, and employment (as dependent variables).

### **Study Area**

The study area selected for this research is situated near a cluster of two significant development projects, namely Forest City and Tanjung Pelepas Port, which have emerged around the Tanjung Kupang subdistrict. One of the primary reasons for these mega projects' appeal to domestic and foreign investments is the strategic location of Tanjung Kupang, which offers proximity to Singapore, hence the accessibility. Forest City and Tanjung Pelepas Port have played a crucial role in bolstering the national economy, particularly in terms of the socio-economic well-being of the local community. The positive contributions made by these projects to the overall growth of the economy cannot be overlooked.

In addition to their economic impact, it is noteworthy that these two mega projects are situated near several traditional villages, including Kampung Pok and Kampung Tiram Duku (Figure 3). These two villages have their own administration, namely *Jawatankuasa Pembangunan dan Keselamatan Kampung* (JPKK). There is a total population of 1575 and 610 residents, respectively. Their location is only within a one-kilometre radius of the mega projects. Therefore, the developments of Forest City and Tanjung Pelepas Port are expected to affect the communities of Kampung Pok and Kampung Tiram Duku directly and indirectly. Understanding the implications of these effects on the residents is an essential aspect of this study.

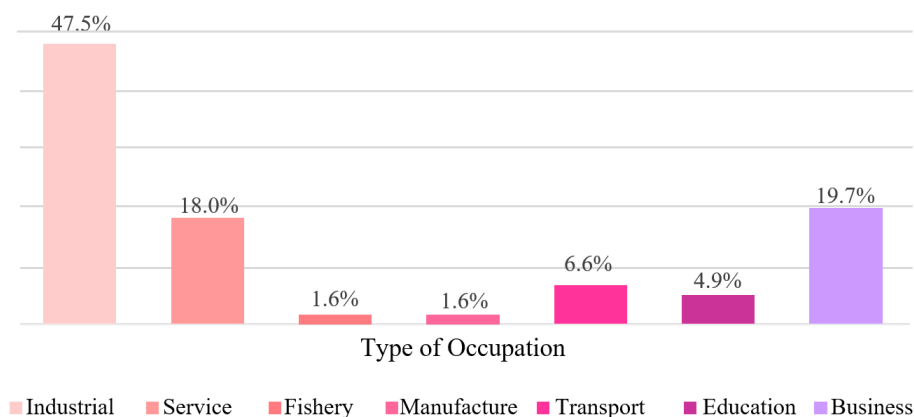


**Figure 3:** Location of Two Study Areas in Majlis Bandaraya Iskandar Puteri, Johor  
*Source: Author (2023)*

## **ANALYSIS AND DISCUSSION**

### **Finding on Economic Sectoral Occupation of Rural Communities**

The study showed that rural communities in Tanjung Kupang subdistrict are involved in three job sectors which are their main source of income. Among the main employment sectors are the industrial sector (47.5%), the business sector (19.7%) followed by the service sector (18.0%). In terms of income level, this study found that most of the rural communities in Tanjung Kupang subdistrict are B40 group where their average monthly income is RM2,550 even though they are involved in the industrial sector as operators. Based on Figure 4 it can be concluded that the majority of household heads are working in the industrial sector in these two villages, which are 29 people (47.5%). It is due to a large industrial area, namely Port of Tanjung Pelepas (PTP), within the proximity radius of one kilometre from these two villages.



**Figure 4:** Background of Head of Households

The study found that the business sector with a total of 12 people (19.7%) and the service sector with a total of 11 people (18.0%) also contributed to the change in the type of occupations available within these two villages. However, only one head of household (1.6%) works in the fisheries sector. With regard to the rural community’s employment sector, most of the heads of households in the two villages are not involved in rural economic activities (such as the agricultural sector). This is because most of them prefer to work in the industrial sector for a more stable income.

### Impact of Mega Project Development Towards Rural Development and Transformation

Six impacts were analysed to assess the significance of the mega project development, specifically Tanjung Pelepas Port and Forest City, on the rural development and livelihood of communities in the Tanjung Kupang subdistrict. The mega projects were found to have diverse effects on the rural communities in terms of job opportunities, accessibility to infrastructure, resettlement, competition between foreign and local workers, sustainability of income sources, and the quality of natural resources (refer to Table 2).

**Table 2:** Mega Project Development Impact on Rural Areas and Its Community

Impact	Mean Score*	Socio-economic Components Dependent Variable (t-test)**			
		1	2	3	4
<b>Job Opportunities</b>					
Mega projects have provided opportunities to venture into various job sectors	1.64	0.024*	0.000*	0.176	0.277
<b>Accessibility to Infrastructure</b>					
Basic infrastructure in the village is complete	4.03	0.014*	0.456	0.010*	0.028*

Impact	Mean Score*	Socio-economic Components Dependent Variable (t-test)**			
		1	2	3	4
and good					
<b>Resettlement</b>					
More villagers were moved to a new settlement	1.82	0.098	0.013*	0.025*	0.312
Level of satisfaction with the compensation received	2.00	0.042*	0.120	0.410	0.292
<b>Competition between Foreign and Local Workers</b>					
Foreign workers live in the village because the place of work is near the village	4.23	0.017*	0.388	0.133	0.015*
Communication competition between foreign workers and local people in key sectors in mega projects	4.43	0.000*	0.000*	0.000*	0.226
<b>Sustainability of Income Source</b>					
Mega project developments have improved villagers' income from specific sectors like industrial	4.48	0.008*	0.029*	0.008*	0.169
Yield from rural economic activities (agriculture) is decreasing	4.33	0.000*	0.022*	0.187	0.390
<b>Quality of Natural Resources</b>					
Natural resources in the village are not affected	3.20	0.365	0.299	0.410	0.013*
Natural disasters do not occur	3.33	0.038*	0.165	0.034*	0.009*
Villages often have problems with pollution, such as water, air, etc.	2.52	0.296	0.282	0.355	0.000*

Note\*: Interpretation level (1.0-2.0) very low; (2.1-3.0) low; (3.1-4.0) high; (4.1-5.0) very high

Note\*\*: Dependent Variables (1) Income; (2) Employment; (3) Education; (4) Health

\*Significant value at 0.05

The impact on job opportunities reveals a concerning low level (mean score of 1.64) as the majority of rural communities in the Tanjung Kupang subdistrict lack the necessary startup capital to venture into the business sector. Consequently, they are unable to harness additional economic activities from the development of mega projects in their vicinity. The absence of financial resources poses a significant barrier to tapping into the potential employment opportunities these projects might bring. On the other hand, the impact on accessibility to infrastructure exhibits a commendable high level (mean score of 4.03). The multiplier effects of the mega project development have led to substantial improvements in basic infrastructure, particularly roads, which are now properly maintained. Furthermore, the rural subdistrict has experienced enhanced access to public transportation, facilitating smoother travel to the city centre of Johor Bahru, thereby fostering better connectivity and convenience for the local population. This finding is related to the Rashid et al. (2023) research, which

highlights the importance of rural-urban connectivity in improving the socio-economic performance of rural populations.

Regarding resettlement, the impact is considerably low (mean score of 1.82). The majority of the rural community in Tanjung Kupang subdistrict staunchly opposes the idea of relocating their settlement areas. This resistance may stem from their deep-rooted connections to their ancestral lands and cultural heritage, making them unwilling to uproot their lives and livelihoods for the sake of development projects. The competition between foreign and local workers, as indicated by most household heads (75.7%), has resulted in a significantly high impact (mean score of 4.43). The development of mega projects appears to prioritise workers fluent in English, and there is a notable influx of foreign workers imported from China. Consequently, the locals face fierce competition for employment opportunities in certain sectors, like construction and industry, leaving them at a disadvantage in securing jobs within the mega projects. Yusoff et al. (2021) proved that competition for employment opportunities is one of the main challenges for rural communities when big development projects take place within their proximity.

In terms of income source sustainability, the impact is impressively high (mean score of 4.48). Many household heads are involved in the industrial sector and secure stable monthly incomes. The completion of mega project developments, such as Tanjung Pelepas Port, has prompted a transition from traditional agricultural and fishery activities to more lucrative opportunities in the industrial sector, thereby boosting the financial well-being of the local population. Lastly, the impact on the quality of natural resources is relatively high (mean score of 3.20). The villages largely rely on the Sungai Perpal as their primary natural resource; fortunately, water pollution is not a regular occurrence. However, monitoring and conservation efforts are necessary to safeguard the sustainability of this vital natural resource and prevent potential environmental degradation in the future.

In addition, the correlation between the identified six impacts and socio-economic components can also be observed in Table 2. It was found that most of the impacts have a significant relationship to income. However, only selected impacts correlate with employment, education, and health.

## **CONCLUSION**

In conclusion, this study successfully sheds light on the importance of considering the socio-economic impact on the surrounding communities when undertaking development projects. The objective of this research was achieved by identifying and analysing the impact of mega project development on the socio-economics of rural communities in the Tanjung Kupang subdistrict, with a particular focus on two selected study areas, Kampung Pok and Kampung Tiram

Duku. This study showed that high-impact or large-scale developments in rural areas can lead to positive and negative consequences for the local population. Consequently, it is imperative for all planning and development processes to thoroughly account for the potential impacts that rural communities may experience. Further research may cover different types of rural settlements in Malaysia, such as fishery villages, water villages, land settlement scheme villages, aboriginal villages, new villages, estate settlements, and planned villages, where the nature of economic activities and physical structure are different from that of a traditional village.

In addition, this study serves as an essential tool for measuring the real impact of mega projects' development and emphasises the significance of community involvement, particularly in sectors with high impact, such as industrial and real estate sectors. By actively engaging the community in the planning and development processes, developers can ensure that the resulting impact is positive and beneficial for everyone, particularly the surrounding communities. This awareness will foster a more inclusive and sustainable approach to development, where the well-being of the community remains at the forefront of decision-making.

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#### **DISCLOSURE STATEMENT**

The authors agree that this research was conducted in the absence of any self-benefits, commercial or financial conflicts and declare absence of conflicting interests with the funders.

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## **ENHANCING SUSTAINABLE DEVELOPMENT AND LAND UTILISATION THROUGH GIS-BASED MULTI-CRITERIA DECISION METHOD FOR FELDA RAJA ALIAS, NEGERI SEMBILAN AND FELDA GUNONG BESOUT, PERAK IN MALAYSIA**

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### **Abstract**

The proposed approach integrates Geographical Information System (GIS) technology and Multi Criteria Decision Analysis (MCDA) techniques to evaluate and prioritise Sustainable and Highest and Best Use (SHBU) lands for sustainable development in FELDA. Spatial data representing various criteria, including accessibility, environmental factors, social amenities, and economic viability, are collected and incorporated into a comprehensive GIS database. The objectives of this study are to evaluate the sustainability potential of SHBU lands in FELDA using a GIS-based MCDA approach and to optimise land utilisation within FELDA by determining the highest and best use of SHBU lands. This study aims to develop a model that utilises GIS and MCDA to assess the suitability of different land parcels within FELDA for SHBU development. Analytical methods, such as weighted overlay analysis and spatial analysis tools, are employed to assess the suitability of different areas within FELDA for SHBU land development. The criteria weights are determined through consultations with stakeholders and expert opinions, ensuring a participatory approach in decision-making processes. The GIS-based MCDA model provides a quantitative framework to evaluate and rank potential SHBU lands in FELDA based on their suitability for sustainable development. The model's outputs can assist land use planners, policymakers, and stakeholders in making informed decisions regarding SHBU land allocation, promoting sustainable housing, and building practices within FELDA's land settlement schemes.

**Keywords:** FELDA, GIS, Land Use Planning, MCDA, SHBU

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## **INTRODUCTION**

Federal Land Development Authority (FELDA) is a Malaysian government agency known for its land settlement schemes, which aim to provide agricultural land to rural communities. However, with evolving societal and environmental priorities, there is a growing emphasis on incorporating sustainability considerations and optimising land use to achieve the highest and best use of land. Sustainable, Highest and Best Use (SHBU) lands are defined as land parcels that emphasise sustainable development practices while concurrently maximising their intrinsic value. This includes considerations, such as environmental sustainability, economic viability, social welfare, and efficient land utilisation. This research aims to make a meaningful contribution to optimising land development for its highest and most beneficial use. Clearly, this study is closely aligned with two key strategies of FELDA, namely, the New Model of FELDA and the Empowerment of Settlers and the New Generation.

To address these challenges, a GIS-based Multi-Criteria Decision Analysis (MCDA) approach is proposed. Geographic Information Systems (GIS) offer a powerful framework for capturing, storing, analysing, and visualising spatial data. It enables the integration of various data layers representing environmental, social, and economic factors relevant to SHBU land development. MCDA techniques provide a systematic and objective way to evaluate and compare different land use options based on predefined criteria (El Sayed, 2018). By combining GIS and MCDA, the approach allows for comprehensive spatial analysis and decision-making, considering multiple factors simultaneously (Marta Dell'Ovo et al., 2018).

The aim of this study is to develop a model that utilises GIS and MCDA to assess the suitability of different land parcels within FELDA for SHBU development. This involves collecting and analysing relevant spatial data layers, assigning weights to criteria based on stakeholder consultations and expert opinions, and applying analytical tools to prioritise and rank potential SHBU lands. It provides a quantitative framework to guide sustainable development practices, optimise land utilization, and ensure the highest and best use of available land resources.

## **LITERATURE REVIEW**

### **The Concepts of Sustainable and Highest and Best Use (SHBU)**

SHBU lands refer to land parcels that prioritise sustainable development practices while maximising their potential value (Rashid et al., 2022). In the context of FELDA in Malaysia, which is known for its land settlement schemes, there is a growing recognition of the need to incorporate sustainability considerations and optimise land use to achieve the highest and best use of land. To effectively attain

this, a GIS-based Multi-Criteria MCDA approach is proposed for SHBU lands model development.

On the other hand, the concept of Highest and Best Use (HBU) refers to the utilisation of an asset in a manner that maximises its potential value, taking into account factors, such as physical feasibility, legal permissions, financial viability, support, and overall financial feasibility (Salbiah et al., 2023). It entails identifying the most advantageous and optimal use of the asset that generates the highest value and aligns with legal and regulatory requirements (Akmaluddin & Christiono Utomo, 2013; SPI, 2015; Christiono Utomo et al., 2018; Adelita Fitriani, 2019).

### **GIS-based MCDA Model for SHBU Lands in FELDA**

Traditionally, decision-making processes in land use planning have relied on subjective judgement and limited spatial analysis. However, the integration of GIS and MCDA techniques offers a more comprehensive and objective approach. The development of a GIS-based MCDA model for SHBU lands in FELDA holds the potential to facilitate sustainable land development, balance economic benefits with environmental and social considerations, and enhance the overall land utilisation practices within the FELDA land settlement schemes. Multiple authors have characterised MCDM as a valuable approach that has demonstrated its utility in a wide range of decision-making scenarios, effectively conducting analyses involving multiple criteria (Guarini et al., 2018; Torrieri & Batà, 2017; Kazak, 2017; Gigović et al., 2017; Bottero et al., 2013).

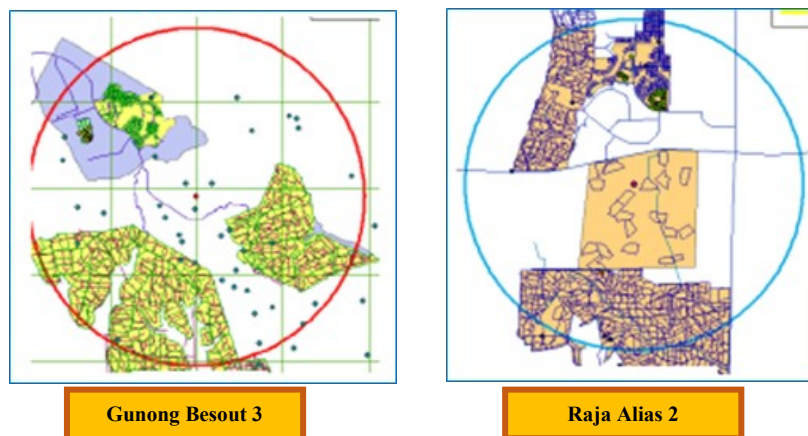
This approach acknowledges the evolving societal and environmental priorities and aims to guide decision-makers in making informed choices regarding land use planning, resource allocation, and sustainable development in FELDA. The development and implementation of a GIS-based MCDA model for SHBU lands in FELDA have the potential to facilitate sustainable land development by integrating environmental, economic, and social considerations. This approach enables decision-makers to assess and prioritise land use options based on a comprehensive set of criteria. By utilising GIS technology, spatial data can be effectively analysed and visualised, allowing for informed decision-making and the identification of optimal land utilisation practices (Özkan et al., 2019)

### **RESEARCH METHODOLOGY**

Two case studies have been chosen to implement the SHBU model, guided by established criteria related to strategic land development issues and the economic activities of residents. The selection of these case studies, namely FELDA Gunong Besout 3 and FELDA Raja Alias 2, was made in consultation with FELDA officers who are representatives of the organisation (refer to Figure 1).

In this study, only areas within a 2km radius of the central points of each case study were delineated for the execution of the SHBU model. This decision was made due to constraints in capturing UAV images using UAV technologies and generating GIS data layers. However, it was ensured that this approach would maintain the overall outcomes and accuracy of the research.

In this context, palm areas and settlements were considered when preparing the GIS databases based on UAV images. The aim was to provide a comprehensive and up-to-date dataset that would support the execution of the SHBU model. The information and dataset derived from these GIS databases will be instrumental in formulating FELDA land development intervention strategies, taking into account both the agricultural and residential aspects of the selected areas.



**Figure 1:** The Boundaries of The Three Case Studies Have Been Defined Within A 2km Radius of Their Central Points.

### **Data Acquisition for Developing a GIS Database**

In this study, the data acquisition process for developing a GIS database for SHBU land development in FELDA involves collecting various spatial and non-spatial data layers such as UAV images, land use, road access, rainfall, contour data, soil and socio-demographic data. These data components form the basis for a comprehensive GIS database that integrates multiple layers of spatial information. By combining these datasets and applying MCDA techniques, it becomes possible to analyse and prioritise SHBU lands based on criteria, such as environmental sustainability, economic viability, social welfare, and efficient land utilisation.

### Optimising UAV Image Capture by Drone Technology

On-site UAV image capture was conducted to obtain the latest information on crop patterns and physical land uses. The data acquisition process primarily focused on capturing images of settlements and plantation areas in Raja Alias, and Gunong Besout, utilising UAV technology. Prior to the flight missions, careful consideration was given to flight planning. This involved configuring parameters, such as flight altitude, percentage of side and front overlap, and coverage of the study area. By following this process, all necessary parameters were set up before acquiring the data, as depicted in Figure 2. The image acquisition result during the flight mission was influenced by these parameters. Specifically, in this study, the flight path of the site area was conducted using a stereo-flying mode at a flying height of 200 metres. The image overlapping parameters were set at 85% for front overlap and 75% for side overlap, effectively covering the delineated areas. These predetermined settings ensured comprehensive coverage and optimal image capture for the study.

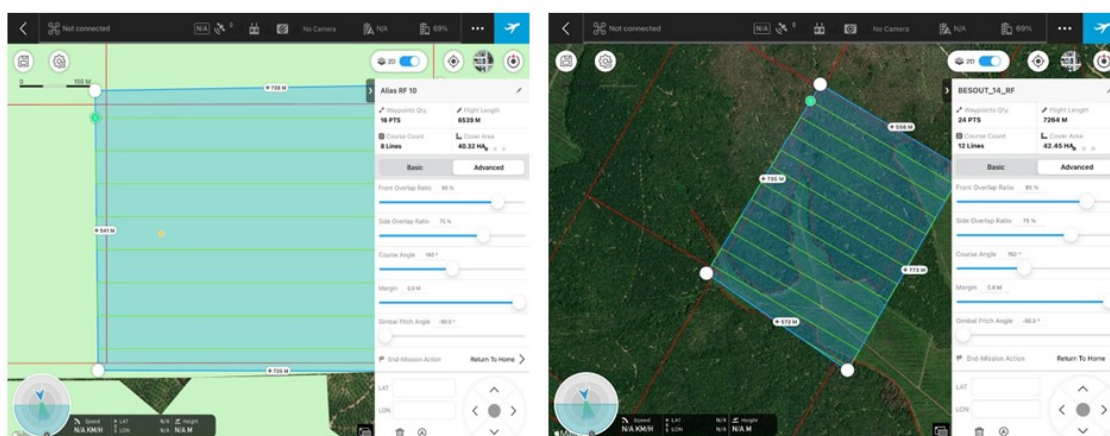
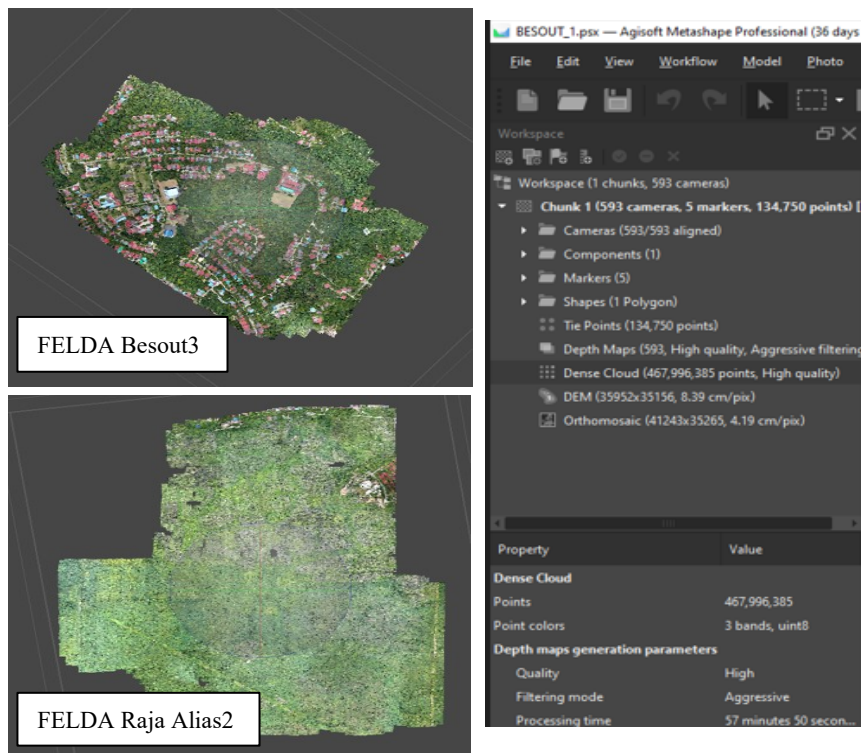


Figure 2: Planning the Flight Path: A Crucial Step in UAV Image Acquisition

### UAV Image Capture for Enhancing SHBU Model Generation in FELDA

UAV images were captured as a vital component of the data collection process for generating a SHBU model in FELDA. These high-resolution aerial images provide valuable and up-to-date information about the land and its surrounding features, enabling a comprehensive assessment of the land's potential for sustainable development and optimisation for the highest and best use. In order to achieve the desired outcomes of the SHBU model, the captured UAV images were segmented into two distinct categories: crop areas (specifically, plantation areas) and settlements. These segmented images played a crucial role as the

primary source of GIS data for generating the criterion map required for the SHBU model. Through a rigorous and validated process, the UAV images were further processed to generate various GIS databases, including crop areas, slope levels, accessibility information, and other relevant datasets (refer to Figure 3). These GIS databases provide essential spatial information and attributes that are integral to the SHBU model, enabling a comprehensive analysis of the land's suitability for sustainable and optimal land use planning within the FELDA context.



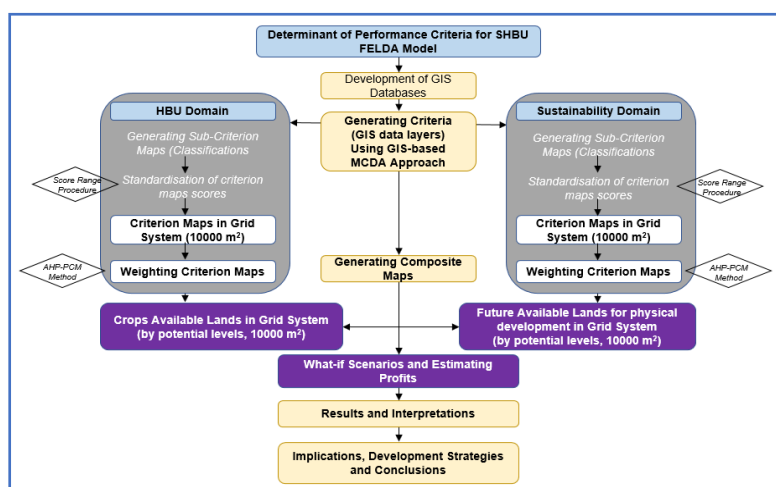
**Figure 3:** Orthophoto Generation from Aerial Imagery

### **A Comprehensive Guide to Implementing GIS-MCDA**

To accomplish the desired objectives of the SHBU model, the imagery acquired by UAVs was segregated into two distinct classifications: crop areas and settlements. These UAV images served as the primary source of GIS data for generating the criterion map in the SHBU model. Once the process was validated, the UAV images were utilised to create GIS databases, including crop areas, slope levels, and accessibility. Figure 4 demonstrates the utilisation of a GIS-based



MCDA approach as an effective analysis tool (Prieto-Amparán et al., 2021) for handling and managing spatial decision problems. This approach proves valuable in addressing various aspects of FELDA land development, particularly within the HBU (Housing and Business Unit) domain for crop cultivation, as well as future-physical potential projects, such as business centres, residential compounds, and agro-preneur centres within the sustainability domain.



**Figure 4:** Unlocking Spatial Decision-Making Potential: An In-Depth Process of GIS-MCDA Application

The execution of the SHBU model involves three primary stages: a) generating criterion maps and sub-criterion maps, b) assigning weights to criterion maps, and c) creating composite maps that depict crop land suitability and future-physical development outcomes. The process of generating sub-criterion maps includes a classification step that incorporates the standardisation of criterion scores. Classification is a necessary step to ensure that all criterion maps are inclusive and quantifiable, allowing them to be linearly combined in the generation of composite maps. Each sub-criterion map, after standardising the scores, is subsequently transformed into a grid system (raster data) with a resolution of 100 x 100 square metres.

Additionally, the process continues by assigning weights to the criterion maps, which determines their relative importance in generating the SHBU composite maps. To differentiate the magnitude of impact, the pairwise comparison method (PCM) is employed in this case for weighing the criterion maps. The SHBU outcomes can be categorised into three stages, each serving different purposes, such as planning scenarios, intervention strategies, and profit



estimations. Table 1 illustrates that the five criterion maps for assessing crop land suitability possess varying degrees of significance within the overall assessment. It displays how the values (scores) located in the upper right corner, specifically the shaded values, were obtained through pairwise comparisons of the relative significance among the five performance criteria. This process was conducted during group discussions involving the researcher's expert panel.

**Table 1: Results (Shaded Scores) Crop Lands Potential Levels**

Criterion Maps	Judgment Process					Weights
	C1	C2	C3	C4	C5	
C1	1	2	3	3	5	0.402
C2	0.5	1	2	3	4	0.273
C3	0.33	0.5	1	0.5	2	0.110
C4	0.33	0.33	2	1	2	0.146
C5	0.2	0.25	0.5	0.50	1	0.068
Total						<b>1.000</b>
Consistency ratio (CR)						<b>0.012</b>

Note: C1=Crops map, C2=Slope levels, C3=Access to estate (Estate access network), C4=Fertile Areas map, and C5=River/water bodies (water resources)

The remaining values in Table 1 were calculated through logical reasoning involving reciprocals. For instance, when comparing C1 to C2, where  $C1 > C2 = 2$ , it implies that  $C2 < C1 = 0.5$ . Similarly, for  $C1 > C3 = 3$ , it signifies that  $C3 < C1 = 0.33$ . In cases where a dimension is compared to itself, the evaluation scale (ratio) was set to one, indicating "equal importance." A comparable method was employed in the balance judgement process.

## ANALYSIS AND DISCUSSION

The SHBU model's ability to generate a composite map of croplands' potential plays a vital role in aiding FELDA management or crop plantation planners to maximise land utilisation for crop cultivation. Moreover, the SHBU model offers valuable information, including attributes like the size and distribution of relevant areas for crop plantation management, as well as cost and profit estimation. Therefore, this undertaking contributes substantial value to the field of cropland development and crop plantation literature. The outcome of cropland suitability for FELDA Raja Alias 2 and FELDA Gunong Besout 3 is illustrated in Figure 5, showcasing four distinct levels or areas based on their potential. These levels are categorised as follows: (a) areas with the highest potential, (b) areas with significant potential, (c) areas with lower potential, and (d) areas constrained by various factors. Importantly, the SHBU composite crop map generation results can provide insights into optimising cropland usage by comparing them to existing plantation areas. This comparison allows for the identification of

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opportunities to increase and optimise potential cropland areas instead of cultivating on land with constraints.

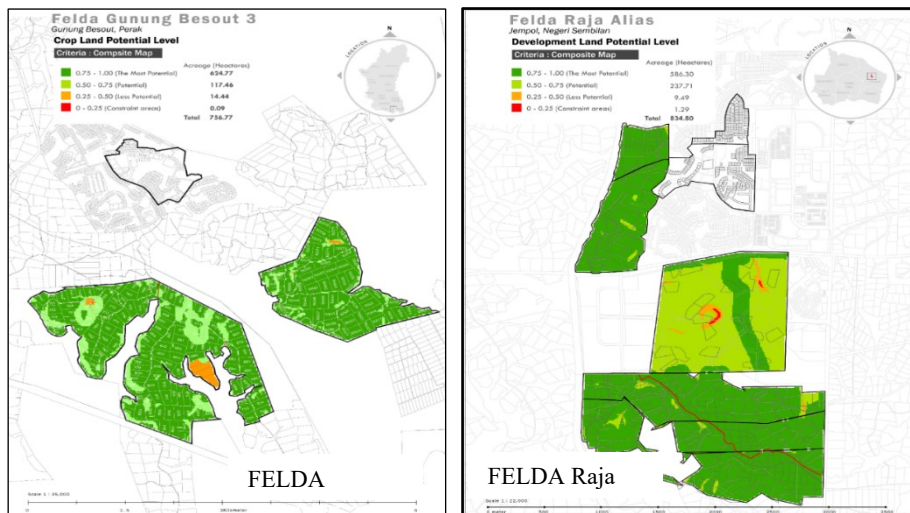


Figure 5: The Suitability of Croplands Across FELDA Raja Alias 2 and FELDA Gunung Besout 3 is Assessed based on Different Potential Levels

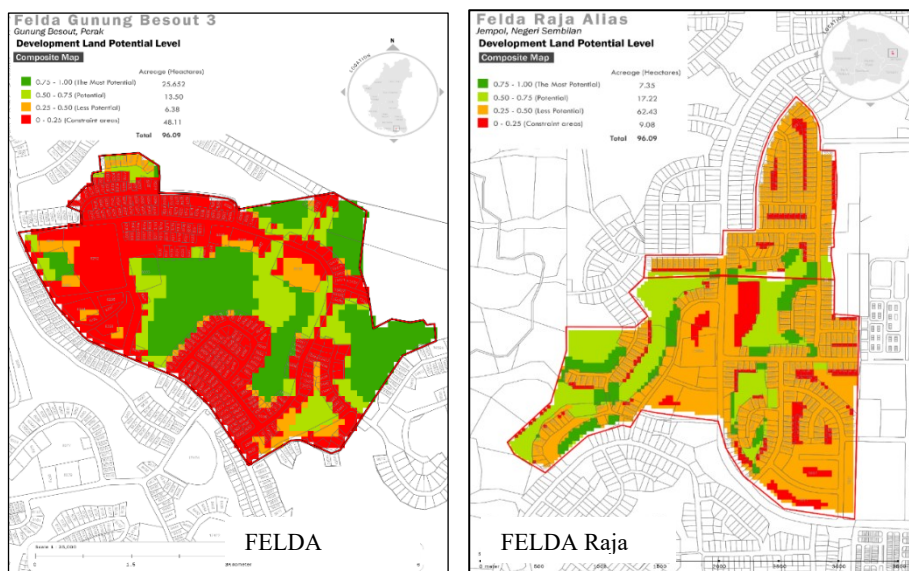


Figure 6: The Levels of Potential Future-Physical Development in FELDA Gunung Besout 3 and FELDA Raja Alias 2

The suitability of future-physical development in FELDA Gunong Besout 3 and FELDA Raja Alias 2 is depicted in Figure 6, showcasing four distinct potential levels. These levels include (a) the most suitable areas, (b) areas with potential, (c) areas with lower potential, and (d) constraint areas. Among these levels, only the areas with the most potential and areas with potential will be taken into consideration for future development. The outcome showcases the effectiveness of the SHBU model in generating a comprehensive map depicting the potential for future-physical development in FELDA Gunong Besout 3 and FELDA Raja Alias 2. This map serves as a valuable resource for FELDA management to strategically utilise available lands for upcoming developmental requirements. Furthermore, the SHBU model offers insightful attributes including area size, distribution of prime locations, and scenario planning. These details are crucial in making informed decisions regarding future land development initiatives.

The following is the outcome of the SHBU implementation which resulted in the identification of suitable regions for crops and land development. This yields a what-if scenario for optimising FELDA land development and achieving a higher return (net profit). What-if planning scenarios are developed by identifying crops and projects based on land potential levels and profit estimation. Table 2 presents the findings derived from the SHBU model, which serve as inputs or foundational elements for recommending and implementing intervention strategies aimed at optimising the land in FELDA Raja Alias 2. These findings provide valuable insights and key information to guide the development of effective strategies for maximising the potential of the land.

**Table 2:** The Matrix Table of FELDA Raja Alias 2 Crucial Findings (SHBU Model).

Aspects of Findings	Potentials (P)			Challenges (C)			Findings (Remarks concerning the SHBU model)
	L1	L2	L3	L1	L2	L3	
Site location and the existing development (including surroundings)			/		/		P3 – close and easy access to Bandar Seri Jempol (BSJ) C2 – Commercial units already established in BSJ that meets the population threshold.
Residents' Socio-demographic profiles		/			/		P2 – Human resource, age group (youth) is very potential/promising with current the youth-oriented programs C2 – Increase competitive income for youth employment with FRA 2 activities
D1: Felda Industries-based crops (FibC)					/		C2 - RnD of main crops, i.e., palm oil as the preferred industry-based crop. It is because of the competitive current market price of palm oil.
D2: FELDA business centre (FBC)			/		/		P3 – Small neighbourhood comprises of housing & shoplots

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Aspects of Findings	Potentials (P)			Challenges (C)			Findings (Remarks concerning the SHBU model)
	L1	L2	L3	L1	L2	L3	
							C2 – Current business activities in BSJ. Future Felda Jaya commercial units planned. Competition.
D3: FELDA residential compound (FRC)			/		/		P3 - Reserve land is available – from composite map. C2- Ready new residence for sale in BSJ
D4: FELDA agro-preneur (FAGP)			/		/		P3 – create a market of interim product (PPP) - market chain – supplier to end user (including online marketing) C2 – low awareness/skill in IT marketing
D5: SHBU management plan			/		/		P3 – Willingness of management and settlers to new knowledge. P3 – Land title recipients – Boost morale and confidence in FELDA management. P3 – Development strategies included in State Structure and Jempol District Local Development Plan 2045. C2 - 5-10 % own managed – inefficient/unproductive, high-cost individual burden. C2 - Non-active Cooperative

Table 3 presents significant findings that support the implementation of the SHBU model for the recommendation and intervention strategies in optimising the land in FELDA Gunung Besout 3. These findings provide a concise overview of essential information obtained from the model, enabling a comprehensive understanding of the land's characteristics and potential. These insights serve as a valuable foundation for devising effective strategies and interventions tailored to FELDA Gunung Besout 3.

**Table 3:** The Matrix Table of FELDA Gunung Besout 3 Critical Findings (SHBU Model).

Aspects of Findings	Potentials (P)			Challenges (C)			Findings (Remarks concerning the SHBU model)
	L1	L2	L3	L1	L2	L3	
Site location and the existing development (including surroundings)	/			/			C1 – location of the study area is quite far from adjacent small towns (Sungkai and Slim River). P1 – the study area has the potential to be a successful small business centre that offers goods and services which suit local demands, such as sundry shops, hardware outlets, vehicle workshops, petrol kiosks, etc.
Residents' Socio-	/			/	/	/	C1 – low mean of settler monthly income (RM3220.15) during the first half of 2021.

Aspects of Findings	Potentials (P)			Challenges (C)			Findings (Remarks concerning the SHBU model)
	L1	L2	L3	L1	L2	L3	
demographic profiles							<p>C2 – all pioneer settlers are elderly now. Most of them cannot operate the oil palm crop as effectively as in their younger days.</p> <p>C3 – the current population is quite small (about 1500). It is insufficient to support the demand of farm operators.</p> <p>P1 – the remaining young generation in the study area can be trained to be agropreneurs.</p>
D1: Felda Industries-based crops (FibC)	/	/	/	/	/	/	<p>C1 - only oil palm plantation is allowed in the study area. Other crops are prohibited.</p> <p>C2 - illegal oil palm plantation is found on FELDA reserve land.</p> <p>C3- poor drainage system (leads to flood) and soil erosion occur at the farm, especially at Stage 003 of the plantation area.</p> <p>P1 - potential for interim crops (PPP projects), managed by Koperasi (in crops area). But it must get permission from the FELDA management. Suggested interim crops such as bayam, sawi (high productivity).</p> <p>P2 – potential for enhancing Bukit Selfie and oil palm farm as recreation and tourism attractions.</p>
D2: FELDA business centre (FBC)	/			/			<p>C1 - FBC should be proposed at Trolak regional or cluster level to support its viability.</p> <p>P1 – the adjacent business centre at Gunung Besout 01 should be strengthened.</p>
D3: FELDA residential compound (FRC)	/			/	/		<p>C1 - no vacant land to create FRC at the study area.</p> <p>C2 - the proposed 100 units of houses at FELDA Gunung Besout 02 for the second generation are insufficient.</p> <p>P1 – available FELDA reserve land has the potential to develop as a small neighbourhood that comprises a housing and shop lots</p>
D4: FELDA Agropreneur (FAgp)	/	/	/	/			<p>C1 - Previous SDP projects conducted by individuals are not continuous. Nobody took over the projects to run them as usual when the participants died.</p> <p>P1 - the proposed FAgp project that the individual runs should have a protégé to continue the business in case of the death of the participant.</p> <p>P2 - the study area has many potential tourism products, such as a beautiful open view at Bukit Selfie, an oil palm farm tour and a serene FELDA village environment that can be marketed to tourists.</p>

Aspects of Findings	Potentials (P)			Challenges (C)			Findings (Remarks concerning the SHBU model)
	L1	L2	L3	L1	L2	L3	
							P3 - to overcome the labour shortage at the farm, the young generation of FELDA should be attracted and exposed to the oil palm industry.
D5: SHBU plan management	/	/	/	/	/	/	C1 - only 117 settlers (43.2%) surrendered their farm to FELDA management. Other 154 settlers (56.8%) managed the farm themselves. C2 - Loss of oil palm plantation income was due to settlers selling the palm fruit to other oil palm mills. P1 – it is a potential for FELDA management in the study area to take appropriate initiatives and attract 154 other settlers (56.8%) to join the FELDA farm management. P2 - to avoid the loss of oil palm plantation income, FELDA management should encourage all settlers to sell their yield to the FELDA oil palm mill only.

The table highlights that the advantages and potential outweigh the challenges with the identification of key development projects that are necessary for Gunung Besout 3. These include the establishment of a small neighbourhood, a business centre to cater for daily and weekly needs, PPP agricultural projects, and a PPP marketing hub. Additionally, FELDA Gunung Besout 3 boasts various potential tourism products, such as the picturesque Bukit Selfie with its scenic views, an oil palm farm tour, and a tranquil FELDA village environment, all of which can be effectively marketed to attract tourists. Due to the findings, particularly from the composite maps, specific recommendations and suggestions for each case study have been proposed. It is hoped to improve settlers' livelihoods by fully utilising the FELDA lands and human resources to maximise profits.

## CONCLUSION

The creation of composite maps for crop and physical land development greatly assists the FELDA management and crop plantation planners in optimising land utilisation for both crop cultivation and future physical development. These maps provide essential spatial information and attributes, including the size and distribution of areas suitable for crop management and the ideal locations for physical development, enabling accurate cost and profit estimation. This endeavour enhances the existing literature on cropland development and FELDA lands, introducing novel contributions, such as performance criteria, processes, and techniques employed in generating composite maps specific to FELDA lands. By utilising the insights derived from the composite maps, targeted

recommendations and suggestions have been put forward for each case study, aiming to enhance cropland development within FELDA. These efforts are geared towards improving the livelihoods of settlers by maximising the utilisation of FELDA lands and human resources to optimise profitability. These initiatives are in line with the national rural policies and the Sustainable Development Goals (United Nations, 2020), reflecting a shared commitment to sustainable development. The outcomes of these endeavours contribute to FELDA's ability to ensure sustained high returns, benefiting both current settlers and future generations within the FELDA community in a holistic manner, encompassing various aspects including income generation. These future studies can help refine and enhance the utility of the SHBU framework and MCDA-GIS system, making them valuable assets not only for FELDA but also for rural land development initiatives worldwide.

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## **ATTRIBUTES AND ACTIVITIES IN PUBLIC URBAN SPACES OF MALAYSIAN CITIES**

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### **Abstract**

In contemporary society, urban spaces have emerged as the predominant locale for communal assembly among the general populace. However, a significant deficiency of urban spaces is observed in the majority of metropolitan locations in Malaysia. This study raises the question of how urban space could promote community space in an urban area while considering activities and site physical attributes. Therefore, this study aims to identify the urban space attributes and activities in two categories of Malaysian cities: new urban areas and historical areas. This study uses cross-comparison and descriptive analysis to derive key attributes of urban spaces, including high walkability, diverse activities, vibrant street art, and green elements. The dominant attributes based on the evaluation were walkability, urban activities, street art, green elements, and aesthetically pleasing historic buildings. Primary activities were walking, photography, and cycling (100%). Predominant urban activities based on evaluation were walking, photographing, and sales booth streets. Sungai Segget Johor Bahru (mix of historical and new urban areas), Melaka Jonker Street (historical town) and River of Life Kuala Lumpur (a mix of historical and new urban areas) have the highest of urban space elements. Therefore, urban activities are highest in historical cities such as Melaka Jonker Street and Penang Street Art. This study provides stakeholders valuable insight into different urban space attributes and activity patterns between cities. By expanding the analysis scope beyond the main capital city in Malaysia and recommending further exploration of additional attributes, this research offers a more nuanced understanding of the interplay between urban space and activities.

**Keywords:** Malaysian Cities, Relationship Attributes, Urban Activities, Urban Spaces

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## **INTRODUCTION**

In urban contexts, public spaces are indispensable elements that underpin the design and evolution of cities (Pasaoglulari Sahin & Doratli, 2004). Such spaces are characterised by their openness, granting unrestricted access to shared physical environments equipped with facilities for recreation (Plane & Klodawsky, 2013). Beyond mere physicality, effective public spaces act as arenas for human interaction and congregation, fostering a sense of community. They not only engender a salubrious lifestyle but also augment cognitive functions, bolster academic performance, and enhance fitness levels (Donnelly et al., 2016). Furthermore, they play a pivotal role in mitigating mental health concerns and attenuating stress (Department of Local Government Sport and Cultural Industries, 2023). As underscored by Nasution and Zahrah (2017), public spaces remain an integral facet of urban design.

In contemporary urban settings, particularly given spatial constraints, the meticulous identification and evaluation of urban space attributes and their associated activities is paramount. Such an approach facilitates the mitigation of potential adverse repercussions on community cohesion (Francis et al., 2012). Public spaces, intrinsically tied to well-being and health, significantly influence a locale's sense of place (Wilkie et al., 2018). Notably, the urban emphasis is especially pertinent in the Malaysian context, where forecasts suggest an urban population surge of 85% by 2040 (Tey et al., 2014). Public space has a broad overview, to focus on and address urban issues, this study focused on urban space. Urban space is known also as a public space. However, it is focusing on public space in urban areas.

Malaysia, in general, grapples with a dearth of urban social spaces. Given this backdrop, the present study seeks to interrogate how urban spaces can foster community integration in urban settings, with a particular focus on activities and physical attributes of these spaces. The calibre of public spaces, encompassing architectural elements, furnishings, design, accessibility, and adaptability to diverse population needs, inevitably dictates both user density and the broader urban quality of life (Kostrzewska, 2017). Beck (2009) posits that well-conceptualised public spaces directly enhance inhabitants' quality of life. Yet, a disconcerting trend emerges: the planning and evolution of urban areas frequently overlook the vital role of public spaces, a sentiment echoed by multiple scholars (Pasaoglulari Sahin & Doratli, 2004; Duffy, 2020). Given these considerations, the primary problem this study addresses revolves around the optimization and revitalization of urban spaces in Malaysia.

The design of public spaces should inherently encapsulate principles that foster integration and promote activities facilitating social inclusion (Kostrzewska, 2017). Such activities not only augment the social dimensions of spaces but also infuse them with vibrancy. For these public domains to retain their relevance and utility, it is imperative they are conceived and maintained as

vibrant social hubs (Chitrakar et al., 2017). A pressing concern, however, is the conspicuous dearth of social activities within these public realms (Shahpasand et al., 2016). Malaysia, in particular, faces a significant deficit in urban social spaces (Norhafizah & Shuhana, 2015). It becomes crucial, then, to quantitatively and qualitatively assess urban activities that could potentially catalyse the emergence of more such social spaces within the country. The efficacy of a public space can be gauged through the spectrum of amenities it offers, coupled with its spatial capacity to accommodate a myriad of activities across temporal scales (Harun et al., 2021).

Molina and Grundström (2012) advocate for a nuanced reconceptualization and reinterpretation of public spaces within the ambit of built environment research. While the discourse on public space is expansive, to zero in on urban challenges more effectively, this study narrows its lens to urban spaces, often synonymously referred to as public spaces. This study aims to identify the urban space attributes and activities in two categories areas in Malaysian cities: new urban areas and historical areas. This research begins by identifying the attributes of urban spaces in the study areas, thereby determining the types of activities in urban spaces at different locations.

## **METHODOLOGY**

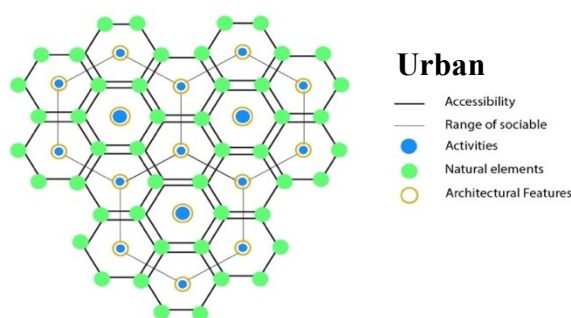
### **Study Area**

This study focused on six urban spaces in Malaysian cities, involving six urban spaces in five urban areas. The location was selected due to its population density and the criteria of historic buildings and a mix of new urban development. The study sites were chosen based on specific criteria: notably their population densities, the presence of historic architecture, and a blend of contemporary urban development. The locations, which include Ipoh Street Art, Penang Street Art, River of Life in Kuala Lumpur, Bukit Bintang Shopping Centre in Kuala Lumpur, Jonker Street in Melaka, and Sungai Segget in Johor Bahru, were selected due to their significant public concentration and their status as popular urban areas.

The data collected through structured observations at Ipoh Street Art, Penang Street Art, River of Life Kuala Lumpur, Bukit Bintang Shopping Centre Kuala Lumpur, Jonker Street Melaka, and Sungai Segget Johor Bahru. Each site's physical attributes and current activities were observed and evaluated. The observation was made in September 2022 at Ipoh Street Art and Penang Street Art during the weekend. However, observations for the River of Life in Kuala Lumpur, Bukit Bintang Kuala Lumpur, Jonker Street Melaka, and Sungai Segget Johor Bahru were made in early October 2022 during the weekend. The weekend period was chosen because more activities occur during this time, and people tend to visit urban spaces during the holidays rather than on weekdays. Weekends offer a wonderful opportunity to consider larger issues and engage in more

contemplative thinking. This study used cross-comparison and descriptive to review types of urban space attributes and types of activities.

The Central Place Theory was used to extract urban space attributes: accessibility, sociability range, activities, natural elements, and architectural features. This theory was highlighted to support the behavioural study. A German geographer, Walter Christaller, established the theory (Briney, 2022; Capello, 2009). It is important to explain each urban space attribute in this research as *“public space factors such as access, visual attraction, natural elements, and many others are significant, creation of social events is more important than physical features in social presence and interaction since it can provide participation opportunities in social activities and improve the sense of belonging to the place”* (Bigdeli & Ngah, 2013).



**Figure 1:** Urban Space Attributes Concept (Adapt from the Central Place Theory)

Accessibility is essential in urban life to connect one place to another. Regardless of social circles, everyone should have access to public spaces (Aini et al., 2019). The second aspect of urban space attributes is the sociability range. People can connect and participate in spectacles and ceremonies, or simply sit or wait in relative comfort and safety when there is life and sociability in the public realm (Das, 2008; Tibbalds, 2001). The variety of activities creates more diversity to enhance the well-being aspect of public life. Activities are the main attributes to attract more people to enter and use the public space. Natural elements play a role in attracting people to utilise various design characteristics and activities in urban spaces. Green spaces are necessary landscapes in an urban area that offer a natural setting and hasten other life events (Jabbar et al., 2022). The emphasis on architectural design will progressively consider our expanding knowledge of human senses and how they interact (Spence, 2020). The five main elements of urban space in this study, as shown by the connections in Figure 1.

To evaluate the attributes and activities in the study area, this study used a scaled matrix structured observation criteria. In the urban design scope, Mironowicz et al. (2021) used the matrix of the study to identify the typology of

the observation places and the spatial impact scale. Usually, the observation matrix scale is divided into three to five scale measurements. Wang et al. (2015) conducted the study with three scales for a matrix scale observation. In this study, the matrix scale observation with three scales ranging from low (1), medium (2), and high (3) were used. Table 1 shows the matrix scale observations of urban space attributes. Zero (0) represents a non-existing urban space attribute at the physical site.

This study measured the following urban space attributes: walkability, activities, wall street art, light sculpture, media architecture, art sculpture, aesthetical historical buildings, green elements, and water elements. The measurement for the walkability aspect involved obstacles and walkway ease of use. Activity measurement is as follows: low (1 activity), medium (3 activities), and large-scale activities (more than 4 activities). The wall street art measurement is based on attractive design, colour, and scale proportion. Light sculpture, media architecture and art sculpture were also measured according to low, medium, and large scale. The aesthetic of historic buildings by the percentage of historic buildings in the study area was rated: 0-30% is low (1), 31%-60% is medium (2), and 61%-100% is high (3). This study observed green elements by the least, medium, and more green elements. The measurement of water elements context as lowest, medium and more water elements.

**Table 1:** Matrix Scale Observations of Urban Space Attribute

Urban Space Attributes	Matrix scale observation			
	<b>0</b>	<b>1 Low</b>	<b>2 Medium</b>	<b>3 High</b>
Walkability	None	There are obstacles	Moderate obstacles	Easy to use for walking
Urban Activities	None	Only one (1) activity in the urban area	3 Activities in the urban area	Over four (4) activities in the urban area
Wall Street Art	None	<ul style="list-style-type: none"> <li>• Not attractive design and colour</li> <li>• Small scale</li> </ul>	<ul style="list-style-type: none"> <li>• Attractive design and colour</li> <li>• Medium scale</li> </ul>	<ul style="list-style-type: none"> <li>• More Attractive design and colour</li> <li>• Large scale</li> </ul>
Light sculpture	None	<ul style="list-style-type: none"> <li>• Small scale</li> </ul>	<ul style="list-style-type: none"> <li>• Medium Scale</li> </ul>	<ul style="list-style-type: none"> <li>• Large scale</li> </ul>
Media Architecture	None	<ul style="list-style-type: none"> <li>• Small scale</li> </ul>	<ul style="list-style-type: none"> <li>• Medium Scale</li> </ul>	<ul style="list-style-type: none"> <li>• Large scale</li> </ul>
Art Sculpture	None	The Lowest hardscape elements	Medium hardscape elements	More hardscape elements

Urban Space Attributes	Matrix scale observation			
Aesthetical historical building	None	0%-30% of the historical aesthetic buildings in the area	31%-60% of historical aesthetic buildings in the area	60%-100% of the area's aesthetical historical buildings
Green elements	None	The least amount of green elements	Medium green elements	More green elements
Water elements	None	The Lowest water elements	Medium water elements	More water elements

Table 2 shows the urban activities' matrix scale observation. It is divided based on the three-scale matrix, i.e., 1, 2 and 3. The zero (0) value refers to no activities in the urban space, one (1) stands for low, two (2) for medium, and three (3) for high. The walking measurement matrix scale is the lowest, medium and highest number of walking activities. Likewise, the scale for cycling activities. The photograph was measured by the photography provisions and activity: low, medium and high. Rickshaw activities are measured as small, medium and large-scale activities. Likewise, for river cruises. The same scale was used for the sales booth street activities.

**Table 2:** Matrix Scale Observations of Urban Activities

Activities Attributes	Matrix scale observation			
Scale	0	1 Low	2 Medium	3 High
Walking	None	The lowest number of walking activities	Medium number of walking activities	The highest number of walking activities
Cycling	None	The lowest level of cycling activity	Medium level of cycling activities	The Highest Level of cycling activities
Photograph	None	<ul style="list-style-type: none"> <li>• Low photography section</li> <li>• Low Photography activities</li> </ul>	<ul style="list-style-type: none"> <li>• Medium photography section</li> <li>• Medium photography activities</li> </ul>	<ul style="list-style-type: none"> <li>• High photography section</li> <li>• High photography activities</li> </ul>
Rickshaw	None	Small-scale rickshaw activities	Medium-scale rickshaw activities	Large-scale rickshaw activities
River Cruise	None	Small-scale river cruise activities	Medium-scale river cruise activities	Large-scale river cruise activities

Activities Attributes	Matrix scale observation			
Sales booth streets	None	Small-scale sales booth streets	Medium-scale sales booth streets	Large-scale sales booth streets

## RESULTS AND DISCUSSION

### Urban Space Attributes Cross-Comparisons

In this study cross-comparison analysis utilized to identify the urban space attributes and urban activities in two categories within Malaysian cities: newly developed urban areas and areas with historical structures. In the present study, an empirical evaluation was conducted to count, compute the percentages, and assess urban attributes using a matrix-scale observation criterion. The attributes of urban spaces were cross-compared based on observations collected in September and October 2022. This study used cross-comparison analysis to identify the urban space attributes findings based on our observation in Table 3. The result indicates that the highest percentage of urban space attributes are walkability (100%), activities (100%), green elements (100%), wall art street (100%), and aesthetic historic buildings (83%). Bukit Bintang area has most of the new modern buildings along the main street. A moderate percentage of urban space attributes are art sculpture elements (67%), media architecture (50%), and natural water elements (50%).

**Table 3:** Cross-comparison Urban Space Attributes Findings

No.	Attributes	A	B	C	D	E	F	Count	Percentage (%)
1.	Walkability	/	/	/	/	/	/	6	100%
2.	Urban Activities	/	/	/	/	/	/	6	100%
3.	Art street wall	/	/	/	/	/	/	6	100%
4.	Light Sculpture	x	x	x	x	/	/	2	33%
5.	Media Architecture	x	x	/	/	x	/	3	50%
6.	Art sculpture elements	x	x	/	/	/	/	4	67%
7.	Aesthetical historical building	/	/	/	x	/	/	5	83%
8.	Green elements	/	/	/	/	/	/	6	100%
9.	Nature Water elements	x	x	/	x	/	/	3	50%
Total		<b>5</b>	<b>5</b>	<b>8</b>	<b>6</b>	<b>8</b>	<b>9</b>		

Note: The location names are as follows; A- Ipoh Street Art; B- Penang Street Art; C-River of Life Kuala Lumpur; D-Bukit Bintang Kuala Lumpur; E-Jonker Street Melaka; F-Sungai Segget Johor Bahru

The pattern in media architecture is shown in Sungai Segget Johor Bahru, Bukit Bintang Kuala Lumpur, and River of Life Kuala Lumpur. Only the River of Life Kuala Lumpur, Bukit Bintang Kuala Lumpur, Jonker Street Melaka and Sungai Segget Johor Bahru have the art sculpture elements. In the urban design view, the sculpture elements are one of the visitor attractions to encourage more interest and vibrancy. However, natural water elements like those at the River of Life Kuala Lumpur, Jonker Street Melaka, and Sungai Segget Kuala Lumpur, can be used for recreation. The geographical area with natural rivers can be used as an attraction. The light sculpture is a minor attribute (33%), as listed in Table 3. Two areas have light sculptures: Jonker Street Melaka and Sungai Segget Johor Bahru. Light and art sculptures have tiny implementation attributes. The study found art sculptures at Bukit Bintang Kuala Lumpur, Jonker Street Melaka, and Sungai Segget Johor Bahru. However, light sculptures are only at Jonker Street Melaka and Sungai Segget Johor Bahru. These attributes are not implemented widely in Malaysia's main capital city urban space.

To summarise, most areas have walkability, activities, and Wall Street art elements. Wall street art is the main concern in most of Malaysia's urban spaces. The geographical and historical areas influence certain areas' lack of attributes. There are no rivers at Penang Street Art, Ipoh Street Art, and Bukit Bintang Kuala Lumpur. Likewise, there is no historical factor at Bukit Bintang. However, Penang Street Art and Ipoh Street Art have a historical factor. Ipoh Street Art and Penang Street Art lack light sculpture, media architecture, art sculpture and nature water elements. Bukit Bintang Kuala Lumpur lacks light sculpture, an aesthetical historical building and natural water elements. Furthermore, River of Life lacks light sculpture elements, while Jonker Street Melaka lacks media architecture elements. Sungai Segget Johor Bahru has all urban space attributes listed in Table 3. These attributes help us identify and review the current attributes in different areas.

The evaluation result in Table 4 is based on the matrix scale observation of urban space attributes in Table 1. This study evaluated the result by the percentage and mean value for each element in urban space attributes to see its average percentage. Table 4 shows the evaluation result of the urban space attributes. Several attributes have the highest percentage: walkability (16%), activities (16%), wall street art (15%), green elements (13%), and aesthetic historic buildings (12%). Six locations are rated easy to walk; the River of Life Kuala Lumpur had only moderate obstacles. The walkway along the river is well-maintained. The following areas have more than four (4) activities: Ipoh Street Art, Penang Street Art, Jonker Walk Melaka, and Bukit Bintang Kuala Lumpur. Sungai Segget and River of Life Kuala Lumpur only have three (3) activities.

Penang Street Art, Ipoh Street Art, Bukit Bintang, and Jonker Street Melaka are the highest because they have the most attractive designs and colours. River of Life Kuala Lumpur was rated medium scale, while Sungai Segget Johor



Bahru has only small-scale wall street art. Based on the site’s physical conditions, River of Life Kuala Lumpur, Jonker Street Melaka, and Sungai Segget have the highest green elements. Bukit Bintang has medium green elements, and Penang Street Art and Ipoh have the least green elements. Most old town cities in Malaysia, such as Penang, Ipoh and Melaka, have the highest number of historic buildings. River of Life Kuala Lumpur was rated medium, while Johor Bahru was rated the lowest. The historical factors influenced the historic aesthetical building in Malaysia. The following elements were rated moderate: water elements (9%), media architecture (7%), and art sculpture (7%). The lowest percentage is light sculpture (5%). Light sculpture attained the lowest evaluation result because it is the least implemented element in Malaysia's city urban spaces. Only three areas have water elements: River of Life Kuala Lumpur, Jonker Street Melaka, and Sungai Segget Johor Bahru. The geographical factors influenced this attribute.

**Table 4.** Cross-comparison Urban Space Attributes Findings Evaluation

No.	Attributes	A	B	C	D	E	F	Count	Percentage (%)	Mean
1.	Walkability	2	3	2	3	3	3	16	16%	2.67
2.	Urban Activities	3	3	2	3	3	2	16	16%	2.67
3.	Art street wall	3	3	2	3	3	1	15	15%	2.50
4.	Light Sculpture	0	0	0	0	2	3	5	5%	.83
5.	Media Architecture	0	0	3	3	0	1	7	7%	1.17
6.	Art Sculpture	0	0	1	1	2	3	7	7%	1.17
7.	Aesthetical historical building	3	3	2	0	3	1	12	12 %	2.00
8.	Green elements	1	1	3	2	3	3	13	13%	2.17
9.	Water elements	0	0	3	0	3	3	9	9%	1.50
Total		12	13	17	15	22	20	100	100%	

Note: The locations are as follows; A - Ipoh Street Art; B- Penang Street Art; C-River of Life Kuala Lumpur; D-Bukit Bintang Kuala Lumpur; E-Jonker Street Melaka; F-Sungai Segget Johor Bahru

The River of Life Kuala Lumpur and Bukit Bintang Kuala Lumpur are rated large scale while Sungai Segget Johor Bahru is low scale. Sungai Segget Johor Bahru has the highest number of art sculptures, Jonker Street Melaka is rated medium, and River of Life Kuala Lumpur and Bukit Bintang Kuala Lumpur are rated the lowest. Sungai Segget Johor Bahru is rated as the largest scale for

light sculpture, and Jonker Street Melaka is rated as medium. Other locations do not have the light sculpture element.

This study used mean descriptive to see the average value for each urban space attribute. Walkability and activities attain a neutral mean score (2.67). The following attain low mean values: wall street art (2.50), media architecture (1.17), art sculpture (1.17), aesthetical historical building (2.00), green elements (2.17) and water elements (1.50). Light sculpture attains a very low mean score (0.83). The mean score is reflected in the percentage level of the cross-comparison evaluation.

### Urban Activities Cross-Comparison

Table 5 shows the observations of urban activities in the six study areas. This study used cross-comparison analysis to identify the activity’s attributes and findings. The result listed in Table 5 indicates that the highest number of activities, and hence the major activities, are walking (100%), photography (100%), and cycling (100%). Only a few locations offer sales booths on streets (67%), rickshaws (33%), and river cruises (17%). Sales booth streets refer to areas that offer kiosks and sell something between the lanes in the old commercial area, such as in Penang, Ipoh and Melaka. Penang Street Art, Ipoh Street Art and Jonker Street Melaka are the most famous sales booth streets. Various businesses attract tourists to go there. The following sites offer sales booth streets between the lane and outdoor services: Penang Street Art, Ipoh Street Art, Melaka Jonker Street and Bukit Bintang Kuala Lumpur.

**Table 5:** Cross comparison Urban Activities Findings

No.	Urban Activities	A	B	C	D	E	F	Count	Percentage (%)
1.	Walking	/	/	/	/	/	/	6	100%
2.	Cycling	/	/	/	/	/	/	6	100%
3.	Photograph	/	/	/	/	/	/	6	100%
4.	Rickshaw	x	/	x	x	/	x	2	33%
5.	River Cruise	x	x	x	x	/	x	1	17%
6.	Sales booth streets	/	/	x	/	/	x	4	67%
Total		4	5	3	4	6	3		

Note: The location names are as follows; A- Ipoh Street Art; B- Penang Street Art; C-River of Life Kuala Lumpur; D-Bukit Bintang Kuala Lumpur; E-Jonker Street Melaka; F-Sungai Segget Johor Bahru

The rickshaw activities are famous in historical town centres such as Melaka and Georgetown. Ipoh and Georgetown have the same historical concept, but there are no rickshaw activities in Ipoh. Rickshaw activities are popular in Melaka and Georgetown, where they are offered to local and international tourists. There are only three sites with a river: River of Life Kuala Lumpur,

Sungai Segget Johor Bahru and Jonker Street Melaka. Jonker Street Melaka is the only site that offers river cruise activities. The geographical factor with nature elements also influences river cruise activities. Melaka river cruise is popular among visitors, especially during the weekend and public holidays. Table 5 shows Jonker Street Melaka has the highest activities provision, such as walking, cycling, photographing, rickshaw, river cruise, and sales booth streets. It offers more user attractions and various activities. It is influenced by the historic sites that attract visitors. Melaka, a city rich in culture and history, is one of Malaysia’s most popular tourist destinations (Ying Yi Chung & Tan Terence, 2021).

The second highest activity is at Penang Street Art, offering walking, cycling, photography, rickshaw, and sales booth streets. Penang is the highest visitor attraction in Malaysia. The various activities are linked to visitor attractions. Melaka and Georgetown are the United Nations Educational, Scientific and Cultural Organization (UNESCO) heritage sites. In the Straits of Malacca, Melaka and George Town have grown over more than 500 years of trade and cultural contacts between East and West (Jyoti et al., 2021). Asia and Europe’s influences have given the towns a unique, concrete, intangible multicultural legacy (Jyoti et al., 2021). Based on the activities listed in Table 5, Ipoh Street Art and Bukit Bintang Kuala Lumpur offer walking, cycling, photography and sales booth streets. River of Life Kuala Lumpur and Sungai Segget Johor Bahru offer walking, cycling and photography.

This study evaluated all activities and assigned either low, medium or large scale. Table 6 shows the urban activities evaluation, where the highest (large scale) urban activities are walking (26%), photography (26%), and sales booth streets (18%). Walking is distributed by the lowest, medium, and highest number of walking activities. Most areas have the highest number of walking activities. This measure is based on studying the crowd and walking density.

**Table 6:** Cross-comparison Urban Activities Findings Evaluation

No.	Urban Activities	A	B	C	D	E	F	Count	Percentage (%)	Mean
1.	Walking	3	3	2	3	3	3	18	26%	2.83
2.	Cycling	2	3	1	1	3	1	11	17%	1.83
3.	Photograph	3	3	2	3	3	3	17	26%	2.83
4.	Rickshaw	0	3	0	0	3	0	6	9%	1.00
5.	River Cruise	0	0	0	0	3	0	3	4%	.50
6.	Sales booth streets	3	3	0	3	3	0	12	18%	2.00
Total		11	15	5	10	18	7	67	100%	

Note: The location names are as follows; A- Ipoh Street Art; B- Penang Street Art; C-River of Life Kuala Lumpur; D-Bukit Bintang Kuala Lumpur; E-Jonker Street Melaka; F-Sungai Segget Johor Bahru

Most people have a smartphone and can use it everywhere. Photography has been popular since 2010 because a smartphone captures everything with a visual display. The place can attract people through the photography section. Most study areas offer more views for the photography section with many exciting elements. This study measured the photography activity and section in urban space. The measurement scale is low, medium, and high photography activity and sections. Most urban spaces provide the highest photography section and activities regarding the cross-comparison activities findings evaluation. River of Life Kuala Lumpur has a medium section for photography. By October 2022, there are several new enhancement points in providing urban fabric elements such as softscape, hardscape elements and wall street art in River of Life Kuala Lumpur (Figure 2).



**Figure 2:** Urban Fabric Elements in River of Life Kuala Lumpur

Most sales booth streets are at Ipoh Street Art, Penang Street Art, Bukit Bintang Kuala Lumpur, and Jonker Street Melaka. The sales booth street offerings at Ipoh Street Art, Penang and Jonker Street Melaka use the same concept of being located between a lane and commercial shop houses because of the urban form and historical factors. The following activities are rated medium: cycling (17%), rickshaws (9%), and river cruising (4%). Most cycling activities are in Penang Street Art and Jonker Street Melaka. It is also in a historic place with the same urban form concept, influencing the cycling activities there. However, there are medium cycling activities in Ipoh, and the lowest is in the River of Life Kuala Lumpur, Bukit Bintang Kuala Lumpur, and Sungai Segget Johor Bahru. Only Penang Street Art and Sungai Segget Johor Bahru offer rickshaw activities, and both have large-scale rickshaw activities. Most rickshaw activities in Melaka and Penang are offered in the evening and at midnight.

The river cruise activities are only offered at Jonker Street Melaka. The trip frequency is 15 – 30 minutes at midnight on the weekend. This activity is in high demand from the visitors. The mean value is the average for each attribute. Walking (2.83) and photography (2.83) have a neutral score mean value. Cycling (1.83), rickshaws (1.00), and sales booth streets have a low mean value. The lowest mean value is river cruise (0.50). The average mean value represents the

percentage result in (Table 6). The result shows the highest is walking (2.83) and photographing (2.83), the rest shows a low score mean.

## **CONCLUSION**

This study aims to identify the urban space attributes and urban activities in two areas in Malaysian cities: new urban areas and historical areas. Data were collected via structured observations. Key attributes of urban spaces include high walkability, diverse activities, vibrant street art, and green elements. Light sculptures were the least prevalent. Dominant attributes based on the evaluation were walkability, urban activities, street art, green elements, and aesthetically pleasing historic buildings. Primary activities were walking, photography, and cycling (100%). Predominant in urban activities based on evaluation were walking, photographing, and sales booth streets. Rickshaw activities were popular in historical centres like Melaka and Georgetown. Jonker Street offered various activities: walking, cycling, photography, rickshaw rides, river cruises, and street vending. Common activities included walking, photography, and sales booths. Urban spaces across six study areas involved walking, photography, and street vending.

This study yields insights for stakeholders regarding the pattern of urban attributes' and activities. It provides academia with insights into the interplay between urban attributes in contemporary and historical areas. Urban space usage is vital for health crisis planning and fostering social interactions. Urban spaces can boost social interaction through diverse activities. To summarise, Sungai Segget Johor Bahru (a mix of historical and new urban areas), Melaka Jonker Street (a historical town) and River of Life Kuala Lumpur (a mix of historical and new urban areas) have the highest urban space attributes. Therefore, urban activities are highest in historical cities such as Melaka Jonker Street and Penang Street Art. Jonker Street Melaka not only has attribute but also offers a vibrant urban experience. The study focuses on Ipoh, Georgetown, Kuala Lumpur, Melaka, and Johor Bahru. Further research in different urban areas is recommended for a comprehensive understanding. For a broader grasp of the urban-activity relationship, extending the analysis beyond primary centers and considering additional variables is advised. Public space provision is essential to support local government efforts to build a livable city and promote urban development towards a sustainability framework.

## **DISCLOSURE STATEMENT**

The authors declare no conflict of interest.

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## **ESTABLISHING A SUSTAINABLE SOLAR ENERGY COMMUNITY IN THE MALAYSIAN RURAL ENERGY LANDSCAPE: A CASE STUDY OF PERAK TENGAH, MALAYSIA**

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### **Abstract**

The extensive reliance on conventional electricity from fossil fuels has heightened dependence in Malaysian communities, but escalating costs, CO<sub>2</sub> pollution risks, and the depletion of fossil fuel resources signal its unsustainability. This study investigates the potential of solar PVs to shift rural communities away from fossil fuel-dependent electricity, aiming to foster self-sufficiency. The objective is to enable Malaysian rural communities to benefit from solar technology through a communal-sharing concept. A purposive sampling case study in central Perak reveals that solar energy applications offer communities sustainable electricity access. This approach addresses underutilised roof spaces in Malaysian communities, creating a model for sustainable, resilient living with self-sufficient electricity. Results show successful implementation, with a public building supplying solar-generated electricity to two houses and acting as community storage with a power system of 2 kWp for 24 hours. Illuminance levels improved by 50% to 80%. Town planners and engineers' support is crucial for nationwide dissemination, aligning with the 11th and 12th Malaysia Plan goals for sustainable electricity provision. This effort contributes significantly to achieving national development objectives focusing on providing sustainable electricity for the people.

**Keywords:** Photovoltaics, Rural Community, Solar Energy, Sustainable Electricity

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## **INTRODUCTION**

The increasing trend of energy-dependent living in Malaysia has been heavily reliant on its fossil fuel resources, which have played a crucial role in generating national electricity and improving the overall quality of life in the society (Ahmad & Jamian, 2021). Additionally, these resources have enabled the government to subsidize electricity costs. However, the continued use of fossil fuels raises concerns about their depletion and poses threats to Malaysian energy security, especially in light of the South China Sea territorial conflict (Macaraig & Fenton, 2021). The local communities are particularly vulnerable to energy supply disruptions, highlighting the need for a more sustainable and secure energy model (Ahmad, et al., 2019).

This research aims to establish a sustainable community's model that ensures a consistent and secure electricity supply through the adoption of alternative energies, in particular solar energy for the rural development of Malaysia. This initiative aligns with the Malaysian rural development policy and supports the standpoint of planners in ensuring that rural developments are assessed for their environmental and economic impacts (Malaysia, 2021). In alignment with the 12<sup>th</sup> Malaysia Plan (12MP) initiative (under the pillar of Shared Prosperity and the dimension of Environmental Sustainability), the utmost focus is promoting sustainable citizen well-being through energy security. This aspect plays a crucial role in achieving the 12<sup>th</sup> Malaysia Plan (Malaysia, 2021). While global sustainable communities' models, such as 'Eco-village' (Hassan & Wall, 2017) and 'Co-housing' (Iberdrola, 2023) can be adapted to Malaysia, they currently lack a comprehensive solution to address the energy security challenges faced by a society that is heavily reliant on subsidized electricity. A concept of 'Rural Sustainability' was introduced by Ngah (2006), which defines the principles of a sustainable community. One of the fundamental aspects under this principle is the provision of sustainable electricity.

To tap into Malaysia's significant potential for establishing sustainable communities, this paper will focus on exploring key factors that demonstrate how solar photovoltaics (PVs) can power local communities and enable a more self-sufficient electricity supply. The paper tries to adopt an exploratory research design, primarily targeting middle and low-income communities.

The findings of this research will contribute to the formulation of a significant nexus living concept, integrating energy resources to ensure sustainable power supply for communities. Ideally, this living concept can be employed by the government to establish 'solar-communities', where solar energy is locally distributed through locals (Joshi & Yenneti, 2020). Significantly, this action may provide a future guideline for PLANMalaysia in establishing a more sustainable community for the rural energy development of this country (PLANMalaysia, 2020). By harnessing Malaysia's abundant solar

energy resources, such sustainable communities can contribute to national energy security and reduce dependency on subsidized electricity, fostering a more sustainable and resilient energy landscape.

## **LITERATURE REVIEW**

In 2022, the International Energy Agency (IEA) reported that global subsidies for fossil-fuel consumption amounted to USD\$1 trillion, with electricity subsidies making up nearly 60% of the total (IEA, 2023). This report highlighted the issue of lower end-use prices resulting from subsidies, creating distorted price signals that encourage excessive electricity consumption. This raised concerns about the global population's electricity consumption habits. In the case of Malaysia, ensuring equitable distribution of electricity poses a challenge, as the risk of inadequate electricity production increases due to the South China Sea oil territorial issue (Macaraig & Fenton, 2021) and increasing electricity tariff (TNB, 2023). As energy insecurity issues are projected to rise, middle and low-income groups become vulnerable to various problems, such as higher electricity prices (TNB, 2023), frequent power outages, business closures due to blackouts, security issues, and reduced household incomes from closed-down businesses. These issues can ultimately lead to poverty and adversely impact national households. Solar-generated electricity is not only a clean and environmentally friendly source of energy but also plays a pivotal role in reducing pollution. Its affordability makes it a crucial component in addressing both environmental concerns and the energy needs of local communities. To address this, efforts are needed to establish a more sustainable community focused on securing energy resources, particularly by diversifying alternative energy sources (Joshi & Yenneti, 2020).

Under the 11<sup>th</sup> and 12<sup>th</sup> Malaysia Plan, the Malaysian government aims to promote sustainable lifestyles among its citizens (Malaysia, 2021), which prioritizes citizen well-being through securing energy resources. This is also has been supported by the Malaysia National Energy Policy (NEP) 2020-2024, which outlines the country's strategic directions and goals in the energy sector by addressing the key areas such as energy security, sustainability, efficiency, and affordability. The NEP 2020-2024 has listed the important criteria, as follows:

- a) Diversification of energy sources that promote various renewable energy sources such as solar, wind, biomass, and hydropower.
- b) Improving energy efficiency is able to enhance the overall productivity of energy use across different sectors, including residential areas.
- c) Focusing on sustainability and environmental aspects that set targets for reducing carbon emissions and promoting environmentally friendly practices.

- d) Ensuring energy security by enhancing domestic energy production and securing energy resources.
- e) By providing energy affordability for consumers through strategic energy prices and subsidies effectively.

The United Nations (UN) report 2016 emphasized that communities must have diverse energy resources to avoid uncertainties and inadequacies in energy supply. Global sustainable communities have introduced models like Eco-villages (Hassan & Wall, 2017) and 'Co-housing' (Iberdola, 2023) communities that utilize various approaches to generate electricity while sharing ecological values. However, these green models have not yet provided a significant solution for maintaining energy security in nations like Malaysia, which is heavily reliant on subsidized centralized electricity. Abu Bakar et al. (2021) highlighted that, in establishing a sustainable community for Malaysia, it is essential to evaluate the communities by determining the human-nature connection with respect to the green initiative efforts. Thus, there is a need to establish a sustainable community model tailored to Malaysia's conditions.

Adopting a self-sufficient electricity lifestyle is a new and unfamiliar concept, especially for typical Malaysian communities (Ahmad & Jamian, 2021), particularly the middle and low-income groups accustomed to subsidized electricity from the government. Overseas examples have demonstrated that generating self-sufficient electricity can meet local energy demand, reduce the government's fiscal burden on energy, and contribute to the communities' self-sufficient energy (Joshi & Yenneti, 2020).

Community models like "Co-housing" groups have successfully generated their electricity through shared resources, such as biomass and solar energy generation (Iberdola, 2023). If adapted and modified to suit Malaysia's conditions, such community models could establish sustainable communities. With Malaysian abundant solar energy resources, with at least 10 sun hours daily, as indicated by Ahmad et al. (2019), harnessing and exploring this energy source could have a significant positive impact on the country.

However, with the increasing population, meeting the demand for energy becomes a challenge for the government, leading to competing access to energy security. The nation's fiscal burden will also increase. Therefore, communities must become sustainable in generating and utilizing energy. Additionally, Malaysia has been actively working on promoting solar energy adoption, including schemes and programs aimed at residential areas (see Table 1).

**Table 1:** Solar Energy Adoption Program (Since 2004) (SEDA, 2023)

<b>The Malaysian Building Integrated Photovoltaic (MBIPV) Project (2004)</b>	<b>Feed-in Tariff (FiT) Program (2011-2019)</b>	<b>Net Energy Metering (NEM) Scheme (2019 – to date)</b>	<b>Green Technology Financing Scheme (GTFS) (2019 – to date)</b>
<p>The incorporation of solar photovoltaic (PV) elements into the design and construction of buildings.</p> <p>The foundation milestone towards the passing of the Malaysia RE and SEDA Acts 2011.</p>	<p>To encourage the adoption of renewable energy, including solar power, by residential users.</p> <p>Under the FiT system, homeowners who install solar photovoltaic (PV) systems can sell excess electricity generated back to the grid at a predetermined tariff. The FiT rates are typically set by the government and aim to provide an attractive return on investment for residential solar installations.</p>	<p>Allows residential solar PV system owners to offset their electricity bills by exporting excess energy to the grid.</p> <p>Under NEM, homeowners with solar installations can receive credits for surplus electricity produced, which can be used to offset the cost of electricity drawn from the grid during periods of low or no solar generation. This encourages homeowners to invest in solar panels for self-consumption and grid support.</p>	<p>A financial incentive that provides loans at a lower interest rate for individuals, including residential homeowners, looking to invest in green technologies, including solar energy systems.</p> <p>This scheme aims to make it financially more feasible for residents to install solar panels on their properties.</p>

However, these schemes and programs primarily focus on high-income groups with strong financial capabilities and are essentially targeted for urban landscapes. The Malaysian government recognizes this issue and places great emphasis on the National Key Result Areas (NKRA) (PLANMalaysia, 2020) and the 11<sup>th</sup> and 12<sup>th</sup> Malaysia Plan objectives to make the country more energy self-sufficient and safe through the aid of renewable energies for all income groups (Malaysia, 2021). Given the vital role of energy in society and the abundant resources of solar energy in Malaysia, this paper explores opportunities for co-locating solar energy technologies in local communities (using public buildings) to cater to their energy demands and explore the limited availability of sustainable community models linked to the nexus of solar technologies in Malaysia.

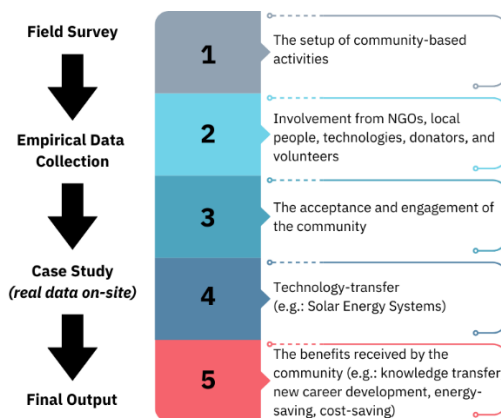
## RESEARCH METHODOLOGY

This research employs an exploratory mixed-method research design, which integrates both quantitative and qualitative methods in a sequential manner to explore the viability of establishing solar-sustainable communities in Malaysia.

The research aims to introduce the concept of a community grid to a typical community in Malaysia, enabling them to utilize excess electricity by sharing it within the community neighborhood. Given that not all households can afford a PV system (Ahmad et al., 2019), community buildings in the case study can be utilized for generating, storing, and distributing electricity.

The research began with a qualitative approach, focusing on observing and identifying suitable areas for co-locating solar energy technology in alignment with the local conditions of the communities. The study emphasizes generating solar energy as a means of achieving self-sufficient electricity from public buildings, thereby promoting sustainable energy practices within the community. It assessed the feasibility of generating electricity from the panels and sharing it with the communities through nearby public buildings, such as schools, mosques, or hospitals. A quantitative study was also conducted to evaluate the feasibility of co-locating solar PV technologies in selected areas. This study involved small-scale modelling and simulation of selected case studies to provide input for the development of the solar-community model. Finally, specific empirical data on the energy output of the solar panels were established and compiled over a 24-hour duration.

By adopting the research process outlined in Figure 1, the electricity produced by solar PV panels is fed into the community's grid system by a designated user acting as the 'generator' (a public building equipped with PVs). Individuals without PV panels can then directly purchase electricity from the PV generator. This approach can be integrated with public buildings in the community, such as schools, public clinics, mosques, and town halls, all of which can be equipped with solar PVs. For this research, a school has been selected since most rural communities have a public school.



**Figure 1: The Research Process**  
*Source: the authors (2023)*

In a rural community, the community leader can play a crucial role as the focal person responsible for managing the distribution of energy among these shared facilities. This cost-effective solution benefits the community as it allows for the installation of solar PVs on multiple public buildings with the involvement of many stakeholders. At the same time, it provides technology exposure for rural communities.

### **DATA COLLECTION AND ANALYSIS**

The analysis of the case study is based on data gathered through field research, including site visits to the selected case study. Typically, roofs in Malaysia hold significant potential with vast areas and slopes generally less than 20°, making them well-suited to receive ample solar irradiation. With the full capacity of the roof areas on public buildings, the establishment of a successful solar community can become feasible. For this study, a typical school in a rural area in Perak Tengah, Malaysia, has been selected, representing a public building actively used by the community (see Figure 2).



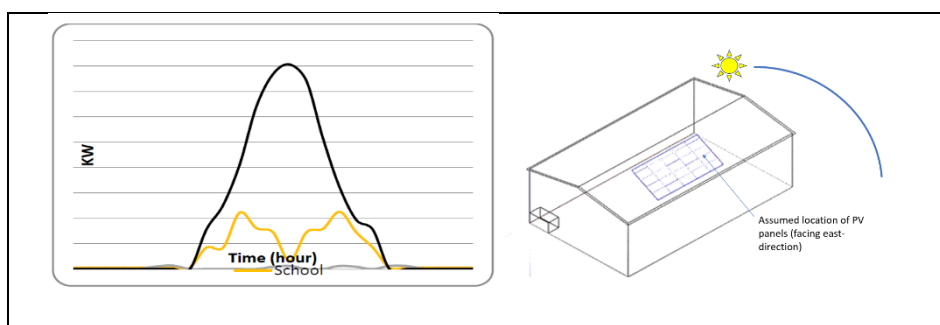
**Figure 2:** The Selected Case Study - A Public School in Perak Tengah, Malaysia

The observation and field survey period spanned for about 3 months, including the load profile collection by using data power logger and a pilot test involving an actual PV-system installation. Additionally, a small-scale simulation was conducted, and researchers compared the results with the actual collected data on the efficiency of the installed solar system (see Figure 3). The temperature on the day of installation was 27°C, and the sky condition was clear.



**Figure 3:** The Actual Process of the Research on Site.

Typically, only 10% of the average roof area of public buildings in the case study, which has an overall roof area of 1300 m<sup>2</sup>, is required for installing solar PV panels. A small-scale simulation by PVSyst software (PVSyst, 2023) has illustrate the solar capability for this school which facing the east-direction with the consideration of this 10% (See Figure 4).



**Figure 4:** The Simulation Process Runs by PVSyst Software and The Load Profile of PV System Generated from the Roof of the Public School for 24-hours


This size is feasible and cost-effective for the buildings, considering the power requirements of the local community are small, if located in rural areas. This school holds the potential to supply solar-generated electricity from its panels and serves as electricity storage for the community. A 2 to 20 kWp PV system is deemed feasible for the school (Ahmad et al., 2019).

In this study, 10% of the overall area of the roof's building is approximately 130 m<sup>2</sup> (from 1300 m<sup>2</sup> of roof area) and has been installed with the solar PV system. To achieve an optimal peak of energy load, a 2-kWp stand-alone solar PV system with an efficiency of 20% was recommended for a pilot test (Ahmad et al., 2019). At the actual site, the system was successfully installed on the school's roof, and it was connected to the storage battery, inverter, and solar charge controller. Between 7 pm and 7 am of the next day (12 hours), the PV-systems effectively powered the outdoor lighting of the school, demonstrating the significant potential for increasing the number of installed solar panels on the roof. Figure 4 also illustrates that the energy received from the sun is substantial from the morning (7 am) until the afternoon (12 pm) and gradually decreases after noontime.

During this stage, a Lux Meter (Kyoritsu 5202 Lux Meter device) was used to measure the illuminance level at the site during nighttime. Table 2 illustrates the school's illuminance and brightness levels before and after the solar PV system installation, revealing a substantial difference between the two periods.



**Table 2:** Total of Improvement for the Illuminance and Brightness Level

Point	The Illuminance Condition is darker (Before the Installation)	The Illuminance Level (Before the Installation)	The Illuminance Condition is brighter (After the Installation)	The Illuminance Level (After the Installation)
Point 1		0 lux		50 lux (>50%)
Point 2		1 lux		80 lux (>80%)
Point 3		1.5 lux		100 lux (>67%)

From Table 2, it can be found that a public school can play a significant role in assisting communities by storing the surplus energy generated from PV panels and providing this energy to the locals when required. The findings have shown that with the aid of solar PV for this school, it can illuminate the surrounding areas, including the nearest residents, especially during nighttime.

### DISCUSSION

According to the conducted research, the installation of solar PV system resulted in a significant improvement of 50% to 80% in the illuminance level around the school. This highlights the relevance and importance of schools as the catalyst of a community to adopt solar PV applications, especially during nighttime. These installations contribute to enhanced visibility, lighting of the surroundings, and increased security levels in the community. Significantly, public schools can assist the communities by storing the excess energy generated from the PV panels

and sharing this energy with the locals when needed. This becomes particularly crucial during prolonged power blackout issues or flood disasters, where the power infrastructure is often disrupted due to flooding.

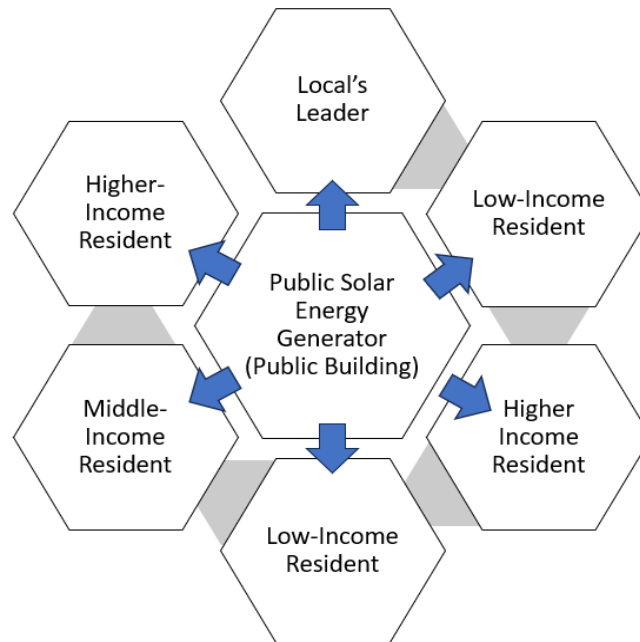
In this research, it is estimated that if the average daily sunlight hours are 5 hours, with the minimum 2 kWp system:

- a) **Daily Energy Production (kWh)** =  $2 \text{ kWp} \times 5 \text{ hours (Solar Peak Hours)} = 10 \text{ kWh/day}$
- b) **Daily Energy Usage for School Lighting (kWh) (from 7 pm to 7 am)** =  $0.3 \text{ kWp} \times 12 \text{ hours usage} = 3.6 \text{ kWh/day}$
- c) **Excess Daily Energy (kWh)** =  $10 \text{ kWh/day} - 3.6 \text{ kWh/day} = 6.4 \text{ kWh/day}$

With the aid of batteries, an energy storage device can store electrical power and connect to a plug for a power source, known as the charging station. Buildings may act as a charging station, allowing nearby villagers to access electricity from a community-shared PV for basic electricity usage. With an excess of 6.4 kWh per day, it can power at least two rural houses, considering a consumption of 3 kWh of energy for each house. An actual energy production can vary based on factors like weather conditions, shading, and the orientation and tilt of the solar panels. Consequently, this energy-sharing can help provide energy security for rural communities. If a larger system, for instance, a 20 kWp system, is invested, a greater excess of energy-sharing can be provided in the communities, benefiting a higher number of rural residents from this energy.

The concept of energy-sharing can be implemented to foster a sustainable solar community. Community involvement is vital, enabling residents with limited financial resources to access solar energy facilities through sharing with other community members with higher incomes. A community leader, along with various stakeholders, can organize and facilitate this energy-sharing concept for the locals.

A comprehensive approach is recommended for the Government to provide holistic assistance to local communities, ensuring that these people can achieve self-sufficiency and sustainable electricity. With the assistance of town planners and engineers, this ideal concept can be effectively disseminated throughout the country, contributing to the achievement of the 11th and 12th Malaysia Plan's goal of providing sustainable energy for the people. Ideally, the concept of a sustainable solar community can be visualised like in Figure 5. A public building can function as a public solar energy station, storing all the energy generated from PV panel systems in its battery banks locally. The locals can then access this stored power by using extension outlets for lighting or powering other electrical appliances in their houses.



**Figure 5:** The Concept of a Sustainable Solar Community for Malaysia  
*Source: the authors (2023)*

## **CONCLUSION**

This study successfully investigates the potential of a sustainable solar community model that capitalizes on utilizing large community areas as co-locations for solar energy technologies. It encourages resilient practices, enabling communities to achieve energy independence through solar technologies while establishing public buildings as nexus hubs to promote overall sustainability in energy generation. This approach effectively addresses energy insecurity issues among locals, fostering energy generation and increasing self-sufficiency, ultimately contributing to the development of sustainable communities in Malaysia.

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## **THE PARADOX OF THE REN: A LOOK AT REAL ESTATE NEGOTIATOR (REN) PRACTICES IN MALAYSIA**

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### **Abstract**

This paper explores the findings of a focus group discussion held to examine the current state of Real Estate Negotiator (REN) practice in Malaysia. RENs, acting as representatives of estate agencies, play a crucial role in facilitating property transactions. However, the discussion revealed significant ambiguities surrounding their responsibilities, ethical considerations, and the efficacy of the REN Tag system. Participants recounted instances of misrepresentation of property details, inflated rental/prices, and deceptive marketing activities. This highlighted the need for stronger measures to promote ethical conduct within the profession, including awareness campaigns, stricter disciplinary measures, and a robust complaint mechanism.

**Keywords:** Estate Agency Practice, Real Estate Agents, Real Estate Negotiators

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## **INTRODUCTION**

A dynamic network of players i.e. property consultants, Real Estate Agents (REAs) and Real Estate Negotiators (RENs) drives the Malaysian real estate agency landscape. Among these, Real Estate Negotiators (RENs) occupy a curious space. Acting as representatives of REAs, they are the frontliners at the forefront of property transactions, yet their role remains shrouded in ambiguity, burdened by issues of legitimacy and ethical conduct.

On the surface, RENs play a crucial role – they are the liaisons between buyers and sellers, navigating the complexities of property viewings, negotiations and legal documents. As representatives of REAs, they are entrusted with promoting properties to let/sale, securing deals, and ultimately, contributing to the financial success of the agency. However, their obligations towards this role are surprisingly minimal. Compared to real estate agents, who undergo rigorous training and hold licenses, RENs require only a two-day certification course and registration with the Board of Valuers, Appraisers, Estate Agents and Property Managers (BOVAEP). This minimal barrier to entry raises concerns about the quality of service and the potential for unethical practices.

## **BACKGROUND TO REAL ESTATE NEGOTIATORS (RENS)**

To regulate the profession, all new potential candidates who wish to become negotiators are required to attend a two-day course known as the Negotiator Certification Course (NCC). Upon successful completion of the course, the candidates will need to apply for REN Tags as official identification that they are legitimate negotiators employed by REAs. The introduction of REN Tags aims to legitimize the negotiators and weed out illegal brokers. By making RENs readily identifiable, the system promotes transparency and accountability. In theory, landlords, tenants, buyers and sellers can verify the credentials of any negotiator they encounter through the BOVAEP on-line database, safeguarding themselves from unscrupulous individuals. However, the effectiveness of REN Tags is hampered by the lack of stringent entry requirements. Without proper vetting procedures, the system remains vulnerable to infiltration by individuals with questionable ethics or limited knowledge of the industry.

This vulnerability manifests in the form of integrity issues and misconduct. Cases of misrepresentation, inflated property rentals/values, and even outright fraud tarnish the reputation of the entire profession. The absence of clear roles and functions for RENs further exacerbates the problem. Their responsibilities often overlap with those of estate agents, creating confusion and ambiguity that can be exploited by unscrupulous individuals. This lack of clarity also makes it difficult to hold RENs accountable for their actions, further perpetuating the cycle of misconduct.

Despite these challenges, the role of RENs remains vital as intermediaries to the Malaysian real estate market. Their frontline efforts drive

sales, connect buyers and sellers, landlords and tenants and so reducing the information asymmetry arising from the imperfect property market.

### **LITERATURE REVIEW**

Real estate negotiators are taking major roles in the present structure of estate agency practice in Malaysia. According to the Malaysian Estate Agency Standards (MEAS), a REN is a person who is employed or engaged by an estate agent to assist him/her in the estate agency practice. A Negotiator shall include Real Estate Negotiators (RENs) and Probationers who shall always be under the immediate direction and supervision of a registered estate agent. Except for the probationary estate agent, RENs are not subjected to any academic or professional qualifications. Anyone interested in becoming a REN is required to attend a 2-day Negotiator Certification Course (NCC) conducted by a firm or institution recognized by the Board. With the certification, the individual can apply to the Board to obtain a REN registration number and also a tag before they can be employed as real estate negotiators.

Negotiators means a person who is employed by a registered estate agent in the estate agency practice (s22c(2A), Act 242). The Board gives each Real Estate Negotiator a REN number upon his application being approved. They are usually salespersons who are paid a fee or commission based upon the conclusion of a successful estate agency transaction, usually not more than 40% of the professional fees. Negotiators can also be under the direct employment of registered estate agents and be paid salaries rather than fees or commissions. Except with the express permission of the Board, no estate agent shall have more than 50 Negotiators at any time; the estate agents should keep a register of all their Negotiators with the dates of their respective appointments and fees or commissions paid. The number of negotiators can be increased to 100 with the permission of the Board if the past/track record of the REA is good. Table 1 illustrates the roles of registered estate agents and negotiators.

**Table 1:** Roles of Real Estate Agents (REAs) and Real Estate Negotiators (RENs)

<b>REAs</b>	<b>RENs</b>
Governed by the Act	Function as assistants to REAs
Manages the agency company	Work according to the Malaysian Estate Agency Standards
Operates a proper agency office	Can be employed/engaged under 'Contract of Service' or 'Contract for Service'
Fiduciary duties to their clients	Must be registered by the agency firm to the Board
Operates Clients account	
Trains and manages RENs	
Accountable for any misconduct/ misdemeanors by RENs under REAs employment	

*(Source: Author)*

## RESEARCH METHODOLOGY

The Focus Group Discussion was conducted on the 24th of September 2019 at the Concorde Hotel, Shah Alam (9 am to 1 pm). Nine out of twelve invited experts attended the discussion:

- i. To examine whether the code of conduct (1986) is still applicable in modern estate agency times.
- ii. To obtain industry feedback on the practices of REAs and RENs in particular.

**Table 2:** List of Experts for FGD

Organisation	Number of representatives
PEPS	1
RISM	1
EAPC, BOVAEP	1
MIEA	1
MIPEAC	1
UM - Academic	2
UiTM - Academic	1
Practicing REA	4
Total	12

## ANALYSIS AND DISCUSSION

The Real Estate Negotiator (REN) landscape in Malaysia is like a bustling marketplace – full of activity, potential, and, as our focus group revealed, a few lingering uncertainties. While RENs act as the face of estate agencies, engaging in property viewings, negotiations, and paperwork, their responsibilities and obligations remain surprisingly undefined. This ambiguity, coupled with some concerns about the current REN Tag system and ethical practices, raises some key questions for consideration:

### A. Real Estate Negotiators (RENs)

#### 1. The REN Identity: Blurred Lines and Minimal Obligations

One key concern raised by FGD participants was the minimal barrier to entry for RENs. The existing two-day certification course and registration with the BOVAEP were perceived as insufficient safeguards against unqualified or unethical individuals entering the profession. This lack of stringent vetting procedures was linked to concerns about the quality of service offered by RENs and the potential for misrepresentation and misconduct in the property market.

#### 2. REN Accountability

Furthermore, the focus group highlighted the lack of clearly defined roles and responsibilities for RENs. The overlap with estate agent duties was seen as a



source of confusion and ambiguity, hindering accountability, and potentially enabling unethical practices. This lack of clarity was further exacerbated by the introduction of the REN Tag system, which, while aiming to legitimize the profession and identify authorized negotiators, was perceived as ineffective due to the aforementioned minimal entry requirements.

### **3. Ethical Conduct of RENs**

The Focus Group revealed concerns about unethical practices and misconduct among some RENs, including misrepresentation, inflated rental/price, and even fraud.

Participants emphasized the need for awareness campaigns and stricter disciplinary measures to promote ethical conduct throughout the industry.

As one participant aptly summarized, "RENs have the potential to be the backbone of the real estate market. Let's equip them with the tools and standards for negotiators to be trusted and accountable."

### **B. Real Estate Agents (REAs)**

The REAs are allowed to employ 50 RENs under each REA. The REAs are responsible to supervise and monitor the conduct and practice of the RENs under their supervision. The estate agency firms are responsible for providing training and knowledge transfer to RENs.

One central theme from the FGD participants involved the responsibility for upholding ethical standards. While some participants advocated for REAs, as license holders, to actively impose ethical frameworks within their firms and organizations, others pointed out the limitations of this approach. The lack of disciplinary action towards RENs was seen as a loophole that could potentially undermine ethical efforts.

Another key concern revolved around the limited oversight exercised by estate agents over REN activities. Participants described situations where RENs operated with minimal supervision, potentially engaging in misrepresentation of properties or unfair negotiation practices. This lack of monitoring was perceived as a breeding ground for unethical behaviour and a violation of client trust.

The issue of imbalance commission sharing between REA and REN also emerged as a significant ethical concern. Participants shared experiences of REAs neglecting established commission structures with RENs to as low as 10:90 ratio leaving REAs feeling undervalued and financially exploited. This lack of transparency and fairness was another factor eroding trust and confidence within the system.

Furthermore, participants expressed concern about the unethical practice of estate agents sub-letting their licenses, essentially outsourcing their professional obligations for personal gain. BOVAEP should publicise such

breaches of the code of conduct and take serious actions or penalties to deter similar misconduct in the future.

### **Suggestions**

To address these concerns, the focus group proposed several potential solutions:

- a) Strengthening entry requirements: This could involve mandatory exams, experience criteria, and ongoing training programs that would ensure a higher standard of competence among RENs.
- b) Defining clear roles and responsibilities: A clear delineation of duties between RENs and estate agents would address overlap and enhance accountability.
- c) Promoting ethical conduct: Regular training, awareness campaigns, and a robust complaints and enforcement system would foster a culture of professionalism and integrity within the profession.
- d) Strengthened monitoring mechanisms to ensure that estate agents effectively oversee the activities of RENs within their firms.
- e) Mandatory ethical training programs for both REAs and RENs, focusing on professional ethics, code of conduct, transparency, accountability, fair commission practices, and fair employment practices through diversity, equity, and inclusion (DEI).
- f) Enhanced enforcement of existing disciplinary actions, including consequences for agents who sub-let licenses or disregard the commission sharing ratio.
- g) Exploration of alternative regulatory frameworks that go beyond the current reliance on estate agents to hold RENs accountable.

### **CONCLUSION**

The current state of REN practice in Malaysia presents a paradox. While RENs are essential players in the real estate market, their minimal obligations, the issues surrounding REN Tags, and the lack of defined roles create an environment susceptible to unethical practices. Addressing these challenges through stricter regulations, clearer roles, and a relentless focus on ethical conduct is vital to unlocking the true potential of RENs and ensuring a robust and trustworthy real estate market in Malaysia.

However, to unlock their full potential and foster a truly ethical and professional environment, several key steps are necessary. Firstly, strengthening the entry requirements for RENs through stricter vetting procedures and ongoing training programs is crucial. Secondly, defining clear roles and responsibilities for RENs within the larger framework of estate agency operations will ensure accountability and prevent overlap. Finally, promoting ethical conduct through awareness campaigns and stricter disciplinary measures will send a strong message of professionalism throughout the industry.

By addressing key issues, Malaysia can build a more robust and transparent REN ecosystem, benefiting both clients and the real estate industry as a whole.

In conclusion, the focus group discussion unveiled significant ambiguities and ethical dilemmas within the current REN practice in Malaysia. By addressing the concerns raised, including strengthening entry requirements, clarifying roles and responsibilities, and promoting ethical conduct, Malaysia can create a more professional, sustainable and trustworthy REN ecosystem.

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## **A FRAMEWORK OF PRACTICAL ECONOMIC INDICATORS FOR TRANSIT-ORIENTED DEVELOPMENT (FPEI-TOD): IDENTIFICATION AND EXPERT VALIDATION**

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### **Abstract**

Transit-Oriented Development (TOD) can be one of the tools to achieve sustainable urban management (SUM), as promoted by SDG11 on Sustainable Cities and Communities. In the context of Malaysia, TOD is seen as a potential solution to urban challenges, i.e., traffic congestion, pollution, rising cost of living, lack of employment opportunities, and the prevalence of crime. However, in determining a balanced approach to SUM, TODS must have a framework of indicators that can be used to guide its implementation so the three sustainable development dimensions are catered for, particularly the economic dimension. A review of previous studies and literature on TOD revealed a dearth of studies on economic indicators for TOD in Malaysia. Using the sequential mixed methods approach, this research aimed to improve the current implementation of TOD for sustainable urban management by proposing a framework for practical economic indicators of TOD and endeavouring to close the gap in practical TOD assessment in Malaysia. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) were used to extract the economic indicators before deploying a questionnaire survey for experts' validation. A total of 48 economic indicators that are practical to implement for TOD were produced based on the experts' opinions. These indicators would serve as measuring tools for ensuring sustainable TODs that not only provide greater transit facilities but are also resilient in facing future urban challenges.

**Keywords:** Sustainable Development, Transit-Oriented Development (TOD), Urban Management and Economic Sustainability, Indicators

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## **INTRODUCTION**

TOD is a planning strategy that focuses on creating compact, mixed-use communities around public transportation facilities, such as train or bus stations (Gomez et al., 2019). The goal of TOD is to encourage sustainable urban development by promoting efficient and convenient public transportation options, reducing reliance on private cars, and fostering a more pedestrian-friendly and environmentally-friendly urban environment (Bista, 2008). TOD is crucial for sustainable urban management as it offers a holistic approach to urban development that integrates transportation, land use, and environmental considerations, contributing to more resilient, liveable, and environmentally friendly cities (Chan et al., 2016; Khalid & Samsudin, 2023). Many recent studies on TOD tap into the influence of economic aspects on urban function, which refer to the various activities, land uses, and functions within a development to support a transit-friendly environment (Yu et al., 2022). The urban function within TOD areas typically aims to enhance accessibility, walkability, and the overall quality of life in the communities (Zhang et al., 2022). The current challenges to TOD faced worldwide are primarily land use zoning and regulation, which hinder the efficient development of mixed-use, and high-density areas around transit nodes, which are essential for successful TOD (Liu et al., 2020). Others include gentrification and affordability, which displace existing lower-income residents near transit nodes (Chava & Renne, 2022), last-mile connectivity, which ensures convenient and safe connectivity between transit hubs and final destinations (Venter, 2020), and integrating new technologies such as ridesharing, electric scooters, and autonomous vehicles into TOD planning (Butler et al., 2020; Cervero, 2020; Litman, 2021).

Examining the economic indicators for TOD is crucial as it provides valuable insights into the economic impact, viability, and sustainability of TODs (Cucuzzella et al., 2022). Economic indicators offer a comprehensive understanding of how TOD initiatives contribute to local and regional economies (Almatar, 2022; Newman et al., 2021). These indicators provide a quantitative basis for decision-making, encourage informed planning, and help stakeholders understand the broader economic implications of TOD on urban areas (Liu et al., 2020; Maheshwari et al., 2022). The lack of a structured framework for economic indicators can hinder the ability to comprehensively assess, plan, and manage TOD projects (Furlan et al., 2021), besides the risk of unintended economic consequences such as uncontrolled gentrification, insufficient job creation, or an imbalance in the mix of land uses within TOD areas (Asiz, 2020; Surya et al., 2020).

This paper is part of larger research that aims to develop a framework of practical economic indicators for TOD in Malaysia. The purpose of this paper

is to present the preliminary findings after the first round of Delphi expert validation. This paper is organised into the following sections: a literature review to establish the framework and context of this paper; research methodology that describes methods and procedures used; analysis and discussion to analyse and interpret results in the context of the paper's aim; and a conclusion to summarise and emphasise the significance of this paper and its contribution.

## **LITERATURE REVIEW**

### **Concept of Transit-Oriented Development (TOD)**

TOD is a recent concept focusing on efficient modes of transportation other than the automobile (Chan et al., 2016). The concept of TOD was introduced by Peter Calthorpe, who urged planning for pedestrians and transit “not to eliminate the car, but to balance it” (Ibraeva et al., 2020; Ramlan et al., 2021). TOD is one of the best alternatives for various sustainable challenges, especially preventing urban sprawl (Olaru et al., 2011). It is seen as a logical means towards compact urban development and sustainable transportation (public transit, cycling, and walking) (Thomas & Bertolini, 2017). Other benefits of TOD include strengthening local economies by improving local public transit, which reduces vehicle transportation costs and time spent commuting (IPA, 2013). TOD also creates compact communities and strong transit systems. These criteria would help to attract innovative youngsters towards the inner city, thereby creating more jobs and a vibrant environment. Generally, TOD is about creating an urban environment with mixed and diverse land use and a walkable transit stop that balances the need for sufficient density to support convenient transit services (Rahim, 2018). According to Thomas and Bertolini (2017), as well as Mu and de Jong (2012), TOD planning principles have been adopted around the world to control urban growth, reshape the quality of urban form, and provide efficient transportation systems. The possibilities of TOD to address urban problems such as traffic congestion that results from urban sprawl have also been studied by various Asian governments such as China, Hong Kong, Singapore, and Japan (Hasibuan et al., 2014; Mu & de Jong, 2012; Sung & Oh, 2011). Gomez et al. (2019) emphasised that the main concept of TOD is aimed at providing a vibrant and liveable community. In practice, there are different approaches proposing different quantitative measurement criteria for TOD.

### **TOD Core Principles and Components**

The core of TOD is to reduce car use (Ali et al., 2021). By reducing the need for vehicle travel, mixed-use development brings shared community spaces such as plazas, parks, and sidewalks to foster interaction among community members (Zamorano & Kulpa, 2014). According to Calthorpe (1993), there are seven **core principles** associated with TOD: (i) Compact growth should be organised at

regional level and be transit-supportive; (ii) Housing, offices, and “civic uses” should be located within walking distance of transit stops; (iii) Streets should be bike and pedestrian friendly and connect to local destinations; (iv) There should be a mix of housing types, densities, and costs; (v) Ecosystem services should be preserved, as well as high-quality open space; (vi) Public space should be the central focus of buildings and neighbourhoods; and (vii) Existing neighbourhoods requiring infill should be redeveloped along transit corridors.

The University of Delaware (2013), referring to the core principles of Calthorpe (1993), further listed five (5) **key components** of TOD: (i) It contains a walkable, high-quality pedestrian environment that integrates streetscaping; (ii) The highest housing densities are located closest to the transit centre to decrease sprawl and promote compactness; (iii) The transit centre is also at the centre of a destination that has a diverse and mixed-use development; (iv) The community has quality public transit facilities and services; and (v) Parking is carefully located, designed, and managed.

### **Issues Faced by TODs**

Despite the numerous benefits of TOD, issues in urban areas are still on the rise. The various issues include zoning and regulatory barriers that impede the efficient development of mixed-use, high density around transit nodes (Mathur & Gatdula, 2023), hindering the TOD concept, inadequate public transport structures that limit the effectiveness of TOD initiatives (Ibraeva et al., 2020), and the security and safety of commuters at transit stations, which can deter people from using public transport (Ruslan et al., 2023; Soto et al., 2022). These prevailing issues of TOD are an alarm that suggests the practical indicators for transit development are timely and crucial to ensuring the TOD-ness of transit development in Malaysia, especially in solving the economic-related problems in the urban area.

### **TOD Indicators**

The selection of indicators should be based on the essential details of TOD (Nyunt & Wongchavalidkul, 2020), including land use characteristics, built environment, and design characteristics (Loo et al., 2010; Sung & Oh, 2011) that could potentially facilitate planning decisions, and possibly both spatial and nonspatial indicators (Sulistyaningrum & Sumabrata, 2018). The indicators are mapped out according to the Economic Pillar of Sustainable Development Dimension (SDD) and grouped according to the TOD principles. These scholars were screened and selected through the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocols and reported according to the PRISMA Statement (which is further elaborated in the methodology section).

## TOD in Malaysia

TOD in Malaysia was defined by PLANMalaysia (2018) as a development concept centred around rail transit or bus stations that promotes high connectivity, is public transportation-friendly, pedestrian-friendly, and bike-friendly, along with reducing dependency on private vehicles. Now, TOD has become a key concept for developers and property players in urban planning to create a quality, prosperous, and sustainable living environment (Gomez et al., 2019).

PLANMalaysia established specific guidelines that contain comprehensive guidance for transit development (Abdullah et al., 2022; PLANMalaysia, 2018). Kuala Lumpur is currently one of the cities that is extensively promoting transit development by introducing transit zoning. Transit zoning allows for higher density and compact development around the transit area to attract investors to redevelop and compensate the high land price with other physical and monetary incentives (Kidokoro, 2020)

## RESEARCH METHODOLOGY

To achieve the aim of this paper, a mixed-methods approach was used. Firstly, economic indicators of TOD were extracted from the literature. The relevant studies were identified and screened using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The PRISMA statement table was created using the most important parts of TOD, like land use, built environment, and design, along with the set criteria for finding the right indicators for this study. The PRISMA statement table is presented in Figure 1.

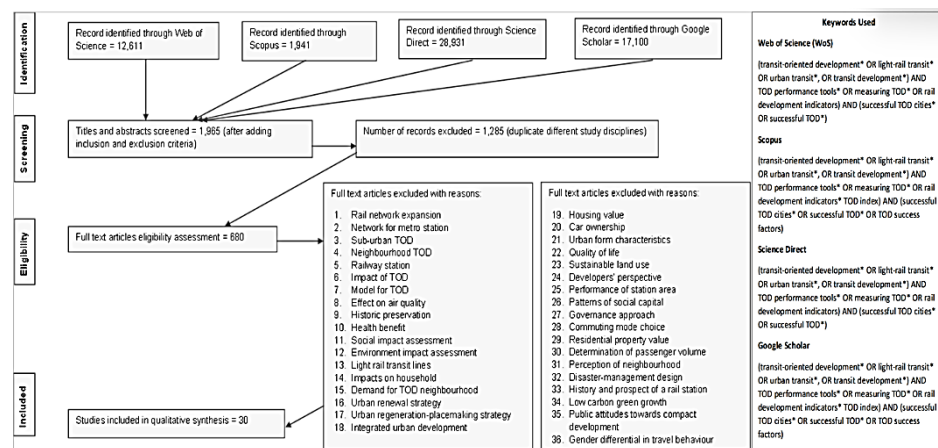


Figure 1: PRISMA Statement Table

Source: Researcher (2023)

Following the extraction of the economic indicators from the literature, the Delphi technique was used to finalise the indicators. The Delphi technique is



a structured and iterative method of communication and consensus-building among a group of experts to reach a consensus on a particular issue or topic by gathering and synthesising the opinions of a diverse group of experts (Beiderbeck et al., 2021). To serve the objectives of this research, three rounds of iterations will be carried out. A set of questionnaires was distributed to selected TOD experts to gauge the convergence of consensus among the experts. The questionnaire consists of 5-point Likert scale questions. This quantitative method was applied to validate the practical economic indicators for sustainable urban TOD assessment. A total of 16 TOD experts were selected from different planning authority levels in Malaysia (i.e., federal, state, and local government levels). These experts were top management officers who possess the related background, knowledge, and experience regarding TOD (see Table 1). To achieve the objective of this paper, Delphi Round 1 was carried out to gather the experts' opinions on the practical economic indicators for TOD to be implemented in Malaysia. The analysis and results from the Round 1 Delphi are presented in the following section.

To analyse the questionnaire, descriptive analysis of the central mean was used to eliminate impractical indicators derived from the survey. The results from Delphi Round 1 were then used to modify the questionnaire for Delphi Round 2. The results from the descriptive analysis were then verified using Principal Component Analysis (PCA) to validate the reliability and validity of the first iteration.

**Table 1: List of experts in TOD**

Organisations Level	Organisation	Experts' Designation	Number of Officers	Number of TOD Projects
<b>Federal</b>	PLANMalaysia HQ	Deputy Director (R&D Unit)	1	5
		Head of Division (Sustainable Development Unit)	1	3
		Head of Division (Heritage and Urban Design Unit)	1	3
		Senior Town Planner	1	4
		Senior Town Planner	1	4
<b>State</b>	PLANMalaysia Selangor	Senior Deputy Director	1	6
		Head of Unit (Development Control)	1	4
		Senior Town Planner	1	3
<b>Local Authority</b>	Subang Jaya City Council	Director	1	7
		Deputy Director	1	4
		Senior Deputy Director	1	5
		Senior Town Planner	1	5
		Senior Town Planner	1	4
		Senior Town Planner	1	4
		Senior Town Planner	1	4
<b>Total</b>	<b>3</b>	<b>16</b>	<b>16</b>	<b>73</b>

*Source: Researcher (2023)*

## ANALYSIS AND DISCUSSION

Table 3 demonstrates the result of the descriptive analysis from Delphi Round 1. The elimination process was undertaken by referring to the mean score range (Chyung et al., 2017; Garland, 1991) (refer to Table 2). A mean score above 3.50 was accepted and selected for Round 2 of the Delphi Survey (Chyung et al., 2017).

**Table 2: Mean Score Range**

Scale	Likert Type	Mean Score Range
1	Strongly Disagree	1.00 – 1.80
2	Disagree	1.90 – 2.60
3	Neutral	2.70 – 3.40
4	Agree	3.50 – 4.20
5	Strongly Agree	4.30 – 5.00

*Source: Chyung et al. (2017)*

The central mean analysis confirmed a total of **48 indicators** from the initial **77 economic indicators** to be retained for Delphi Round 2. This recorded a **38%** reduction from the result of Delphi Round 1. The retained indicators, in the view of the experts, are practical and suitable to be established in the transit development in Malaysia.

**Table 3: Descriptive Analysis Results**

Variable	Initial Item	Round 1 Results
Land use	11	7
Density	8	6
Population	5	0
Transit facilities	13	8
Property development	6	0
Value recapture	7	6
Economic attributes	27	21
<b>Total</b>	<b>77</b>	<b>48</b>

The result from the Delphi Round 1 survey was also verified by using the factor reduction method of Principal Component Analysis (PCA) to achieve credibility for the results, as well as enhance the validity of the survey. The factor reduction was performed using **varimax rotation**, with the **factor loading** criteria set at **0.60**. Components that loaded below the criteria set were eliminated for the round of the Delphi survey. The result of the PCA is presented in the following table.

**Table 4: Factor Loading of Component Matrix**

SD Dimension	Variable Components	Factor		
		1	2	3
Economic	<b>Land Use</b>			
	Quantity of mixed-used development		.775	
	Comprehensive development		.897	
	Efficient land use patterns	.860		
	Location efficiency	.786		
	Diversity of housing types	.834		
	Access and accessibility	.708		
	Urban development		.807	
	<b>Density</b>			
	Density of development	.914		
	Population density	.820		
	Business density	.702		
	Ground floor retail density		.931	
	Retail density		.924	
	Land use density	.901		
	<b>Transit Facilities</b>			
	Information display system	.948		
	Frequency transit service		.686	
	Safety of commuters at transit stops	.907		
	BRT facilities	.748		
	Points of interest (POI)		.748	
	Stations in CBD		.892	
	Number of public facilities	.846		
	Average distance from public facilities to commercial area		.698	
	<b>Value Recapture</b>			
	Increase in property value	.903		
	Tax earnings of the municipality	.934		
	Value recapture	.912		
	Financial return	.934		
	Land prices	.752		
	Private investment	.828		
	<b>Economic Attributes</b>			
	<b>Subset 1</b>			
Number of business establishment		.827		
Economic development	.875			
Average car ownership			.924	
Degree of multifunctionality	.868			
Household income		.887		
Real per capita income	.647			
Industrial accident rate			.810	
Transport and communication	.811			
Utility efficiency		.735		
Sustainable urbanisation rate	.900			
Strengthening national and regional development planning	.727			

<b>Subset 2</b>		
Liveability	.708	
Percentage of professional jobs/service jobs/other jobs		.876
Number of workers in economic cluster		.682
Poverty rate	.894	
Unemployment rate	.834	
Average rental to household income	.698	
Delivery system	.894	
Institutional strengthening	.905	
Enforcement and monitoring	.832	
Serviceability	.875	
<b>Total</b>	<b>48</b>	

*Source: Researcher (2023)*

The component matrix showcases the strength and direction of the relationships between the observed variables and the underlying factors for practical TOD indicators. The components for each variable resulting from the experts' opinion were lateral to non-spatial indicators as listed by Sulistyaningrum and Sumabrata (2018), such as safety of commuters in transit, frequency of service, number of public facilities, and average distance from public facilities to commercial areas. The component matrix displayed the significant factor loadings, offering a nuanced understanding of how the economic TOD indicators contribute to and align with the underlying factors that affect sustainability. This affirmed that these components represent a significant contribution to facilitating planning decisions for efficient urban management, as mentioned by Sulistyaningrum and Sumabrata (2018).

The finding was consistent with Nyunt and Wongchavalidkul (2020), who suggested that the selection of indicators should be based on the essential characteristics of TOD. The essential details of TOD may possibly be both spatial and nonspatial indicators, as explained by Loo et al. (2010) and Sung and Oh (2011). The confirmed main economic variables entailed the spatial indicators, which include land-use diversity, density, and transit facilities that align with the suggested spatial indicators by Sulistyaningrum and Sumabrata (2018).

The confirmed 48 economic indicators, as per the experts' opinions, are essential in evaluating the success and sustainability of TOD. They offer valuable insights into the contribution of the economic vitality of the TOD and its alignment with economic objectives within a TOD framework (Liu et al., 2020). Thus, these indicators play a crucial role in determining the economic feasibility and impact of TOD projects (Cucuzzella et al., 2022). From the 77 extracted economic indicators, some, in the opinion of the experts, were irrelevant to the Malaysian context. These indicators were extracted from developed countries, while Malaysia is still a developing country. They differed in several ways due to variations in economic structure, levels of development, and the influence of global economic dynamics (Huang et al., 2022; Lin, 2011). The eliminated

indicators may have unique features based on their special circumstances, policies, and development goals (Huan et al., 2021), which may not be suitable for TOD in Malaysia, in the opinion of the experts.

## CONCLUSION

In order to integrate sustainability elements into urban management, there is an essential requirement for diligent monitoring of transit development's impact on economic sustainability through appropriate indicators. Reviews from the works of literature established the need for specific indicators to evidence the effectiveness of TOD engagement in solving economic-related problems in urban areas. Therefore, this study contributed to addressing this identified gap and meeting the main aims of this research.

The outcomes of this study have successfully achieved the objective of this paper, which was to determine the economic indicators for sustainable urban TOD assessment. Round 1 of the Delphi survey also concluded with **48** general economic TOD indicators. The most significant indicators were mainly Density, Transit Facilities, Value Recapture, and Economic Attributes Components, with significant factor loadings, which confirmed that these are the fundamental components in proposing the practical economic indicators framework for TOD. Experts validated the economic indicators to make it easier for decision-makers to evaluate the transit development's performance in terms of economic sustainability within the Malaysian context.

This paper was proposed to determine the economic indicators for sustainable urban TOD assessment and help establish the framework of practical economic indicators for urban transit development. This framework offers valuable insight into the performance and sustainability of TODs, particularly in urban areas. These indicators are anticipated to assist stakeholders, decision-makers, and industry players in making decisions, attract investment, and optimise the economic benefits while considering the broader goals of SDG 11 to create sustainable cities and communities.

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## **THE OLFATORY LANDSCAPE: EXPLORING THE TAPESTRY OF SMELLSCAPE IN BAGAN SUNGAI YU FISHING VILLAGE**

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### **Abstract**

This study explores the olfactory landscape and intricate smellscape in Bagan Sungai Yu, a fishing village in Kuala Selangor, renowned for its distinctive Bagan fishing environment. In addressing the research gap that previously only emphasised the visual character, this study adopts a novel approach by asking the researchers to play the role of visitors during smell mapping. Additionally, 17 local people and 25 respondents from the Kuala Selangor Municipal Council actively contribute to the survey questionnaire phase. The findings emphasise the village's olfactory identity, showcasing the intricate connections between the environment, daily activities, and cultural practices. Beyond shaping cultural identity, the study delves into the interplay between olfactory experiences, human psychology, and memories among residents and authorities. Recognising the potential for intangible landscape preservation, this research seeks to contribute towards understanding the role of smell in fishing villages, establishing smell mapping as a valuable tool. The identified similarities in smell identification underscore the significance of shared olfactory experiences, enhancing the relevance of smell mapping in bridging community perspectives and promoting sustainable practices.

**Keywords:** Olfactory landscape, smellscape, Bagan, fishing village, coastal

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## **INTRODUCTION**

In the enchanting olfactory landscape of Bagan fishing village, additional aromatic dimensions unfold as one delves into the distinctive scents of mangrove, petrol, and the muddy river. The air is infused with the earthy, organic fragrance of mangroves, contributing a natural and refreshing undertone to the coastal symphony. Intermingling with this, the occasional whiff of petrol adds a subtle industrial note emanating from the village's connection to marine activities. The muddy river introduces its robust scent, a blend of rich, mineral-laden earthiness intertwined with the marine fragrances. Together, these diverse olfactory elements create a sensory mosaic, further enriching the immersive experience for visitors and painting a vivid picture of the multifaceted and authentic coastal living in Bagan fishing village. In line with Bell et al. (2023), these olfactory flows generate microgeographies of smell that shape visitors' experience of the particular ambiance.

The smellscape of Bagan fishing village enriches its visual character and plays a pivotal role in shaping landscape memory. Comprising scents like invigorating sea air and traditional dishes, the smellscape enhances the overall perception of the coastal environment, creating a multi-sensory experience (Xiao et al., 2020; He et al., 2022). This fusion of scents becomes intertwined with visual memories, forming a lasting and emotional connection. The smellscape acts as a mnemonic device that contributes to Bagan fishing village's enduring identity and character by fostering a unique and memorable sensory landscape for residents and visitors alike. Previously, Thomas (2015) and Biglin (2020) revealed that specific olfactory elements can evoke the memory of a place due to the emotional connection, which is inherently therapeutic.

Previous research on the Bagan fishing village has emphasised the visual, neglecting the crucial olfactory landscape. User experience can be enhanced by purposefully including scents if there is an effort to recognise the essential functional architecture plays in evoking strong emotions and memories. Space's identity is shaped by many factors, including its materiality, structural audacity, history, and practicality. However, they ignore all other sensations, including touch, hearing, smell, and taste, in favour of concentrating just on vision (Ghisleni, 2023). While visuals are significant, the olfactory experience captures cultural essence, fostering authenticity and tradition (Hickman, 2022). Distinctive smellscape contributes to a community's identity, influencing perceptions and creating lasting impressions (Gorman, 2017; Kang & Xie, 2023). Recognising the importance of the olfactory landscape is crucial for a comprehensive understanding of the interplay between sensory experiences and cultural identity, ensuring the preservation of places like Bagan fishing village. Hence, this study investigates Bagan fishing village's olfactory landscape and

smellscape, discerning their influence on cultural identity and enriching the community's understanding of visitors' overall sensory experience.

## **LITERATURE REVIEW**

In Malay, the term "Bagan" signifies fishing village piers, poles, and wooden bars for fish drying (Mohamed. M.Z., & Hassan. N., 2017). Bagan, relying on fishing, is intricately shaped by environmental and socioeconomic factors, demonstrating clever adaptations to challenging geography through human actions and natural processes (Yahaya, 2020; Felix, 2016). The smellscape of Bagan fishing village, positioned by the river or sea, uniquely defines its identity and reflects its profound connection to the ocean. Recognising the importance of non-visual senses, particularly fragrance interactions fostering emotional links and memories, the concept of "Smellscape," introduced by Xiao et al. (2020), underscores the impact of smells on place identities. Preserving Bagan fishing village's authentic smellscape is vital for safeguarding its cultural heritage and identity. Emphasising the broader "sense of place," encompassing tangible and intangible aspects, shapes human perceptions of the environment. This highlights the crucial role of recognising and celebrating the olfactory dimension in understanding places like Bagan fishing village.

The olfactory landscape, defined by the perception of scents within a specific environment, goes beyond traditional sensory experiences. Linked with smellscape, it shapes landscape memories by evoking emotions and cultural associations, influencing individuals' perceptions and connections with a cultural space. The deep connection with human psychology profoundly shapes how a place is perceived, its image, and its identity within the broader cultural context. Tan & Mohamad (2023) support this idea by highlighting the link between a place's meaning and its social and psychological development, showing how this influences people's perceptions of it. Recognising the importance of scents in shaping human experiences provides a comprehensive understanding of how olfaction influences our perception of the world, thus fostering a deeper connection with the places we inhabit.

The research by Lindborg and Liew (2021) has advanced the exploration of smell mapping and smellscape, methodologies that depict the olfactory environment in a fishing village. Smell mapping involves creating visual representations or maps that capture the distribution and intensity of smells, achieved through surveys, measurements, or artistic expressions. In contrast, smellscape delves into the subjective and cultural aspects of the overall olfactory experience, examining how individuals perceive and interact with real and imagined smells in their surroundings. Smellscape research, particularly in urban settings (McLean, K. 2017), explores emotional, social, and psychological

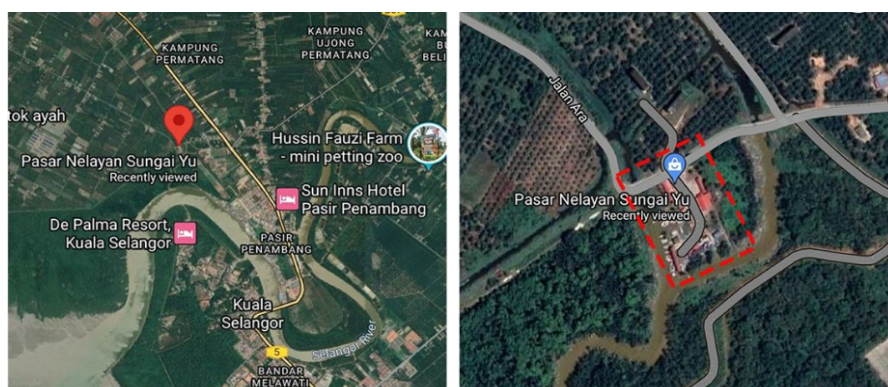
dimensions of smell, and this contributes to a deeper understanding of its role in shaping experiences of space and place.

According to Edler et al. (2020), smell walking is an immersive method that intricately explores a particular place's olfactory landscape and smellscape, unveiling its character's nuanced layers. Therefore, this experiential practice involves purposeful strolls through the village, actively exploring diverse scents to understand the cultural and subjective aspects of how individuals perceive smells in this unique environment. Associated with the concepts of olfactory landscape and smellscape, smell walking provides comprehensive insights into the identity of the fishing village, facilitating a thorough understanding of the sensory experiences embedded in its character. Expanding beyond environmental exploration, this method delves into the psychological dimensions of smell, revealing its impact on emotions and memories. Integrating smell walking into the study of fishing village character enhances individual appreciation for the role of scents in shaping the human experience and cultural identity within these coastal communities.

## **METHODOLOGY**

### **Study Area**

Bagan Sungai Yu stands as a significant fishing village in Kuala Selangor, yet the rapid development in its vicinity poses a potential threat to its existence. Therefore, it is imperative to undertake an olfactory study in this village, revealing intangible elements such as smellscape and smell mapping. These aspects play a vital role in shaping the social memory of both locals and visitors regarding the fishing village. This exploration is fundamental for preserving the cultural landscape and thoroughly comprehending the village's distinctive identity.



**Figure 1:** Key plan (left) and location plan (right) of Bagan Sungai Yu Fishing Village, Kuala Selangor

Source: <https://maps.google.com>

### Method of Data Collection

The olfactory landscape in Bagan Sungai Yu employs qualitative and quantitative methods for a comprehensive exploration. Through smell walking, the qualitative approach delves into subjective experiences and cultural nuances, providing rich and nuanced descriptions. Meanwhile, quantitative methods, exemplified by survey questionnaires, offer measurable data for statistical analysis, allowing broader generalisations and comparative assessments. Integrating these methodologies ensures a thorough and balanced understanding of the olfactory landscape, contributing to effective fishing village preservation strategies. The process of data collection is presented in Figure 2.

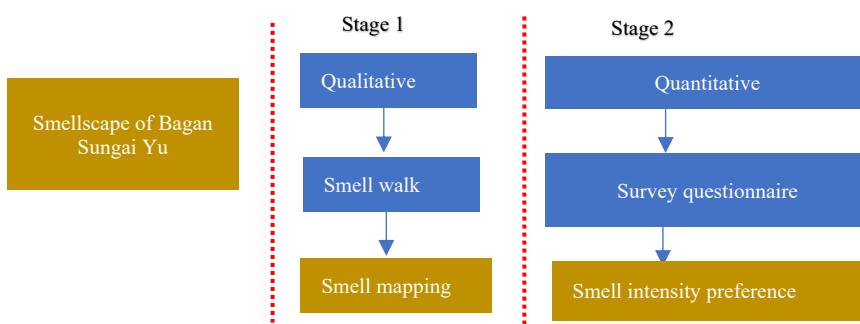


Figure 2: Methods of data collection

### Smell Walk and Smell Mapping

The human nose is actively engaged as a qualitative data collection tool to identify diverse smells in Bagan Sungai Yu. A “smell walk” methodology, coupled with smell mapping, is employed in this approach. Researchers systematically navigate through specific points along a designated route, commencing from the entrance and progressing through the market area, fish collection jetty, and culminating at the coastal region with mangrove trees.

During this olfactory journey, each distinct smell is discerned and meticulously needs to be recorded at various focal points (Song & Wu, 2022). The combination of the human nose and the smell walk approach, complemented by smell mapping, facilitates a comprehensive understanding of the olfactory landscape in Bagan Sungai Yu. The spatial distribution of smells along the route can be observed, and the resulting smell map serves as a valuable output, providing insights into the types of scents present at different locations along the specified route.

## **Survey Questionnaire**

### *Local People*

17 respondents, including locals, fishermen, and visitors, participated in a survey aiming to grasp perceptions and experiences of the smellscape in Bagan fishing village. The questionnaire collects demographic details and prompts respondents to identify distinctive village smells, exploring their cultural significance in fishing practices, cuisine, religious events, and the impact of modernisation. Insights from preferences and perceptions about specific odours aim to gauge smells' emotional and experiential impact. This data will offer valuable insights into the cultural importance of the smellscape, shaping the identity and experiences of the local community in Bagan fishing village.

### *Local Authority*

25 respondents, including officers and technical workers from the Kuala Selangor Municipal Council (*MPKS*), participated in a survey to explore their preferences and identify potential threats to the smellscape in Bagan fishing village. The questionnaire collects demographic information, delving into their experiences with various smells tied to cultural heritage and traditional fishing practices. It seeks opinions on the smellscape's role in promoting cultural identity and sustainable tourism while assessing awareness of threats like pollution and urban development. The survey evaluates the local authority's measures to preserve the unique smellscape, providing valuable insights into their perspective on its importance and commitment to safeguarding its cultural and environmental significance.

## **RESULTS AND DISCUSSION**

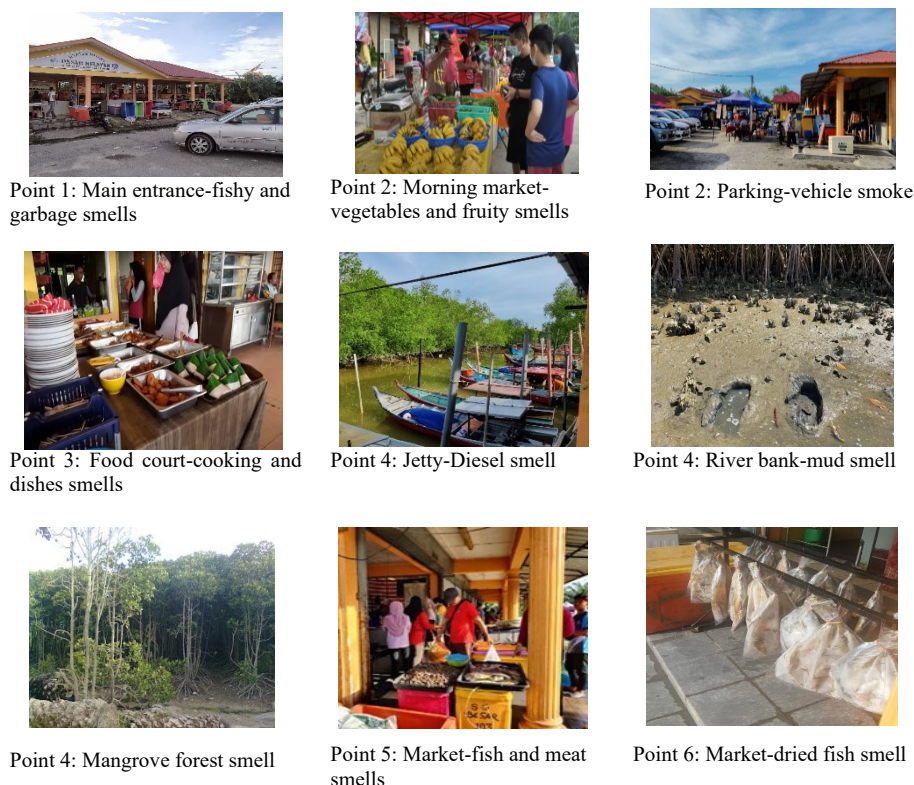
This section will categorize the study's outcomes and discussions into two parts. The first encompasses the outcomes derived from the smell walking method, where researchers act as visitors, observing and mapping scents based on location. The second part includes the survey results involving 17 local residents and 25 respondents from the *MPKS*.

### **Smell Walking and Smell Mapping**

Based on the six points where the smell is observed, each point shows the dominant type of smell based on the activities and elements found in the area (Fig 3).

The smell at the entrance (Point 1) is dominated by the fishy odour from the market and the smell of drains and garbage. In the vehicle parking area (Point 2), the distinct smells of vehicle exhaust and the aroma of fruits, vegetables, and food from the morning market are particularly evident. Moving to the food court area (Point 3), one can perceive the aroma of cooking and pastries sold in the food

court. At the jetty area (Point 4), three noticeable smells can be identified: the scent of boat diesel oil, the aroma of mud along the riverbank, and the fragrance of mangrove trees and other plants along the Sungai Yu banks. In the market section, two distinct odours prevail: the smell of fish and meat and the scent of dried fish and shrimp paste (Points 5 and 6).

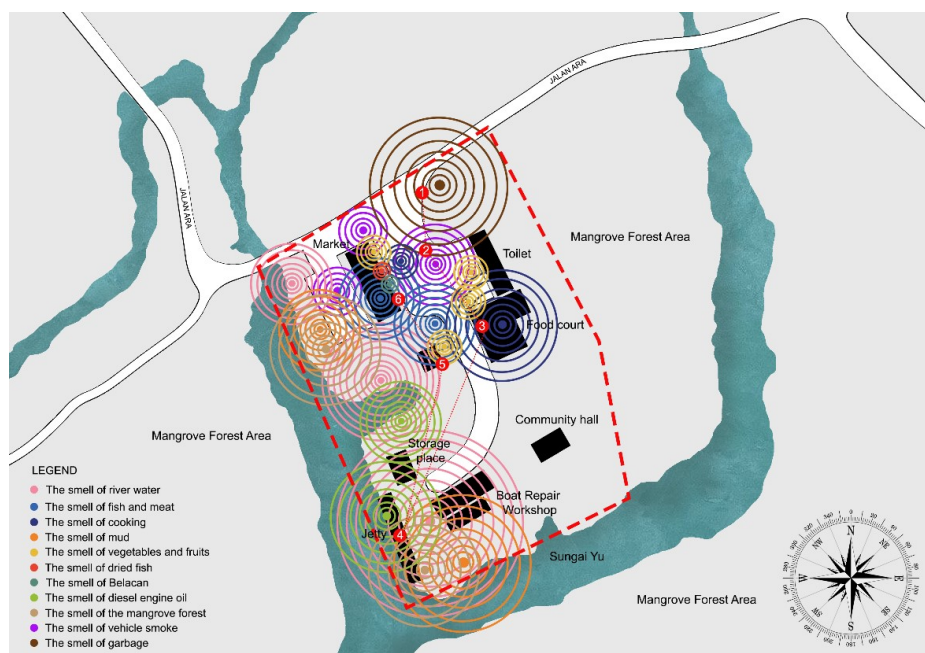


**Figure 3:** The types of smells found at each point along the route  
*Source: Authors, 2023*

Based on the smell mapping depicted in Figure 4, the intensity of each smell is indicated by the size of the circles, with larger circles representing more pungent smells. The smell mapping in Bagan Sungai Yu reflects the intricate influence of the river environment, fish market, local culture, and activities. Three distinct smell patterns emerge from the mapped distribution. At the entrance, prominent smells from garbage bins and drains indicate waste management practices. The dominance of fishy aroma mirrors the influence of sea and river produce activities in the fish market.



The parking area, market interior, and food court also display a blended scent predominantly characterised by cooking aromas, reflecting the rich local culinary practices. The jetty area features a mixed scent dominated by muddy river water, diesel aroma from boat usage, and the fragrance of mangrove trees along the Sungai Yu banks. These patterns highlight the direct connection between environmental elements, daily activities, and the distinctive smellscape shaping the cultural identity of Bagan Sungai Yu.



**Figure 4:** The type and distribution of smells mapped according to the strength of the smell at each point of the route.

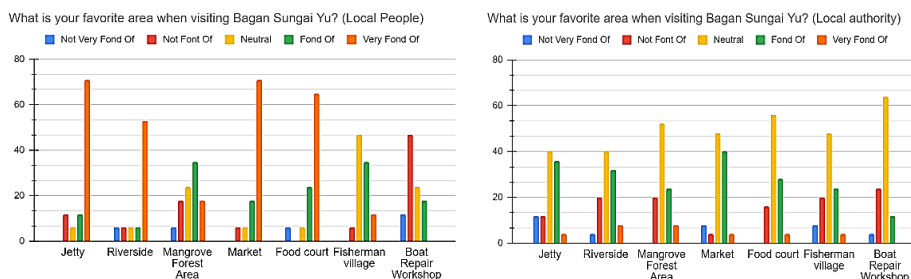
Source: Authors, 2023

### Survey Questionnaire

This section presents the findings and discussions from a survey conducted among residents and MPKS respondents, categorised into three main sections. The first section examines respondents' perspectives on place and types of smells. The second section addresses challenges and issues concerning the fisherman's market, the fishing pier, and Sungai Yu. Lastly, the third section explores insights into the future development and preservation of the landscape character of Bagan Sungai Yu.

*Favourite Place*

Figure 5 illustrates commonalities and distinctions in preferred locations at Bagan Sungai Yu Fisherman's Market, embraced by local residents and authorities. The fishing pier, market, and food court stand out as popular choices, with around 71% of residents favouring the pier and market, 65% the food court, and 52% the riverside. Local authorities exhibit moderate interest across all locations, averaging approximately 50%. Among them, the market takes precedence at 40%, followed by the jetty at 35%, and the riverside at 32%.



**Figure 5:** Respondent's favourite place

Overall, local authorities express an average interest of 28% in piers, fish markets, and the riverside. The differences and similarities between residents and authorities stem from residents' emotional ties to specific areas. In contrast, authorities maintain a comprehensive perspective, considering various factors such as tourism, economy, and development, highlighting the intricate balance between local sentiment and administrative priorities in shaping preferences.

*Intensity of Smell*

In Figure 6, residents generally excel in identifying smell intensity compared to local authorities. Cooking aromas lead at 52%, followed by the scent of dried fish shrimp paste at 47%. Local authorities primarily recognise the smell of fish and meat (40%) and the scent of garbage (31%). Both groups identify intense smells of cooking, fish, and garbage in the market area. Residents outperform authorities (37% vs. average 24%) in identifying river water, mangrove forest, and mud smells. There is a significant difference, with 22% of local authorities unable to identify certain smells compared to 5% of residents.

The observed similarities and differences can be attributed to residents' intimate connection and familiarity with specific scents holding personal or cultural significance. Local authorities approach the assessment more objectively, considering several factors like urban planning, environmental concerns, and tourism development. The discrepancy may reflect residents'

nuanced awareness of natural elements compared to the more generalised perceptions of authorities.

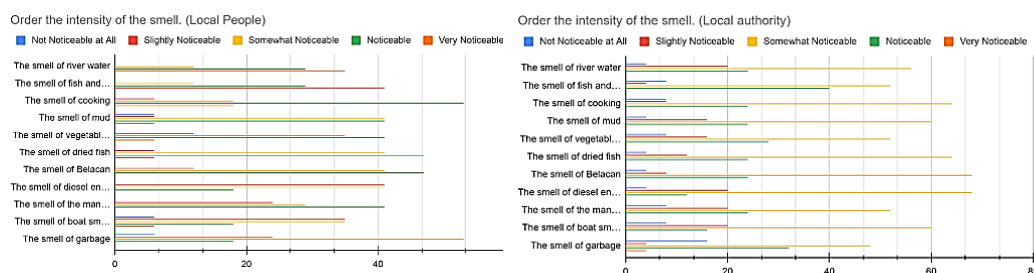
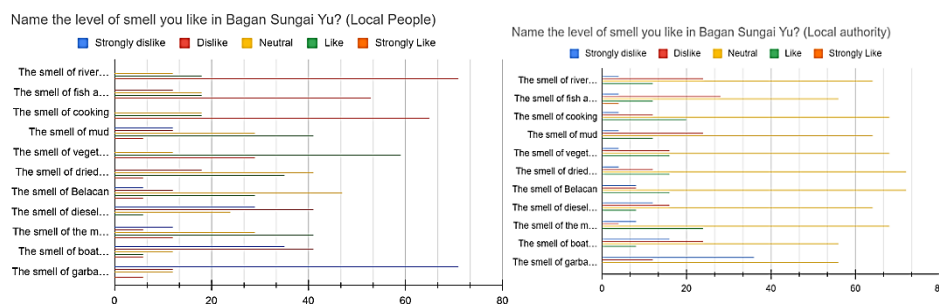


Figure 6: Ability to identify the intensity of smell

### Favourite Smell

The data depicted in Figure 7 delineates both commonalities and distinctions in the preferred smells among residents and authorities. Residents favour the scent of mangrove forests with 41%, while local authorities show a preference for 25%. Overall, residents express preferences for the smells of the river (71%), cooking (62%), fish (52%), vegetables (55%), mud (41%), and mangroves (41%). Conversely, both residents (70%) and authorities (35%) share their distaste for the smells of garbage and diesel used for boats.

The results reveal nuanced preferences and aversions to smells among residents and authorities in Bagan Sungai Yu, offering insights into the interplay of olfactory landscape, memories, and respondent backgrounds. Residents prefer the scent of the mangrove forest, reflecting a deeper connection to their natural surroundings and cultural heritage. Their overall liking for scents associated with daily life, culinary practices, and distinctive features of the environment suggests a desire to preserve the authentic olfactory character of their fishing village. Conversely, the common dislike for odours associated with pollution and industrial activities underscores a collective aversion to unwanted environmental impacts.



**Figure 7:** Favourable smell among local people and local authority

Taking a more objective stance, authorities show a lower preference for specific smells, potentially considering broader factors like environmental management and tourism development. These differences highlight the intricate dynamics of olfactory experiences, memories, and the diverse backgrounds of respondents, contributing to our understanding of how smells shape cultural preservation and sustainable development in fishing villages.

## SIGNIFICANT FINDINGS

Exploring Bagan Sungai Yu's olfactory landscape offers a unique lens into the interwoven fabric of environmental elements, daily activities, and cultural identity. Through a combination of smell mapping and a survey questionnaire, this study unveils the nuanced scentscape of the fishing village. The results provide a visual representation of smell patterns and delve into the preferences, memories, and identification abilities of local residents and authorities. This multidimensional approach allows for a holistic understanding of how smells shape the cultural identity of Bagan Sungai Yu. Three pivotal insights emerged from the results and discussions presented in the preceding section.

### *i. Smell Mapping Insights into Olfactory Landscape*

The first subtopic focuses on the outcomes of the smell mapping depicted in Figure 2. It delves into how the intensity of each smell, represented by the size of circles, provides a visual narrative of Bagan Sungai Yu's olfactory landscape. This section explores the nuances of the identified smells and their spatial distribution, setting the foundation for understanding the interplay between environmental elements and daily activities. The integration of smell mapping as a method underscores its importance in objectively capturing and visually presenting the intricate olfactory features of the village. Therefore, in light of the world's various sensory dimensions and the dominance of visual perception in modern culture, smell mapping emphasises people's ability to feel and create

place through their sense of smell (Endreß, 2023; Paraguai, 2013). As a component of the sense of smell, odour perception is linked to chemical interactions, morphology, and behavioural towards space. These relationships are dynamic and interdependent, involving morphology, behaviour, genetic makeup, and cultural traits (Catullus, 2000)

*ii. Alignment with Local Preferences and Identifications*

The second subtopic bridges the smell mapping results with the preferences and identification abilities observed among residents and authorities (Figures 3, 4, and 5). It highlights the congruence between the mapped smell patterns and the respondents' experiences, emphasising how the dominant fishy aroma in the fish market, cooking aromas in specific areas, and mixed scents at the jetty align with the observed preferences. The survey questionnaire method supplements this discussion as a complementary tool to gather subjective insights, memories, and preferences related to the identified smells. Concerning these insights, Hall (1990) identified proxemic behaviours as cross-cultural interactions between individuals and settings. The sense of smell has a strong ability to promote the aspects of physical space that interactants maintain without realising it, which is essentially the study of Hall's proxemics. According to him, nonverbal cues influenced by physical distance are also included in the olfactory code, a mode of presence and degrees of body and space odours. Olfaction offers an inherently non-reversible, more direct, and less planned interaction with the surroundings. Therefore, alignment with local preferences and identification evokes a direct perception of the neighbouring townscapes (Paraguai, 2013)

*iii. Cultural Identity Shaping Through Smellscape*

The third subtopic expands the discussion to underscore the cultural significance of the identified smells in shaping the identity of Bagan Sungai Yu. It examines how the smellscape, as revealed through smell mapping and the survey questionnaire, intricately weaves together environmental elements, daily activities, and the unique olfactory experiences of the community. This section emphasises the role of the human nose, preferences, memories, and psychological responses in enriching the cultural fabric of fishing villages. The combination of smell mapping and the survey questionnaire emerges as a comprehensive approach, elucidating both objective and subjective dimensions of the smellscape and its cultural implications. These characteristics correlate to the senses as they perceive and are fundamental components of a location's physiognomy (Stefanou & Vasilara, 2013). Senses give us all the instruments to recognise and understand a place's distinctiveness, distinguish its identity, and bring its essence to life. Systems of olfactory classification generate meanings and particular logic; these codes are not universal but relatively local. Smells are associated with cultural

values and are understood as a model and a way to define and engage with the outside world. People who are connected to smell experiences may be able to organise spatial experiences, and as a result, symbolise different ways of acting in the world Haque (2004). The local smellscape, with its unique and familiar scents, significantly enhances cultural and heritage appreciation, enriching the sensory experience and deepening the connection to a place's identity. Mat Radzuan et al. (2024) emphasizes that in an increasingly globalized world, it is crucial for each location to maintain its unique identity, defined by its distinctive characteristics.

## **CONCLUSION AND RECOMMENDATION**

The utilisation of smell mapping has provided a comprehensive understanding of Bagan Sungai Yu's olfactory landscape, offering valuable insights into the village's image and identity. This method has proven pivotal in objectively capturing and visually presenting the intricate olfactory features of the village. The alignment between the mapped smell patterns and the preferences of residents and authorities underscores the harmonisation of objective and subjective dimensions, establishing a robust foundation for exploring the village's cultural and environmental significance. Developing solutions that consider the relationship between all the sensory channels we use to read and perceive the spaces around us includes smell in the design. This course of study and practice is also closely tied to neuroarchitecture, the theory that places can enhance individuals by creating wholesome experiences for their occupants.

While recognising the study's limitations, such as providing a snapshot of the smellscape, future research endeavours could delve into temporal variations and incorporate advanced olfactory analysis techniques. This would contribute to a more nuanced and dynamic understanding of the olfactory landscape. Additionally, exploring the longitudinal changes in smells and their cultural implications over time could enrich the narrative. In conclusion, the combined use of smell mapping and survey questionnaires emerges as a powerful approach, shedding light on the cultural importance and identity-shaping role of smells in fishing villages like Bagan Sungai Yu.

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## **QUALITATIVE RESEARCH CHALLENGES IN ASSESSING RAINWATER HARVESTING IMPLEMENTATION FIDELITY FOR RELIABLE DATA**

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### **Abstract**

Assessing local councils' adherence to rainwater harvesting policy regulated in the by-laws is critical to the success of water conservation efforts. However, there are certain challenges that must be addressed in this assessment. This paper highlights the aforementioned challenges and provides recommendations for future research. The research used a qualitative approach, employing six distinct methods to obtain more robust and reliable data: (i) desk study, (ii) document review, (iii) interviews, (iv) observation, (v) self-analysis questions and (vi) focus group discussion. The success of the implementation-focused research was based on a defined direction of assessment, eligible participants and sites, suitable methods, access to reliable data, robust analysis and writing proficiency. This paper suggests that future search should focus on establishing relevant skills, building relationships with the participants, defining concepts and exploring alternative data sources. Assessing implementation fidelity was not easy because it necessitated substantial resources to draw meaningful conclusions about the extent to which the rainwater harvesting policy was delivered. Addressing qualitative research challenges in assessing rainwater harvesting implementation could enable researchers to suggest implementers on making more informed decisions in attaining Sustainable Development Goal 6.

**Keywords:** Implementation Fidelity Assessment, Rainwater Harvesting, Research Methods, Policy

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## **INTRODUCTION**

With the exacerbation of water scarcity, an increasing number of nations are adopting rainwater harvesting as a viable and sustainable approach to address their water needs. While rainwater harvesting has potential advantages, such as reducing floods and decreasing reliance on municipal water supplies (Azis et al., 2021; Habibullah et al., 2023), a paucity of assessment of the implementation of rainwater harvesting policies by local councils in many regions remains (Suki et al., 2022). The lack of assessment raises concerns about the effectiveness of these policies, known as implementation fidelity or alternatively referred to as integrity (Carroll et al., 2007). Implementation fidelity refers to the extent to which an intervention, policy or programme is carried out in accordance with its intended protocol (Carroll et al., 2007). Assessing fidelity is crucial for understanding the implementation of programmes or policies in real-world settings (Durlak & DuPre, 2008). This allows for the identification of programme components that were present or absent, as well as any deviations, changes or omissions to improve current recommendations and achieve better outcomes (Mowbray et al., 2003).

However, despite the theoretical advancements of implementation fidelity, there is still a significant gap in research assessing the practical implications and real-world phenomena of rainwater harvesting policy adherence (see: Suki et al., 2022). Addressing the noted gap, this paper discusses the academic challenges in the process of assessing rainwater harvesting implementation fidelity. It delves on maintaining consistency between the theoretical framework adopted from the implementation science field and its application in practice, while also identifying key barriers. By highlighting these challenges, this paper aims to provide insights and recommendations for improving the rigour and relevance of future research. This increases the odds of discovering intriguing discoveries in various contexts and offers knowledge on implementation fidelity, allowing researchers to provide more informed guidance to implementers in making decisions that cater to the needs of diverse communities.

## **COMPONENTS OF ASSESSMENT**

The assessment of implementation fidelity provides a comprehensive understanding of what is happening in the programme and how successful it is, which helps eliminate incorrect assumptions (Carroll et al., 2007), such as a programme's success is being greater than what it actually is (O'Donnell, 2008). According to Dane & Schneider (1998), fidelity is commonly defined in terms of five quantifiable dimensions in the health-related research: (i) adherence, (ii) dosage, (iii) intervention quality, (iv) participant responsiveness, and (v) programme differentiation. Until now, no research in built environment or

implementation policy has assessed all five aspects of fidelity. Nonetheless, to better suit the context of this research, the frameworks proposed by Allen et al. (2012) were adopted and integrated with the relationship between concepts depicted by Carroll et al. (2007). By having components from the frameworks selected and pre-determined, it facilitated the assessment of whether the by-laws were implemented as intended.

## **METHODS AND MATERIALS**

Assessment of implementation fidelity can be carried out using a variety of approaches, among the most prevalent of which are the quasi-experiment, the activity, the questionnaire survey, the interview, the document review, the observation, the focus group discussion (see: Suki et al., 2022) and self-assessment questions (see: O'Donnell, 2008). In addition to employing self-assessment questions, interviews and focus group discussions, this study incorporated other qualitative approaches, including document review and observation, to enhance the accuracy and reliability of the collected data. A combination of methods was necessary to provide a comprehensive assessment of implementation fidelity.

In this research, the methods for assessing implementation fidelity were selected based on the research questions, the resources available and the intended audience. In-depth case studies were conducted to assess the relationship between rainwater harvesting implementation strategies and fidelity in six Perak local councils. This has provided rich and thorough information on the implementation process and the factors that influence fidelity. The methods below were used to collect data.

*Desk study:* Desk study was conducted to collect information on six local councils, with the aim of identifying their leaders in order to facilitate the process of obtaining permission to participate in the research. Additional information obtained from the councils' websites encompassed by-laws, checklists for the rainwater harvesting process as well as related practices.

*Interview:* The research utilised organisational charts to locate department heads in local councils for interview sessions. Participants were identified based on nonprobability purposive sampling and contacted via email or in person. Semi-structured interviews were conducted to understand their abilities, opinions, work duties and resources in performing public enforcers duties. Building and engineering department heads were interviewed to understand rainwater harvesting from local councils' perspectives. The interviews covered the department's process from applicant submission plans to project handover. The recorded sessions were transcribed for analysis.

*Document review:* The research analysed implementation records, including rainwater harvesting projects, building approval processes and the by-

laws. Data was gathered from participants or their websites during desk studies, interviews or after the interviews ended and recorded. Construction project details, such as applicant's drawing plans and site visit reports, were also analysed to determine local councils' adherence to by-laws.

*Self-assessment questions:* Self-assessment questions were structured to help participants in assessing their competence and form judgements about their organisational strategies and implementation outcomes. The questions were divided into three sections, based on the research's conceptual framework. In addition to the participants interviewed, others contributed to the implementation of rainwater harvesting were identified using the snowball sampling technique. 15 individuals from six local councils completed the self-assessment, identifying strengths, gaps and areas for improvement. The responses were analysed using a content analysis approach with pre-identified themes.

*Observation:* Observation involved directly observing the local councils' practices in rainwater harvesting, recording information and practices for each visit. Participants' attitudes towards rainwater harvesting were recorded. Site visits were conducted after self-assessment questions were collected. Furthermore, each council provided details of projects required by the by-laws to install rainwater harvesting systems. The observation provided a unique perspective on on-site activities and how councils handled the implementation of designs. Conversations with homeowners were also conducted where possible. Pictures of rainwater harvesting systems were taken using a Sony A6000 digital camera. The observations and conversations were recorded in a diary.

*Focus group discussion:* Focus group discussion was used as a method at the end stage of the current research for more in-depth discussions between the governmental and academic professionals. All local councils and four research team members were invited to participate, with details provided three weeks in advance. Two councils were unable to participate due to conflicting dates and lack of employees. Three other councils, including four research team members, attended the discussion, which lasted about 2 hours with a break. Viewpoints and disagreements were recorded using a Sony A6000 digital camera, an Apple iPhone 12 and written notes. The discussion took place at Cempaka Hall, D'Hotel Seri Iskandar, on 11 January 2023, from 10am to 12pm.

## **FINDINGS**

Implementation fidelity assessment was a difficult task because it required determining how closely a programme or intervention is being carried out in accordance with the intended policy as stated in the by-laws. The task of collecting qualitative data on fidelity implementation from six local councils was peculiarly more difficult because it involved different environments, approaches, sites and individuals. This required a careful planning, execution and analysis.

Below are some inevitable challenges that other implementers and researchers may want to take into consideration in ensuring that the collected data are able to answer the research questions, utilise resources and maintain participant confidentiality.

**Challenge 1: Acquiring a clear framework for fidelity assessment.**

There is currently no framework or methodology being used to evaluate the output fidelity with which local councils implement rainwater harvesting policies. Most of hundreds available fidelity assessment frameworks and models were derived from implementation science, which included several components such as the evaluation of implementation outcomes (e.g.: fidelity, acceptability, and sustainability) and the use of implementation strategies (e.g.: individual competency, organisational factors, and interventions that influence implementation success). This necessitates a thorough grasp of the research problem, aim and research questions to match the existing frameworks, each of which has a unique research design and emphasis. Consequently, it was essential to conduct a thorough search, categorise and match components from various frameworks in different areas of implementation studies in order to refine and align the research design.

Subsequently, the research incorporated essential components from the frameworks proposed by Allen et al. (2012) and Carroll et al. (2007). A case study approach was then carried out at a local council in a state in Malaysia between 2020 and 2021. The framework used was extended based on the findings and used in this current research. The framework deconstructs the implementation fidelity assessment into its constituent components, with rainwater harvesting policy as input, implementation strategies as determinants and fidelity as output. The extended conceptual framework provided a logical foundation for relationships between concepts and guided data collection; however, it still posed challenges in understanding a complex issue in its real-life context.

**Challenge 2: Identifying eligible participants and sites.**

Approaching the leaders of local councils (the district officer or the president) to participate was challenging because email communications were ineffective for some of them. A meeting was scheduled at their workplace and the councils were persuaded to participate due to their public services and awareness of the research's benefits. Their agreement was contingent on privacy and confidentiality assurance, ensuring anonymity for the councils and participants. Confidentiality was crucial as organisations prefer not to reveal their internal processes to the public.

Identifying eligible participants for interviewing regarding the implementation of rainwater harvesting proved to be difficult following the

leaders' endorsement. The number of employees involved in rainwater harvesting implementation varied across local councils, depending on their respective responsibilities and departments. It required considerable effort to persuade them to allocate time for interviews once they were identified, and a few of them did not reply to emails. Thus, the identical approach of conducting face-to-face meetings was utilised. The process of scheduling a meeting was time-consuming and could span several weeks.

Regarding the eligible sites, it was necessary to select completed residential projects so that the outcomes of the local councils' implementation practices could be assessed. The sites they were either suggested by the participants or selected from lists of previously completed projects. There were only a limited number of sites that met the requirements outlined in the by-laws for the installation of rainwater harvesting systems. Thus, a comprehensive analysis and comparison also became restricted. Critical analysis skills were required to correspond data from various sources with limited access.

### **Challenge 3: Having a skilful research assistant.**

Proficient data collection and analysis necessitate a certain level of skills to accurately assess fidelity. It was challenging to constantly educate a research assistant who lacked knowledge and skills in qualitative methodology and research design. The expert research members had to also allocate ample time to review, correct and develop the interview questions to ensure they were open-ended, clear and worded in a manner that fostered a sense of acceptance among participants. Following that, the research assistant required explicit guidance regarding the significance of the developed questions in eliciting information about core beliefs and values, while also indirectly addressing sensitive issues concerning the by-laws adherence and understanding the rationale behind specific actions. This understanding was crucial for the participants to be able to provide impartial and more inclusive responses.

In the initial interview sessions, the research assistant encountered difficulty in promptly processing information and adapting in real time. He experienced uncertainty to be critical while remaining neutral and struggled to make sense of the participants' explanations, thus labelled them as vague. This had restricted his ability to probe questions, particularly when the participants appeared to be lacking knowledge about the topic of rainwater harvesting policy/programmes or were not accustomed to explaining their tasks verbally. Therefore, the research assistant required instruction from the expert research members so that he could be intuitive about how things were related. As a result, several different interview sessions with probing questions had to be re-scheduled. Due to the inability of the assistant to independently develop questions with the

aforementioned targets, the research members also had to review, correct and develop questions for self-assessment, which was time-consuming.

The research assistant also lacked independence, English proficiency, interpretation and reading, necessitating repeated instruction. This required the expert research members to put in more time and efforts to improve his skills through a series of discussions and brainstorming sessions in which questions about the findings were asked at various stages of data collection. Given the iterative nature of qualitative research, the assistant had the chance to ask questions and seek clarification from the expert research members at any stage of data collection and analysis. Nonetheless, the research assistant was self-sufficient in utilising NVivo to analyse data and knew how to quickly establish rapport with participants to gain trust, which aided in data collection at various times. These skills are critical for conducting successful qualitative research, but they can be challenging for individuals who are new to the stance.

**Challenge 4: Gaining satisfactory access to data.**

This study followed the research ethics protocol, in which informed consent was obtained, confidentiality was maintained, and the data was promised to be used only for legitimate research purposes. The data collected was ensured to be obtained in an ethical and dignified manner for the participants. However, due to confidentiality, gaining access to certain data was unattainable (such as audit report). Some other data were also inadequate and not readily available, either because they did not exist (such as interventions), or because the data were not documented (such as participants' own efforts in rainwater harvesting). These had limited the ability to fully analyse implementation fidelity and jeopardised the validity and reliability of the findings. As a result, different methods were required to provide rich descriptions of these complex issues to provide scientifically sound findings.

**Challenge 5: Choosing the right qualitative methods.**

Choosing the optimal qualitative methods and determining the impacts they may have on this research was a challenging task because they affect the reliability and validity of the collected data. A review of previous studies on implementation fidelity to the scope of this research were referred (see: Suki et al., 2022) to inform and support the method selection. This is important because using incorrect method to address a research question can waste time and resources. Table 1 summarises the purpose of selecting each method. It also shows the method-related challenges encountered throughout this research that reflect the limitations and justifications for using multiple methods.

**Table 1:** Qualitative method-related challenges in assessing implementation fidelity.

Methods	Purpose	Challenges
Desk study	To gain fast insights into case studies to help overall investigation at different local councils (through their websites)	Data was limited at providing a complete understanding of processes and individuals. Links to relevant documents on a few websites were inaccessible, resulting in inadequate information. Some of the data on the websites had not been updated (such as the contact person).
Interview	To encourage participants to share useful information in their own words	Several participants were unaware of the contents of the by-laws rainwater harvesting sections and/or the system itself. There were just a few employees in charge of the implementation in each council. Shallowness of answer necessitates more probing questions. Time-consuming.
Document review	To obtain data and/or structured information about strategies and fidelity. Documents were also compared to support data obtained through other methods	Attachments and contents in some documents were incomplete. Missing or non-updated records were still utilised for reporting. Researchers had to be critical and more thorough in gaining essential information. Several other documents were lengthy, making it time-consuming to analyse sections pertaining to rainwater harvesting implementation.
Observation	To gather real-world data on how rainwater harvesting was implemented	Needed skills to make sense of the data in real time. The researchers had to communicate often to interpret circumstances. Only specific sites that were informed by the councils can be observed, restricting the random observation, which may be more fruitful. Costly and time-consuming.
Self-assessment questions	To allow participants to make judgements about the implementation strategies and fidelity	Questions had to be carefully developed to focus on positive traits and achievements, which was necessary to demonstrate the strengths/weaknesses of the strategies and fidelity output. It was challenging to assess and extract meanings from the self-assessment questions so that conclusions could be drawn. Inappropriate answers to questions.
Focus group discussion	To explore the local councils' interests and suggestions for enhancing the rainwater harvesting implementation, as well as their expectations from the academic field	Three local councils were unable to participate, limiting the ability to gain additional insights. A few participants seemed unwilling to voice their concerns due to different practices. Researchers recognised the issue and quickly established rapport during the break so that the participants felt at ease. Costly and time-consuming to gather participants from all six local councils.

### Challenge 6: Writing for publications.

The built environment encompasses buildings, infrastructures, urban spaces and landscapes, involving builders, engineers and architects who mostly collect data in experimental or survey settings for measurable numerical results. Implementation research, on the other hand, collects qualitative data through open-ended methods such as interviews, focus groups and observations. This data is subjective and provides insights into the attitudes, underlying causes and motives. It was challenging to utilise qualitative data in the built environment field as it did not provide quantitative evidence that many built environment publications and practitioners seek. This necessitates the use of alternative data representation, such as visualisations to illustrate the findings in a more



meaningful way to them. However, the findings of this research were not easily visualised due to complexity and richness of data. Whilst words provide valuable insights and can be summarised and illustrated, visualisations are not always necessary. Unfortunately, the inclusion of data visualisations in qualitative manuscripts is often misunderstood by a significant number of reviewers.

In general, qualitative research entails a greater volume of written content due to its reliance on subjective data that is susceptible to interpretation. Words, in fact, are qualitative data. While several publications in the field of built environment acknowledged this effort by permitting qualitative manuscripts to have a higher word count, this might not be sufficient to meet the expectations of built environment reviewers with diverse quantitative expertise, who may provide feedback on aspects that qualitative authors are unable to deliver. For instance, several Scopus-Indexed reviewers rejected two manuscripts from this research, stating that “there is no statistical data”, “no analysis or numerical data processing has been presented in this article, which diminishes the authors' work in this regard” and “the absence of statistical analyses, graphical representations, or other visual aids to complement the data further weakens the impact of the results”. Consequently, the authors had to use more words to convey the broad grasp of the qualitative approach. As much as the authors expected the quantitative reviewers with opposing stance to comprehend the qualitative perspectives, they had the responsibility to explain research design adequately without making the paper lengthy. This task presents a challenge and emphasises the authors' need for skill in writing, specifically in effectively explaining the findings and meticulously drawing conclusions.

## **RECOMMENDATIONS AND DISCUSSIONS**

The findings highlight the significance of clearly defining and measuring the various components of fidelity assessment prior to collecting data. This is crucial to maintain consistent fidelity assessment across different implementation studies. The task of developing a framework to analyse concepts and their interactions was challenging because there were numerous existing frameworks and models especially in the dissemination and implementation research. Additionally, it was difficult to ascertain how well rainwater harvesting practices align with the framework adopted. Hence, it is recommended that a clear unit of analysis is determined.

The unit of analysis is a crucial element in research, defining the scope and concepts involved. It aids in data collection and analysis while maintaining a contextually rich and broad unit of analysis (Roller & Lavrakas, 2015). Research questions are central to determining the unit of analysis, allowing for the recording of understanding, experience, meanings and stories (DeCarlo, 2018). For instance, one of the questions in this current research is "How do local

councils allocate resources to implement legislative regulations on rainwater harvesting?", needing the organisation as the unit of analysis. Employees, who work for the organisation and have access to data, become the unit of observation, allowing for the collection of various types of data and the selection of research methods.

Furthermore, it is also critical to ensure that the research questions are clearly stated so that an appropriate framework/ model/ theory and methodology can be fit for answering them. It will then progress to sample selection, which presents another challenge for fidelity assessment because identifying individuals who involved in the implementation require a clear inclusion and exclusion criteria (Patino & Ferreira, 2018). Proper sampling ensures data reliability in answering the research questions (Etchells & Woodcock, 2018). Inclusion criteria enable the identification of those who involved in the process of rainwater harvesting policy adherence, while exclusion criteria exclude factors that may impact outcome parameters as recognised by Patino & Ferreira (2018), such as employees involved in rainwater harvesting only for the local landscape irrigation.

Due to the fact that different concepts contributes to fidelity, the ideal fidelity assessment methods should be multidimensional (An et al., 2020). As qualitative research continues to gain traction in the implementation studies, it is critical to understand its strengths and weaknesses as a methodology. Qualitative methods enabled this research to obtain first-hand knowledge that captured crucial aspects required for interpretation. Furthermore, qualitative research allowed the exploration of a complicated phenomenon that would otherwise remain unseen due to its observational nature. It is highly recommended that multiple qualitative methods or triangulation is employed to get meaningful insights into dynamics driven by organisational contexts or individuals. Triangulation designs have the ability to identify agreement and validation of findings through various research methods (Hanson-DeFusco, 2023). In this research, the triangulation of document review, interview and observation helped to build understanding of the overall scenario. Miles et al. (2018) emphasised that some advantages of triangulation include allowing creativity in collecting data, offering more assertion in the findings, leading to richer data, allowing for integration of theories, reduce research bias from a single method and uncovering limitations. In other words, integrating the findings of the different research methods helps to validate the results and provides a stronger basis for analysis and interpretation. When several research methods yield the same conclusion, researchers can be more confident in the findings.

However, out of the methods employed, this research has been unable to establish that the self-assessment-questions were useful, similar to the finding of (Noell et al., 2005), and contrary to the claim that it is beneficial because it

requires the individual to be honest as claimed by Khoury et al. (2019). In this research, the selection of supporting roles in answering the questions were less promising because they did not have the necessary information to provide honest feedback. Furthermore, a significant proportion of the participants' responses did not accurately reflect some of the observed practices. This is supported with research that suggests self-assessments are less successful (Fiske, 2008) because the level of fidelity was found higher than what has been observed (O'Donnell, 2008), indicating biasness in the method. Hence, it seems reasonable to infer that self-assessments may not be reliable in assessing fidelity and that other methods should be considered when conducting implementation fidelity, particularly in the built environment discipline.

One condition of applying qualitative methods was that it required "detective-like" skills to search something like puzzle pieces that fit into the overall jigsaw. With this in mind, it was challenging to ensure that the research assistant had a honing set of skills to strengthen the findings of this research. To accomplish that, the assistant was consulted by the experienced research team to develop his critical thinking and analytical skills. To improve his analytical skills, he was taught to pay attention to details and be observant because it allowed him to process the way things work and interact. For the critical thinking part, the assistant was advised repetitively to read more about dissemination and implementation materials, practise empathy, practise active listening, be curious, and gather more information as necessary. These skills were developed mainly through frequent communications during and after each data collection made between the research assistant and research members, especially the lead researcher, to discuss the findings and interpretations. The research assistant also attended relevant courses (NVivo) and performed own knowledge searching especially through YouTube videos to increase his ability in data analysis.

Proficiency in qualitative writing is necessary since it involves an immense amount of complex data, in words. Depending on the context of publication, visualisations such as word clouds, word streams, mind maps, and Venn diagrams may help in the assertion of qualitative results (Nguyen et al., 2021). However, in accordance with the current research, Stikeleather (2013) argued that not all data is appropriate for visualisations because they could not present the complexity of the data set, which leads to misunderstandings and wrong conclusions. Visualisations should thus only be used sparingly and when they may truly aid in the comprehension of the contents. Outweighing that, researchers should pay close attention to explicitly state the methodologies they used because qualitative research is often criticised for having unclear methodology boundaries and being inapplicable to a broader population (Miles et al., 2018). Because the implementation research is a complex subject, it would be beneficial to use a reporting criteria to ensure that the research is conducted

within the standard understanding (Colquhoun et al., 2014). For example, in this research, the Standards for Reporting Implementation Studies (StaRI) checklist developed by Pinnock et al. (2017) was adopted to ensure that the research is reported in a clear and transparent manner. The checklist, while being extensively used in the medical field, was helpful in identifying the scope and limitations of the research design as well as in understanding the difference between reporting on implementation strategies and reporting on implementation interventions. Therefore, to ensure reliable and trustworthy data, it is crucial for researchers to develop a consistent reporting method. This is a distinct topic that calls for a more detailed discussion.

## **CONCLUSIONS**

Rainwater harvesting is an essential strategy for water conservation, particularly in regions with scarce water resources. Local councils have an important role in the implementation of rainwater harvesting policy. Their fidelity in implementing this policy has a substantial influence on the success of rainwater harvesting initiatives. However, this research suggests that assessing the fidelity of local councils is not an easy task. This paper aims to identify the challenges associated with assessing the fidelity of local councils in the implementation of rainwater harvesting policy.

This research revealed challenges in conducting assessments in different disciplines of study, which generally include concerns about the consensus of concepts, confidentiality, critical, analytical skills, as well as access to data. The research has also shown that the methods used to assess implementation fidelity differed in their strengths and weaknesses. Identifying appropriate methods necessitated thorough consideration of the context, the complexity of the situation, and resources available. While being widely used to measure fidelity, self-assessment-questions were found to be unsatisfactory for the context of this research – which focused on overall strategies rather than interventions alone. On the other hand, triangulation of observation, document review and interview have confirmed convergence, complementarity and dissonance of the findings.

Overall, identifying research challenges is important as it provides insights into potential obstacles and allows the development of alternatives ahead of time. It can also uncover any previously overlooked linkages and definitions between concepts that could lead to substantial results. To be more robust in their research methodology, researchers may ask questions such as: "Who will be the participants?", "How will the data be collected?", "When and how will the data be analysed?", "What abilities do the research necessitate?". As a result, objectives and methodology may be refined further by knowing which methods are most suited and how resources and availability may influence outcomes.

Since the research was limited to uncovering the local councils' implementation at organisational level, it was not possible to investigate the perspectives of other external stakeholders, such as rainwater harvesting suppliers, developers and end-users. This hampered a formation of a comprehensive understanding of fidelity. External perspectives regarding the processes of adhering to the rainwater harvesting by-laws that require interaction with local councils for the installation and use of the system, may reveal obstacles that impede effective implementation. Hence, it becomes essential to promote more rigorous and systematic research to assess the implementation of rainwater harvesting that may currently be lacking in these areas. The assessment can help local councils in becoming more transparent and accountable by identifying areas to be improved and areas that are doing well.

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## **REQUISITE OF SUB-ATTRIBUTES FOR SMART CITY CONCEPTUAL FRAMEWORK**

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### **Abstract**

A smart city requires citizen participation and key metrics such as smart city elements and performances. This paper aims to identify the sub-attributes for smart city elements and performances that required the formation of the conceptual framework. This research has studied the past literature related to smart city studies and citizen's needs from the Smart City. This research continues the study by identifying two categories of variables which are Smart City elements and Smart City performance. The investigation of past literature shows that Smart City elements consist of eight attributes namely Administration, Social, Infrastructure and Utilities, Transport, Technology, Human, Economy and Environment. The result of past studies also determines that constructs that are important to Smart City performance are Quality of Life, Resource Management and Economic Competitiveness. To ensure the success of smart city initiatives, this study provides sub-attributes of smart city elements and performance that can assist policymakers and government in selecting the best criteria for sub-attributes for a smart city conceptual framework.

**Keywords:** Smart city, Sub-attributes, Conceptual Framework, Elements, Performance

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## **INTRODUCTION**

The Ministry of Housing and Local Government in Malaysia recently launched the Smart City Framework as a guideline for developing smart cities (Cindi, 2019). Former Prime Minister of Malaysia, Tun Dr Mahathir, stated during the Second Cities 4.0 International Conference and Exhibition in Kuala Lumpur on 23 and 24 September 2019 the importance of integrating sustainable technologies into the city's services to improve community safety and quality of citizen's quality of life. Examples of sustainable technologies include autonomous public transportation, drone deliveries, 5G connection, cashless neighbourhoods, energy-efficient structures, intelligent water treatment and management, and others (Cindi, 2019). The smart city concept has generated a lot of debate among city planners, investors, and local government and attracted more affluent residents, law-abiding citizens, and potential investors. The most effective and efficient use of resources in daily life is another worthwhile topic. The availability of facilities, employment growth, and higher income chances contribute to the growth of the urban population compared to rural areas.

According to Mosannenzadeh and Vettorato (2014), the term 'smart city' refers to a sustainable and green city with excessively first-class lifestyles. The aim of a smart city is to address city challenges by enhancing mobility, optimising resource use, enhancing fitness and safety, improving social development, supporting economic growth, and including participatory governance. By implementing ICT on infrastructure and services, the collaboration of its stakeholders (i.e., citizens, universities, government, industry), integration of its key elements (i.e., environment, mobility, governance, community industry, and services) and financial support for social capital could be achieved. To provide a more robust conceptual framework, this paper extended the research of Mosannenzadeh and Vettorato (2014) and analysed the most recent literature review addressing the sub-attributes of elements and performances of smart cities.

The six sections of this paper are as follows: introduction, smart city conceptual framework, research methodology, discussion on sub-attributes of smart city elements and performances, discussion, and conclusion.

## **CONCEPTUAL FRAMEWORK FOR SMART CITY ELEMENTS AND PERFORMANCES**

Smart city elements are the core subject of establishing a smart city concept. However, smart city performance is the main goal of smart city development. These performances will demonstrate the results that can be acquired by establishing the smart city concept. One of the techniques to assess the performance of the city is by using a modified Giffinger's model improvised by Yasmin et al (2016). The technique is easy to understand and apply in the case

study. Can refer to Yasmin et al (2016) work for more insight into assessing performance of the city by case study. Figure 1 shows a smart city conceptual framework that combines both smart city elements and smart city performances. Scholars have different perspectives on smart city elements. Accordingly, this study compiled the elements and performances from previous research and summarised them in Figure 1.

A smart city consists of eight (8) elements: administration, social, infrastructure and utilities, transport, technology, human, economy, and environment. The first element is administration or governance. Washburn and Sindhu (2009) emphasise that city management is streamlined because, in today's service-based economy, an efficient city administration must provide efficient service and foster businesses for its residents. Besides, smart government service is also crucial because it can attract residents and effectively inform the city's conditions. Thus, a core component to reach this function and to manage city operation services such as healthcare, education, infrastructure, and efficient transportation is applying communication and collaboration technologies.

The second element is social standards to enhance education, increase access, improve quality of life, and reduce living costs. The increased access and engagement and improved quality and experience result from the extensive use of technology in education (Washburn & Sindhu, 2009). Moreover, Barrionuevo, Berrone, and Ricart (2012) reveal that to improve a city's social environment, there is a need for a variety of aspects, including extensive research, inclusive immigration policy, community development, elder and health care, and public health safety.

Next, utilities and infrastructure allow for waste, energy, and water usage reduction. However, infrastructure for efficient current systems contributes new options for producing and delivering water, gas, and electricity. According to Caragliu, Del Bo, and Nijkamp (2011), the use of networked infrastructure has a substantial impact on enhancing economic and political efficiency, which in turn facilitates social, cultural, and urban development that can be advantageous for business services, housing, leisure and lifestyle services, and ICTs. It suggests that the wired city is the primary development model and that connectivity is the source of growth.

The fourth element involves the use of technologies that facilitate domestic operations in government services. This encourages the continuity to transform important government agendas across departments, employees, citizens, and businesses, as advocated by a smart city (Nam and Pardo, 2011). The next element is human capital which is the key point to attract creativity, education, and social learning. A smart city must be a centre of public universities operating that excel in providing a skilled workforce. In addition, the main agenda is connecting communities, governments, businesses, and the general public, emphasising the need for a smart city to incorporate elements to enhance the

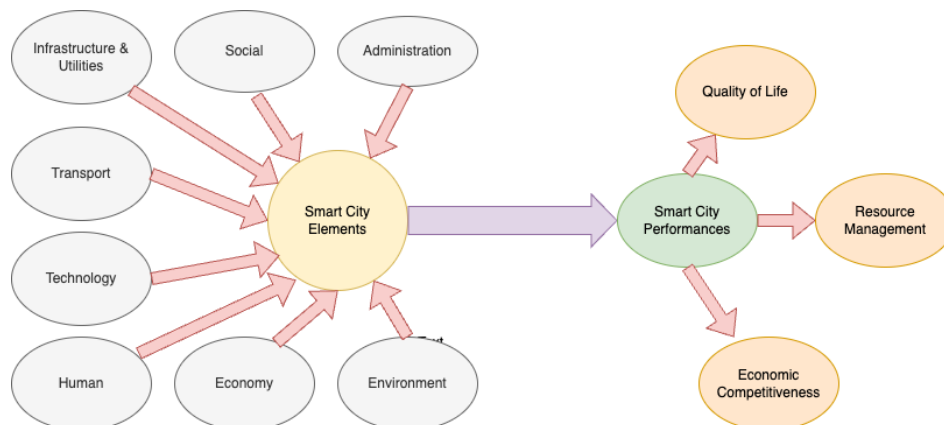
public's creativity, covering education, research, creativity, and talent (Barrionuevo et al., 2012).

The economic factor also encourages business development, economic expansion, and employment creation. According to Caragliu, Del Bo, and Nijkamp (2011), a business that focuses on urban development is vital for a smart city project. Moreover, businesses are one of the key factors in achieving socioeconomic performance in a smart city. The seventh element is the environment. Smart cities address environmental sustainability due to the ongoing depletion of natural resources and deteriorating environmental issues. Simultaneous efforts have been taken to solve pollution issues, manage the continuation of a clean and safe water supply, promote a green building agenda, and increase the use of renewable energy while reducing energy bills. According to Pellicer et al. (2013), a smart city must be able to offer its residents efficient energy use and effective resource management. Caragliu, Del Bo, and Nijkamp (2011) also state that environmental sustainability and social sustainability are important components of a smart city. With the decreasing resources, smart cities are expected to implement the usage of renewable energy.

Transportation is the eighth element. One of the goals of a smart city is to improve public transportation while reducing traffic congestion. Having fewer vehicles on the road reduces traffic congestion and environmental effects like the greenhouse effect and carbon concentration. Washburn and Sindhu (2009) explain that cities like London have successfully reduced traffic congestion in their metropolitan areas, by charging 30 per cent surcharge for entering the city.

The actual objectives, or the anticipated results, of smart city development are smart city performances. An ideal smart city can solve urban issues. Nonetheless, there are intriguing theories or viewpoints on this matter, resulting in varying viewpoints of previous research, such as in the research by Batagan (2011) and Mosannenadeh and Vettorato (2014). This is due to different problems faced in different successful smart cities. As a result, it is suggested that the issues affecting a city are regional and local-centric.

Figure 1 summarises the objective of developing a smart city is based on and includes improvements to the quality of life, economic competitiveness, and resource management. It also presents the other side is smart city performance.



**Figure 1:** Smart City Conceptual Framework  
 Source: Author's Compilation

The term ‘quality of life’ in a smart city programme is interpreted as decreasing community stress levels, offering food infrastructure, increasing security, and increasing health levels. As for resource management, a smart city programme is believed to lower the greenhouse effect, manage waste, use renewable energy, enhance recycling programmes, pollution, optimal utilisation of resources, and many more. Last but not least, the performance of a successful smart city can be measured through economic competitiveness such as population growth rate, reduced unemployment rate, wage growth increase, and increased worker productivity.

Thus, this conceptual framework presents the performance and elements of a smart city. There are eight (8) elements which are administration, social, infrastructure and utilities, transportation, technology, human, economy, and environment. Accordingly, smart cities can be measured through the quality of life, resource management, and economic competitiveness.

## RESEARCH METHODOLOGY

Onwuegbuzie (2012) emphasises that literature and critical analysis can be a tool for analysing and interpreting literature sources by taking into consideration both the scientific and grey literature that is currently available. Therefore, it is necessary to examine the current literature to determine any additional elements, performances, and sub-attributes that can be implemented into the body of knowledge to develop a more robust conceptual framework than that developed by Mosannenzadeh and Vettoroto (2014).

The current study selected three categories of the literature review’s sources: academic, industrial, and governmental. The review focused on academic research papers, industrial papers, and government booklets from 2009

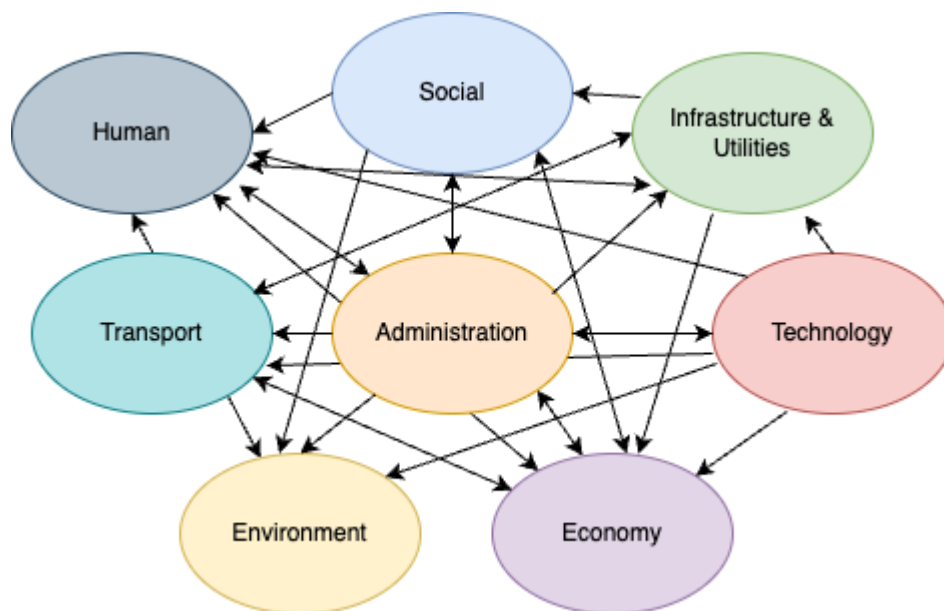
to 2021. The occurrences of the keywords ‘smart city elements’ and ‘smart city performances’ were tallied, and their frequency was calculated using an average.

This paper treated the smart city elements as a significant area of focus and smart city performances as challenges, following the study conducted by Mosannenzadeh and Vettoroto (2014). Therefore, this paper aimed to examine and analyse a literature review of the sub-attributes that enhance the conceptual framework developed by Mosannenzadeh and Vettoroto (2014) for smart city elements and performance.

### **DISCUSSION OF SUB-ATTRIBUTES FOR SMART CITY CONCEPTUAL FRAMEWORK**

Table 1 shows the sub-attributes for the smart city elements and smart city performances. There was a total of 31 sub-attributes of smart city elements identified from 2009 to 2021. For smart city performances, a total of 11 sub-attributes were identified. All sub-attributes are shown in Table 1.

The administration consisted of four sub-attributes: e-governance, smart policy, implementation from an authority, and communication. Administration is important in ensuring all other elements are implemented properly and functioned. Therefore, the strength of authority, administration, or governance is required thoroughly (Chrisidu-Budnik & Przendanska, 2019). In addition, the social aspect is an element that supports smart city frameworks. Therefore, sub-attributes like community/individual intelligence, immigration policy, community development, elder healthcare, and public healthcare are important to ensure a mentally stable, peaceful, and harmonious community. In short, the growth of social society is interconnected with human development (Monfaredzadeh and Krueger, 2015). Figure 2 shows the interconnection between each element in the smart city framework.



**Figure 2:** Interconnection between Smart City elements  
*Source: Author's Compilation*

Human development, which comprises knowledge, skills, awareness of the surrounding society and environment, and good action, as well as modest behaviour, is part of the smart city framework. The support from each citizen contributes to the robustness of the smart city framework. Using skills, knowledge, and awareness, humans can create opportunities, enhance the economy, and utilise technology to the highest use, creating better infrastructure while taking care of the environment (Nam & Prado, 2011). Moreover, smart cities have a good economy, sustainable business, and higher chances of growth than other cities (Chorabi et al., 2012). This is because the development of technology has created a few types of economic opportunities and enhanced entrepreneurship, e-commerce, green investment, and the digital economy. In general, technology plays a vital role in the smart city framework. Technology improves daily life efficiency and promotes better transport, governance, economy, and infrastructure. For example, the Internet of Things (IoT), artificial intelligence (AI), and sensory and remote technology are current topics that can bring humans in a greater direction and perhaps a new opportunity that has never been discovered (Nam and Prado, 2011).

Furthermore, Appreciating the environment that offers essential resources such as shelter, food, water, and other vital provisions (Chorabi et al., 2012), the implementation of the smart city concept can produce an improved

environment as society and individuals actively address and mitigate pollution, adopt sustainable consumption practices, and enhance waste management. Hence, checks and balances are necessary for the various components that constitute the concept of a smart city.

The establishment of smart city performance can serve as a standard that citizens can utilise as a reference to assess the successful implementation, management, and utilisation of the smart city concept. Table 1 displays all the subordinate characteristics of this framework.

**Table 1: Sub-Attributes for Smart City Conceptual Framework**

<b>Smart City Elements</b>		
	<b>Sub-attributes</b>	<b>Author (year)</b>
Administration	E-governance	Lombardi et al. (2009)
	Smart Policy	Bokolo et al. (2018)
	Implementation	Chrisidu-Budnik & Przendanska (2019)
Social	Communicate	Washburn and Sindhu (2009)
	Intelligence	Zhang et al. (2017)
	Immigration policy	Barrionuevo et al. (2018)
	Community Development	Barrionuevo et al. (2018)
	Elder healthcare	Barrionuevo et al. (2018)
Infrastructure & Utilities	Public health	Barrionuevo et al. (2018)
	Networked Infrastructure	Caragliu et al. (2011)
Transport	Connectivity	Caragliu et al. (2011)
	Free congestion	Lawrence et al. (2006)
	Public Transport Efficiency	Frez et al. (2019)
Technology	IoT	Hassan et al. (2021)
	Sensory	Suakanto et al. (2013)
	Remote	Liang et al. (2020)
	Artificial Intelligence	Luckey (2020)
Human	Knowledgeable	Salin & Abidin (2011)
	Awareness	Bokolo et al. (2018)
	Skill able	Bokolo et al. (2018)
	Action	Kumar & Dahiya (2017)
	Behaviour	Kumar & Dahiya (2017)
Economy	Green Investment	Bokolo, Majid, Ramli (2018)
	Entrepreneurship	Kummitha (2019)
	Digital economy	Ivanenko et al. (2020)
	E-commerce	Mahizhnan (1999)
Environment	Sustainable consumption	Bokolo et al. (2018)
	Pollution free	Bokolo et al. (2018)
	Waste management	Bokolo et al. (2018)

Smart City Elements		
Smart City Performances		
Quality of life	Minimum Needs	Fang et al. (2021)
	Stress-free/High happiness index	Shwedeh et al. (2021)
	High-quality facility	Rahmawati et al. (2018)
	Low crime rate	Shapiro (2006)
	Community Engagement	Macke et al. (2018)
Resource Management	Pollution free	Samal et al. (2020)
	Responsive	Pereira et al. (2018)
	Transparency	David et al. (2015)
Economic competitiveness	Jobs creation	Sofrojenevic et al. (2014)
	High income	Hollands (2015)
	Innovation rate	Joshi et al. (2016)

Source: Author's compilation

## CONCLUSION

The current study aimed to identify the sub-attributes of elements and performance of a smart city. A total of 42 sub-attributes that are crucial for establishing a high-quality smart city framework have been identified. These sub-attributes are instrumental in ensuring the success of smart cities. Nevertheless, it was necessary to assess the dependability and accuracy of these characteristics by performing a pilot study. Upon completing the pilot study, it is determined whether there are any additional attributes that should be incorporated into the smart city framework or eliminated through factor analysis and reliability testing.

According to Hollands (2015) and Thomas et al. (2016), citizens are often left out or neglected in the development of the smart city. However, Marrone (2018) emphasises that citizens are not entirely ignored, but rather they are not given the same level of recognition in the publication or work progress of the smart city as the developer and administration. Prior to that, Marrone (2018) contends that it is most advantageous to comprehend the viewpoint of the citizen, as they represent the practitioner-centric group that serves as the end-user and possesses a requirement that must be met before its provision. Not many researchers such as Lim et al (2020) who investigate the importance of participation of citizens in Smart Cities must be considered crucial. As a result, the current study believes that their opinions and suggestions play a vital role in developing the ideal smart city concept because they are the end-users of the proposed smart city model. Thus, the main recommendation of this research is to gain insight from citizens before developing a smart city project by outlining the essential elements and performance indicators required to meet the needs of



citizens in order to equip administrators and governors with a clear and efficient conceptual framework for smart city development.

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## **URBAN FARMING PRACTICE CONCERNING LIFE CYCLE COST COMPONENTS**

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### **Abstract**

Urban farming (UF) has become popular, and several cities are trying to enhance sustainability by improving urban greenery and urban farming. In addition to supporting food security within the area, it benefits the people's health and well-being and the surrounding environment. This results in a shifting of time consumption from spending time outside, like travelling and shopping, to commuting to activities within home boundaries. Therefore, UF is becoming an activity for residential communities besides working and studying. Therefore, this paper aims to identify the significant Life Cycle Cost (LCC) components concerning the UF practices. The objective of the research is to establish the attributes of UF practice throughout the LC phase. Hence, the findings of the paper indicate the conceptual framework for LCC components concerning the UF practices which are beneficial to practitioners. To achieve this aim, previous studies on types, techniques, and components of UF technology and practices throughout the LC phase, have been explored in both local and international contexts. Thirteen (13) papers from journal and conference papers were reviewed to determine the LCC components of UF according to life cycle (LC) phases. The attribute placed in the respective phase is based on thematic techniques. The paper's findings indicate that the LCC components occur during Planning, Installation, Management, Maintenance, and Harvesting/ Disposal.

**Keywords:** Aeroponics, Aquaponics, Conceptual Framework, Hydroponics, Life Cycle Cost Component

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## **INTRODUCTION**




The population has moved and concentrated in urban areas due to urbanisation. According to estimates, 9.7 billion people will inhabit the planet by 2050, with a third of them living in cities (Al-Kodmany, 2018; Hussain et al., 2019; Li et al., 2020; Nafisi et al., 2020). Hussain et al. (2019), Li et al. (2020) and Nafisi et al. (2020) stressed that food security and climate change are the primary impacts of urbanisation. Ahmad et al. (2023) added that Malaysia's rapid urbanisation is endangering the country's green space, particularly its protected areas. Urban green areas in Malaysian cities are still being converted for housing, industry, and transportation infrastructure, even if the amount of green space per capita is decreasing. This trend contributes to environmental problems associated with climate change, such as landslides, floods, air pollution, and rising temperatures. However, areas of green cover must be identified, maintained, and protected since they are essential for supplying ecosystem services, improving the quality of life for urban populations, and balancing the continued expansion of built-up areas. Ivascu et al. (2021), and Marzuki and Jais (2021) confirmed that UF is a new, gradually emerging trend that has the potential to solve the growing food insecurity crisis. Instead of food security, incorporating urban farming into urban planning and design can contribute to the overall liveability of cities. It not only provides environmental benefits by promoting sustainability but also enhances the visual and social aspects of urban spaces (Ahmad et al., 2023). Nevertheless, due to higher initial costs, urban farming must produce adequate high-quality yields, be profitable, protect the environment, and be socially responsible long-term (Keyvenvar et al., 2020). Therefore, this paper aims to establish the conceptual framework that is significant to life cycle cost (LCC) components concerning the UF practices.


## **LITERATURE REVIEW**

### **Scenario of Urban Farming in Malaysia**

UF can be defined as increasing the global food supply without relying on further land clearing as it utilizes the urban area to grow crops. It commands a significant commerce level, making it more than homesteading or subsistence farming. Integrating food production with buildings offers an avenue that does not impinge on the city's many uses for available land. Urban agriculture changes the entire cultivation system to suit the urban environment. More technologically advanced tools are needed to aid farming activity because cities have a different environment than conventional farming areas. In the past decade, investments in agriculture technology have increased dramatically, with \$6.7 billion invested in the last five years and \$1.9 billion in 2018. Modern agriculture practices suit the Urban Agriculture concept and can be used to increase food production within the city area. Moreover, UF has economic, social, and environmental benefits.

**Table 1:** UF Project in Malaysia

<b>Location</b>	<b>UF System/ Plant</b>	<b>Source(s)</b>
Madrasah Tahfiz Raudhatul Baiduri, Bukit Changgang, Banting (2022) 	<b>UF System:</b> Hydroponic System  <b>Plant:</b> Rock melon	Harian Metro (2022), <i>Projek Rock Melon Hidroponik TKHM-Agrobank mula keluaran hasil [METROTV]</i> , <a href="https://www.hmetro.com.my/mutakhir/2022/01/799213/projek-rock-melon-hidroponik-tkhm-agrobank-mula-keluar-hasil-metrotv">https://www.hmetro.com.my/mutakhir/2022/01/799213/projek-rock-melon-hidroponik-tkhm-agrobank-mula-keluar-hasil-metrotv</a> Date accessed: January 21, 2023
Kebun Komuniti 1 (Taman Rimba Desa Presint 9), Kebun Komuniti 2 (Presint 8), Kebun Komuniti 3 (Presint 9) and Kebun Komuniti 4 (Presint 14) (2008) 	<b>UF System:</b> Hydroponic System Fertigation  <b>Plant:</b> Vegetables Chili Rock melon  <b>Program Initiator:</b> Program Pertanian Bandar Putrajaya	Inspirasi Destinasi Menarik Percutian Impian (n.d), <i>Urban Farming Komuniti Presint 9 Putrajaya</i> , <a href="http://destina.my/urban-farming-komuniti-presint-9-putrajaya/">http://destina.my/urban-farming-komuniti-presint-9-putrajaya/</a> Date accessed: January 21, 2023
Kebun Komuniti Garden 8, Taman Perwira Gombak (2021) 	<b>UF System:</b> Hydroponic System  <b>Plant:</b> Vegetables Herbal Plant Flower  <b>Program Initiator:</b> University Community Service (UCS), Universiti Putra Malaysia.	DagangNews.com (2022), <i>Kebun Komuniti UPM capai kejayaan bersama penduduk Taman Perwira</i> , <a href="https://www.dagangnews.com/kebudayaan-komuniti-upm-capai-kejayaan-bersama-penduduk-taman-perwira-18945">https://www.dagangnews.com/kebudayaan-komuniti-upm-capai-kejayaan-bersama-penduduk-taman-perwira-18945</a> Date accessed: January 21, 2023
<b>Location</b>	<b>UF System/ Plant</b>	<b>Source(s)</b>
Balai Bomba Dan Penyelamat, Temerloh (2021)	<b>UF System:</b> Hydroponic System Fertigation	Sinar Harian (2022), <i>BBP Temerloh manfaat kawasan terbiar usahakan kebun hidroponik</i> ,

	<p><b>Plant:</b> Vegetables</p> <p><b>Program Initiator:</b> Program Pertanian Bandar Kategori Kebuniti</p>	<p><a href="https://www.sinarharian.com.my/article/202693/edisi/bbp-temerloh-manfaat-kawasan-terbiar-usahakan-kebun-hidroponik">https://www.sinarharian.com.my/article/202693/edisi/bbp-temerloh-manfaat-kawasan-terbiar-usahakan-kebun-hidroponik</a> Date accessed: January 21, 2023</p>
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Since 2008, the "Bumi Hijau" program has existed in Malaysia. Putrajaya Corporation launched the "Kebun Komuniti Programme," a community gardens project involving the citizens of Putrajaya. The initiative has positive outcomes and enhancement. Interaction through community engagement. The community garden used traditional beds and irrigation for farming at the beginning of the program. Two greenhouses were built at the Community Garden by the end of 2013, an initiative to enhance the Community Garden in Putrajaya.

### **Urban Farming Project in Malaysia**

Table 1 shows the implementation of UF in Malaysia since 2008 to 2022. The UF become popular in Malaysia, as it is available in improve technology, easy to handle and good quality of the product.

### **Urban Farming (UF) Types and Techniques**

Urban farming refers to growing crops and raising livestock in cities and other urban areas. Urban farming is incorporated into the urban ecosystem to feed the surrounding population (Murdad et al., 2022). It has been implemented on grounds, vertical farming, and rooftop farming. Each type includes several UF techniques: hydroponic, aeroponic and aquaponic (Portal Rasmi Jabatan Pertanian, 2023).

### **Hydroponic**

According to Al-Kodmany et al. (2018), and Khan and Vadsaria (2020), the term hydroponics is derived from the Greek words hydro and ponos, which translates to "water" and "labor," presenting "water doing labor" or "water works." Hydroponics is a cultivation technique that employs nutritive solutions for plants' growth with or without inert media or substrates. It involves growing plants with nutrients solution and a soil-less manner. The plant roots are submerged in a nutrient solution that is frequently monitored and circulated to maintain the proper chemical composition (Birkby, 2016; Al-Kodmany, 2018). The primary objective of hydroponics is to supply the ideal nutritional environment for

optimum plant performance in any climate (Khan, 2020). The method has successfully produced vegetables, such as onions, lettuce, and radishes.

### **Aquaponic**

Aquaponics is an intensive fish-vegetable production system that combines aquaculture with plant production in a hydroponic system. Aquaponics can be set up in different ways, but the basic principle is that fish are raised in tanks, and part or all of the wastewater containing excreted nutrients is then circulated to the hydroponic plant production system. The plants absorb the water and nutrients, clean it, and return it to the fish tanks (Birkby, 2016).

### **Aeroponics**

Aeroponics is the science of plant cultivation without incorporating soil or a substrate culture. Where the plant grows in the air with artificial support, and no soil or substrate is required to support the plant. In the air-water culture cultivation system, the plant roots are hung inside a sealed container under darkness and openly exposed in the air to receive water nutrient-rich spray via atomizers. The plant leaves' upper portion and crown extend above the wet zone. The artificially provided structure separates the root and canopy of the plant. The system uses nutrient-enriched spray in the air using pressure nozzles or foggers to sustain hypergrowth under controlled conditions (Lakhiar et al., 2018).

### **Life Cycle Cost Component for Urban Farming (UF)**

Life cycle cost components refer to the various cost categories involved in the entire lifespan of a product, system, or project. The LCC phase for UF needs to be identified to come out with the LCC component (Opawole et al., 2020). Figure 1 displays the mapping of the UF Phase to the LCC Stage.



UF PHASE	MAPPING	LCC PHASE
Planning	Planning Stage	Planning Design
Installation Management Maintenance	Installation, Operation, and Maintaining Stage	Installation Operation Maintenance
Harvesting/ Disposal	Disposal Stage	Disposal

**Figure 1:** UF Phase Concerning LCC Phase

*Source: UF Phases: Hamidon et al. (2020) and Medina-Salgado, García-Muiña, Cucchi & Settembre-Blundo (2021); Source: LCC Phase: Miah, Koh & Stone (2017)*

## RESEARCH METHODOLOGY

Academic journals and conference papers in online databases use to produce the conceptual framework. There are four phases involve. Phase 1 is the **identification**. This phase was where a rigorous search of topics related to urban farming. There were 443 articles discovered using the search string and these were limited to English language articles from the year 2017 to 2022 that covered the subject of urban farming. Second phase is **screening**. In this phase, the identified literature was screened according to the suitability of the topic (Sidrotul et al., 2022) remarks that the screening includes exploring the topic and abstract of the papers. At this phase, 60 manuscripts were reviewed, and only 16 were found to be eligible for this paper’s review. In the next phase **eligibility**, only 13 papers were selected for the analysis after being thoroughly analyzed in the eligibility phase. The final phase is Phase 4: **Data Abstraction**, Table 2 shows the thematic analysis result that was tabulated in the data abstraction phase based on the data from the 13 selected literatures by identifying relevant or intriguing trends in the data.

## ANALYSIS AND DISCUSSION

Table 2 displays the LCC Component in relation to UF Practices based on the reviewed paper. There are five main phases in UF: the Planning Stage, Installation, Management, Maintaining Stage, and harvesting stage.

Table 2: Life Cycle Cost Component in Relation to UF Practices

LIFE CYCLE COST COMPONENT IN RELATION TO URBAN FARMING											TOTAL FREQUENCY (f)																		
	Dorr et al. (2017)	Malaysia	Li et al. (2020)	Malaysia	Sanjnan-Delmats et al. (2018)	Malaysia	Vinci & Rapa (2019)	Malaysia	Farhana & Salim (2020)	Malaysia		Keyvanfar et al. (2020)	Malaysia	Hamidon et al. (2020)	Malaysia	Yusoff et al. (2017)	Malaysia	Zainal & Hamzah (2018)	Malaysia	Ramalloo et al. (2018)	Malaysia	Mah et al. (2018b)	Shanghai	Zheng et al. (2019)	New York	Gou et al. (2013)	Shanghai		
<b>PLANNING</b>																													
Training and workshop			●					●				●														●			
Technology and techniques																													
Transportation																													
Capital																													
Planting area			●																										
Available resources or facilities			●																										
Type of Crop			●																										
<b>INSTALLATION</b>																													
Auxiliary equipment	●																												
<b>MANAGEMENT</b>																													
Seeding																													
Water consumption	●																												
Electrical consumption																													
Fertilizer	●																												
Pesticide	●																												
<b>MAINTENANCE</b>																													
Monitoring and inspection	●																												
Sensor calibration	●																												
Irrigation system maintenance																													
Pest and disease management																													
Nutrient management																													
<b>HARVESTING</b>																													
Auxiliary equipment disposal	●																												
Output																													
Substrate production	●																												

### **Planning**

Table 2 lists the most prominent LCC component. During the initial stage, the attributes with the highest scores are the availability of resources or facilities and types of crops, each with a score of  $f = 9$ . They are closely followed by selecting suitable technology, techniques, and capital, with scores of  $f = 7$  and  $f = 6$ . Meanwhile, training, workshop, and land area all have scores of  $f = 4$ . The lowest frequency of UF practice attributes is transportation, with a score of  $f = 1$ . As a result of the analysis, the practitioner seeks to collect the database to predict the project's feasibility during the planning stage. The data collection stage is essential before starting any UF project (Li et al., 2020).

Moreover, suitable site design and selection are crucial during the beginning stage. The data will assist in deciding the suitable technology or system to be used, suitable areas to place the UF system, and types of crops that benefit them. Ramaloo et al. (2018) urged the responsible authorities, such as Municipal and City Councils and the Department of Agriculture, to train the farmers on the appropriate technology and technique and estimate spending expenses for UF activity. Detailed planning and initial input are required to assist the decision-making due to cost implications. This is in line with Keyvanfar et al. (2020); Li et al. (2020) and Vinci et al. (2019), who agreed that the UF technique requires high initial capital investments and proper data collection must occur before selecting the technique and technology.

### **Installation**

Table 2 presents the activity that usually occurs during installation. The frequency for installing the UF-selected technologies is  $f = 7$ . It is the only attribute during installation. During installation, the practitioner must be familiar with the equipment required for the selected techniques, such as substrates, pots, and all necessary equipment, such as netting, wood Pine sawn wood, and geotextile polypropylene (Dorr et al., 2017). UF consists of various techniques; each technique has specific equipment to fit with the function of the techniques. The supplier must install the equipment to ensure all the parts are properly connected and according to the manual. The testing must be conducted to ensure the equipment can function accordingly after completion. The life cycle of the equipment can be maximized if the practitioner handles it with care.

### **Management**

Table 2 displays the important LCC components during the management phase. The highest-ranked attributes are water consumption and fertilizer, with scores of  $f = 8$ . They are closely followed by seeding and substrate production, with scores of  $f = 7$ . Meanwhile, pesticide scores  $f = 6$ , while the lowest frequency of UF

practice attributes is electric consumption during the management phase, with a score of  $f = 3$ .

Management are the crucial and longest phase compared to the other LC phases. The phase begins with the seeding process. The seeding must be conducted according to the types of crops. During the plant's growth period, which lasts between three weeks and three months, it must be periodically watered, fertilized, and treated with pesticide to ensure it receives sufficient nutrients and is protected from pests and insects. Watering equipment, such as irrigation pipes and tap water, should be considered (Dorr et al., 2017; Hamidon et al., 2019). Instead, Hamidon et al. (2019) added that the plant's temperature, electricity, and water pH should be monitored to ensure the plant's even growth. Vinci et al., (2019) highlight the benefit of applying technology-based UF due to the proper monitoring. For example, hydroponic techniques allow a high control of energy, nutrients, and pesticides. Ideally, it can guarantee even plant growth and reduce waste and resources by automatizing the system.

### **Maintenance**

Table 2 displays the important LCC components during the maintenance phase. The highest-ranked attributes are monitoring and inspection, with scores of  $f = 6$ . They are closely followed by irrigation system maintenance, with scores of  $f = 5$ . Meanwhile, sensor calibration and equipment maintenance scores  $f = 3$  respectively, while the lowest frequency of UF practice attributes is pest and disease management, with a score of  $f = 2$ .

Maintenance plays a crucial role in ensuring the success and longevity of smart urban farming systems. Dorr et al. (2017), Hamidon et al. (2020), Keyvanfar et al. (2020), Mah et al. (2018a), Mah et al. (2018b), Zainal and Hamzah (2018), Zheng and Lyu (2019) agreed that UF required regular monitoring and inspection. Therefore, implement a schedule for regular monitoring and inspection of the smart farming infrastructure, including sensors, automation systems, irrigation systems, and environmental controls. Follow maintenance schedules, clean or replace filters, and ensure proper functioning of equipment. Timely maintenance reduces the risk of equipment failures and maximizes operational efficiency. This allows for early detection of any issues or malfunctions and enables prompt corrective action.

In addition, maintain and clean irrigation systems to ensure proper water delivery to crops. Regularly check for clogs, leaks, or malfunctioning components. Adjust irrigation schedules based on crop requirements and seasonal changes. Proper maintenance of irrigation systems promotes optimal plant health and water efficiency (Farhana & Salim, 2020; Hamidon et al., 2020; Keyvanfar et al., 2020; Mah et al., 2018b; Zheng et al., 2019). According to Dorr et al. (2017), Mah et al. (2018b) Zheng et al. (2019) calibrate sensors regularly to

ensure accurate data collection and monitoring. Check sensor performance, replace batteries if necessary, and clean sensors to prevent interference or inaccurate readings. Proper maintenance of sensors is vital for reliable data-driven decision-making. Moreover, Mah et al. (2018b) and Zheng et al. (2019) added that management of nutrients is also crucial. If using hydroponic or nutrient delivery systems, monitor and maintain nutrient levels according to crop requirements. Regularly check nutrient solution pH and conductivity, and adjust as needed. Keep nutrient tanks clean and well-maintained to prevent contamination or nutrient imbalances.

On the other hand, integrated pest management strategies need to be implemented to prevent and manage pest and disease issues. Regularly inspect plants for signs of pests or diseases and take appropriate action, such as using organic pest control methods or biological agents. Prompt identification and treatment can prevent major infestations and crop losses (Farhana & Salim, 2020) and (Hamidon et al., 2020). In short, proper management and maintenance practices are crucial for maximizing yield, minimizing losses, and ensuring the overall success and sustainability of an urban farming project. Through careful monitoring, adjustment of environmental conditions, and the use of appropriate technologies, farmers can optimize plant growth, resource utilization, and productivity.

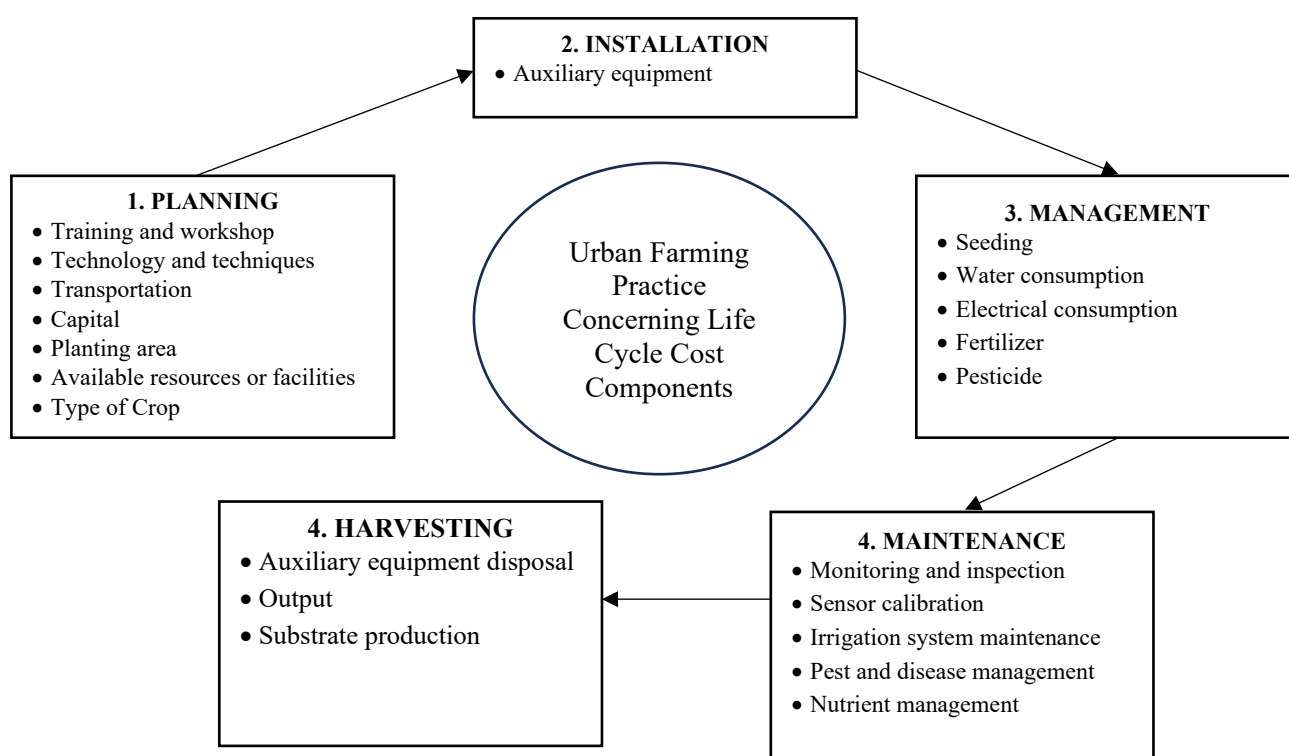
### **Harvesting/ Disposal**

Table 2 represents the auxiliary equipment disposal and output scores of  $f=6$  and  $f=1$ , respectively. According to Hamidon et al. (2019), the seed can be harvested between three weeks and three months. After harvesting, the waste, such as the plant's root, should be disposed of. The output of the product will be calculated. Dorr (2017) added that waste, such as plastic irrigation pipes, netting, drip tape, and geotextile membranes, would be reused at the other site, while the non-recycle waste must be dumped in a legal landfill. The practitioners must be aware of the practices involved throughout the LC Phase, as each practice is the LCC component for the UF works. There are 21 significant LCC components listed according to the theme/ LC phase for UF.

### **FINDINGS**

Figure 2 displays the connection of LCC components relating to UF practice throughout the LC phases. The framework contributes to the practitioner to understand the whole process involved, from the planning stage to the harvesting and disposal of the UF technology. Integrating life cycle cost analysis into the planning aspect of the built environment helps ensure that projects are financially sustainable, cost-effective, and aligned with long-term goals. By considering both initial and ongoing costs, practitioner can make informed decisions that lead to

more resilient, efficient built environments and cost effective. According to Keyvanfar et al. (2020), Li et al. (2020) and Vinci et al. (2019), the UF technique requires high initial capital investments, and proper data collection should be conducted before selecting the technique and technology to ensure the feasible and successful of the project. Although the initial capital is high, Hamidon (2019) mentions that the UF can provide greater production and return yield. Hence, the attributes have the potential to be integrated with the LC cost for each practice.



**Figure 2:** Conceptual Framework for Urban Farming Practice Concerning Life Cycle Cost Components

## CONCLUSION

UF is the best practice in the current world's situation and population. As mentioned earlier, resources, such as land and water, become scarce and limited due to the increasing population in cities or urban areas. As a solution, UF technology was introduced to cater to the space, resources, and limited time problem among urban dwellers. However, UF can improve the dweller's well-being, neighbourhood relationships, stress level, and economy and provide

healthy food sources. Therefore, this study has listed the attributes of UF practice that occur during Planning, Installation, Managing, Maintenance, and Harvesting/ Disposal. The knowledge of the process and the equipment required are important to guarantee the viability of the UF technology because many activities are involved throughout the LC.

### **ACKNOWLEDGEMENT**

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## **THE SIGNIFICANCE OF TRANSIT-ORIENTED DEVELOPMENT (TOD) TOWARDS THE ENHANCEMENT OF PUBLIC TRANSPORTATION RIDERSHIP**

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### **Abstract**

Transit-oriented development (TOD) emerges as a strategic urban planning approach that aims to create well-connected, pedestrian-friendly communities centred around transit nodes. Despite the increasing use of public transportation, many people still rely on single-occupancy vehicles. Several TOD guidelines have been developed to enhance its implementation in Malaysia; however, the current policy context on housing and TOD practices does not adequately reflect the reality that public transport is the preferred mode of transportation for many people. Thus, this study aims to identify the most significant attributes of TOD that can improve public transportation (PT) ridership. Primary data was gathered from 284 respondents using a self-administered questionnaire distributed through simple random sampling. The chi-square test was used to determine the significant relationship between TOD and PT ridership. The findings indicated that eleven TOD attributes and eleven PT ridership attributes had a significant relationship, whilst the remaining relationships were considered null. More than half of the findings were significant, indicating that both TOD and PT ridership were related. In conclusion, a well-designed transit-oriented community can attract and retain public transportation users, making it a catalyst for creating transit-friendly environments.

**Keywords:** Transit-Oriented Development (TOD), Public Transportation Ridership

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## **INTRODUCTION**

Transit-oriented development (TOD) is a crucial concept in urban planning that promotes sustainable and efficient transportation systems. It addresses urban challenges like congestion and pollution by shifting from highway-based zoning to transit-based zoning. Cities in Asia, such as Kuala Lumpur, Toyama, and Jakarta, have successfully implemented TOD, investing heavily in mass transit networks (Kidokoro, 2020). TOD optimizes land use around transit stations, enhancing mobility, productivity, and local businesses, thus making neighborhoods vibrant and maximizing public transport ridership (Khalid and Samsudin, 2023).

The Land Public Transport Commission (SPAD) aims for 40% of Malaysian commuters to use public transport by 2030. However, many single-occupancy vehicles still congest roads, and connectivity within regions like Klang Valley remains underdeveloped (Ravindran, 2021). Public awareness of TOD is low, and existing policies do not effectively promote public transport as the preferred travel mode (Yap & Goh, 2017). The 12th Malaysia Plan (12MP) acknowledges the need for better connectivity and reliability in public transport (Choong, 2021).

Countries like the US, UK, China, and Singapore are shifting towards transit-based zoning. In Malaysia, TOD guidelines focus on preserving the city's image through transit design but lack in promoting public transport connectivity (Azmi et al., 2021). Housing policies emphasize affordable housing and urban design more than connectivity. Thus, this research examines the significance of TOD towards public transportation ridership in the Klang Valley region. It aims to achieve two objectives, namely: (1) to identify the attributes of TOD to enhance public transportation ridership and (2) to analyse the significance of the relationship between TOD attributes towards public transportation ridership.

## **LITERATURE REVIEW**

### **Transit-Oriented Development (TOD)**

Transit-oriented development (TOD) refers to the idea of a mixed-use community within walking distance of a transportation node. The concept was first introduced by Peter Calthorpe in 1993 to develop metropolitan cities in the United States on undeveloped sites, held high potential for redevelopment or reuse, and could initiate more urban growth areas (Calthorpe, 1993). It later gained popularity as a sustainable form of urbanism with a broader array found across the country (Calthorpe, 1993; Cervero, 2004). Calthorpe (1993) believes that TOD can create sustainable urban communities that can reduce the reliance on cars and promote public transportation. The community, in this context, comprises various amenities such as residential, retail, office, open space, and

public utilities for the convenience of its residents and employees to travel by foot, transit, bicycle, or automobile vehicles. The definition of TOD varies according to different guidelines published by different states and countries. The Planning Guidelines for TOD by PLANMalaysia (2018) describes TOD as a well-planned development network, particularly in areas near the transit station. Development in the transit area focuses on high-density, mixed-use, residential, commercial, business, and office buildings that are readily accessible by public transport. Meanwhile, other researchers defined TOD as a vibrant development concept that promotes seamless connectivity within transit distance with the compactness of land activities (Patnala et al., 2020). TOD is believed to be a planning approach that incorporates land use with public transportation, which considers the development surrounding the stations (Yen et al., 2023). The past few decades have witnessed the emergence of many TOD projects in the United States, The United Kingdom, Australia, and various Asian countries, which is vital for the development of cities in providing a basis for the citizens' faith (Ali et al., 2021; Arina Rahmat et al., 2016). This indicates that TOD-related studies are becoming internationally widespread and have become the agenda of state and local governments, stemming from concerns about the sustainability of urban mobility and environmental responsiveness (Doulet et al., 2017).

### **Transit-Oriented Development (TOD) in Malaysia**

The concept of Transit-Oriented Development (TOD) is being implemented in Malaysia, with a focus on the Klang Valley region. This is due to the region's steady growth rate, which is higher than any other region. Currently, there are 24 TOD projects planned along the 31 stations of the Mass Rapid Transit (MRT) Sungai Buloh-Kajang (SBK) line, with two more projects in the pipeline. In the future, more rail transit infrastructures are planned, including projects such as Mass Rapid Transit 2, Mass Rapid Transit 3, Light Rail Transit 3, High-Speed Rail, and East Coast Rail Line. The key to successful TOD development is the proximity of buildings to transit stations, as well as ensuring that the walking experience to and from the station is of high quality. This encourages more people to use public transportation, increasing ridership. A typical TOD neighbourhood has a diameter of a quarter to half a mile (400 to 800 metres), representing pedestrian scale distances of approximately five to ten-minute walk. To encourage TOD in the Kuala Lumpur metropolitan area, the Kuala Lumpur City Hall (DBKL) and surrounding municipalities have designated a Transit Planning Zone (TPZ) within 400 metres of a transit station.

Currently, there are several national policies related to the implementation of TOD in Malaysia, such as the National Physical Plans (NPP27 in 2005 and NPP32 in 2010), Selangor Structure Plan 2020, KL City Plan 2020, 10th Malaysia Plan (RMK-10), National Urbanisation Policy (NUP), and various

regional policies like the Iskandar Region's Comprehensive Development Plan (CDP). According to Buang (2018), the first successful and largest TOD hub in Malaysia is Kuala Lumpur Sentral, best known as KL Sentral. It contains all the major railway stations in Kuala Lumpur, and is considered the best mixed-use development in Malaysia, with luxury condominiums, 5-star international hotels, a shopping mall, corporate office towers, and business suites. The Malaysian government has introduced various plans, guidelines, policies and incentives to promote TOD, including Chapter 6 of the 10th Malaysian Plan (RMK-10), National Physical Plan 3 (NPP3), National Urbanisation Policies 2 (NUP2), and Draft Planning and Design Guidelines for Compact and Liveable Development. These policies and guidelines encourage the use of public transportation, walking, and cycling as alternative modes of transport for urban development. TOD is a key focus in state and local plans, such as the Selangor Structure Plan 2020 and Kuala Lumpur City Plan 2020, as well as regional plans like the Iskandar Region's Comprehensive Development Plan (CDP) (Gomez et al., 2019). Some local authorities provide incentives for developers to build within 400 metres of a transit station, usually by allowing higher plot ratios for commercial development and increased density for residential development.

### **Public Transportation Ridership**

Public transportation ridership refers to the number of people using public transport instead of private vehicles (Taylor & Fink, 2003). In Malaysia, rail service ridership has been increasing annually, from 681,418 in 2017 to 865,713 in 2019 (Ministry of Transportation Malaysia, n.d). Factors affecting ridership are categorized as external (e.g., population, employment) and internal (e.g., fares, service levels) (Taylor & Fink, 2003). Public transportation is vital, especially in metropolitan areas, as it improves the quality of life and attracts businesses (Taylor & Fink, 2009; Weisbrod & Reno, 2009).

Mixed-development projects near transit stations can boost ridership (Buang, 2018; Soehodho, 2017). Studies show that TOD can increase ridership by 20-40% at single stations and up to 50% regionally (Arrington, 2005). Ensuring public transport is safe, fast, and convenient is key to increasing ridership (Calthorpe, 1993). Accessibility should be a priority in design, and TOD areas see higher public transport use due to urban congestion (Panse & Panse, 2019).

In Kuala Lumpur, initiatives like an 11.86 km cycling lane aim to reduce car use and promote cycling (Nathan, 2018). Areas with a mix of commercial and residential uses have higher ridership, especially high-density developments near TOD stations (Abdullah et al., 2020). This aligns well with the theory of TOD, which advocates for high density and intensity of use for areas near TOD stations.

### Tabulation of Attributes

Identifying and understanding the critical attributes of TOD is crucial for gauging its impact on enhancing public transportation ridership. These attributes provide insights into the factors that contribute to the success of TOD in promoting sustainable and transit-friendly urban environments. Table 1 shows the TOD attributes, while Table 2 illustrates the attributes of Public Transportation (PT) Ridership. To systematically analyze these attributes and develop outcomes, researchers will use the Matrix Frequency Analysis approach to transform the chosen attributes into variables. By quantifying these attributes, statistical tests can be used to determine whether the differences observed are statistically significant, providing a basis to conclude the relationships between variables.

**Table 1:** Tabulation of TOD Attributes

No.	Criteria/ Author	Yap & Goh (2017)	Moon- Miklaucic (2021)	Azmi et al. (2021)	Kidokoro (2020)	Gomez et al. (2019)	Thomas et al. (2018)	Ali et al. (2021)	Sohoni et al. (2017)	Pan et al. (2017)	Zhang et al. (2019)	Total
1	Location	x		x								2
2	Land Use Panning			x	x	x	x			x	x	6
3	Mixed-use Development				x		x	x	x	x		5
4	Future Value of Property	x	x		x			x			x	5
5	Density	x	x	x	x	x	x	x		x		8
6	Design			x			x					2
7	Affordability	x		x	x		x					4
8	Amenities	x	x	x	x		x					5
9	Walkability	x	x			x		x	x		x	6
10	Bikeability						x	x			x	3
11	Social		x								x	2
12	Job Opportunity			x				x	x	x	x	5
13	Pedestrian Friendly				x		x	x				3
14	Safety	x	x				x	x	x			5
15	Traffic Congestion	x					x	x	x	x	x	6
16	Travel Behaviour	x	x	x			x	x	x		x	7
17	Car Ownership	x	x							x	x	4
18	Accessibility	x	x	x	x	x	x	x		x	x	9
19	Feeder Bus						x		x	x		3
20	Parking			x	x	x	x		x	x		6
21	Convenience	x	x	x		x		x			x	6
22	Save Time	x								x		2
23	Cleaner							x	x		x	3

No.	Criteria/ Author	Yap & Goh (2017)	Moon- Miklancic (2021)	Azmi et al. (2021)	Kidokoro (2020)	Gomez et al. (2019)	Thomas et al. (2018)	Ali et al. (2021)	Sohoni et al. (2017)	Pan et al. (2017)	Zhang et al. (2019)	Total
24	Environmenta lly Friendly Technology		x	x				x	x			4
25	Open Space							x	x			2
26	Economic Development		x		x	x		x			x	5

**Table 2:** Tabulation of Public Transportation Ridership Attributes

No.	Criteria/Author	Redman et al. (2013)	Chowdhury & Ceder (2013)	Ibrahim et al. (2021)	Sánchez- Atondo et al. (2021)	Azmi et al. (2018)	Total
1	Reliability	x	x		x	x	4
2	Frequency	x	x		x	x	4
3	Coverage		x	x			2
4	Speed	x	x	x			3
5	Accessibility	x				x	2
6	Ticketing Service			x	x		2
7	Facilities			x	x		2
8	Price	x	x		x		3
9	Information Provision	x	x	x		x	4
10	Transfer and Interchange	x	x				2
11	Staff Service			x			1
12	Comfort	x		x	x	x	4
13	Safety	x	x	x	x	x	5
14	Convenience	x				x	2
15	Aesthetic	x					1
16	Signage			x			1

A total of 19 TOD attributes, and 13 PT ridership attributes were selected as variables measured by the questionnaire due to their higher frequency. The remaining attributes analysed in the literature review were voided due to their low frequency from past researchers or incompatibility towards the overall research.

## RESEARCH METHODOLOGY

This research adopted a quantitative approach and used simple random sampling to determine the sample. The pilot study involved ten (10) respondents from the private sector, academia, and MRT commuters. According to Johanson and Brooks (2010), a pilot study should have a minimum of ten (10) to fifteen (15) individuals to make the questionnaire feasible and provide practical benefits. To determine the accuracy and reliability of the research, reliability tests were conducted using Cronbach's Alpha. Tavakol and Dennick (2011) suggest that the alpha value should be between 0.70 and 0.95 to be acceptable, and this research

was categorized as excellent and reliable, with an alpha value of 0.851. The MRT Kajang Line was chosen as it is a significant transit hub attracting diverse commuters. The sample was selected based on the average statistics of public transportation ridership for MRT Kajang Line in Q1 of 2018, 2019, and 2020, as shown in Table 3.

**Table 3:** Average Statistic of Public Transportation Ridership for MRT Kajang Line in Q1 of 2018, 2019, and 2020

Year	2018	2019	2020
Average ridership	11,333,252	14,918,332	13,973,715

*Source: Ministry of Transportation (2020)*

According to Krejcie and Morgan's (1970) table, in order to have a representative sample of a population of one million or more, a sample size of 384 is required. Therefore, 384 self-administered questionnaires were distributed to the public who used the MRT Kajang Line over a period of two months. A total of 284 questionnaires were returned, resulting in a 74% return rate, which is considered sufficient to provide accurate results for confident judgments based on research findings. Morton et al. (2012) justify that a return rate of 70-85% is excellent, and a response rate of 74% is therefore satisfactory and acceptable. The chi-square test was used for variable selection to determine the significant relationship between TOD and PT Ridership. The researcher identified the critical attributes to be used as the main variables through matrix frequency table analysis and established the significance of TOD in enhancing PT ridership. All data was analysed using the Statistical Package for Social Sciences (SPSS) version 27 by comparing each variable's mean average score, finding the squared difference between actual and expected data values, and dividing that difference by the expected data values. A p-value of less than or equal to 0.05 was considered statistically significant. Therefore, variables that significantly contribute to the association with the dependent variable may be retained in the outcome while those with non-significant associations may be considered for removal.

## ANALYSIS

A Pearson Chi-square Test of Independence was conducted to determine whether there is a significant relationship between attributes of Transit-Oriented Development (TOD) that can increase public transportation (PT) ridership and an understanding of TOD and PT ridership. This test is frequently used in empirical research to identify whether two categorical or nominal variables are related. In this study, the two categorical variables were the TOD attributes that could increase PT ridership and a significant understanding of TOD and PT ridership.



The test assessed whether the variables were related to the null hypothesis (H0) or alternative hypothesis (H1). The Ho was that TOD attributes have no effect on PT ridership, and there is no relationship between understanding TOD and PT ridership. The H1 was that TOD attributes enhance PT ridership, and there is a significant relationship between understanding TOD and PT ridership. The alpha level of significance was set at  $\alpha = 0.05$ . The chi-square ( $\chi^2$ ) value was used to determine the significance of any observed differences, as well as to identify precisely which categories accounted for any differences found. A low chi-square value indicates a high correlation between two variables. A p-value was used to determine whether the test results were significant. The results were recorded and analysed in Tables 4 and 5 for further understanding.

**Table 4:** TOD Attribute Relationship Between the Significant Understanding of the Concept of TOD

TOD Attribute Relationship Code	Chi-square Test			Value of p	Significance Understanding of TOD
	Value of $\chi^2$ (Observe Value)	df	Value of $\chi^2$ in Critical Value Table (Expected Value)		
TOD1	12.421	6	12.59	0.053	X
TOD2	25.690	9	16.92	0.002	/
TOD3	14.927	9	16.92	0.093	X
TOD4	10.458	9	16.92	0.315	X
TOD5	25.867	9	16.92	0.002	/
TOD6	20.766	9	16.92	0.014	/
TOD7	17.147	9	16.92	0.046	/
TOD8	18.091	6	12.59	0.006	/
TOD9	19.568	9	16.92	0.021	/
TOD10	23.394	6	12.59	0.001	/
TOD11	17.057	6	12.59	0.009	/
TOD12	16.388	9	16.92	0.059	X
TOD13	23.331	6	12.59	0.001	/
TOD14	23.222	9	16.92	0.006	/
TOD15	12.087	9	16.92	0.208	X
TOD16	12.470	9	16.92	0.188	X
TOD17	6.411	9	16.92	0.698	X
TOD18	13.538	9	16.92	0.140	X
TOD19	19.729	9	16.92	0.020	/

To summarise, findings from Table 4 depict that eleven (11) TOD attribute relationships are considered significant, while the remaining eight (8) attribute relationships are null. The TOD relationship attribute codes that established a significant relationship with the respondents' understanding of TOD are TOD2, TOD5, TOD6, TOD7, TOD8, TOD9, TOD10, TOD11, TOD13, TOD14, and TOD19.

**Table 5:** TOD attribute relationships between the significant understanding of PT Ridership

PT Ridership Attribute Relationship Code	Chi-square Test			Value of p	Significance Understanding of PT Ridership
	Value of $x^2$ (Observe Value)	df	Value of $x^2$ in Critical Value Table (Expected Value)		
PTR1	18.123	6	12.59	0.006	/
PTR2	18.040	9	16.92	0.035	/
PTR3	16.687	9	16.92	0.540	X
PTR4	9.744	9	16.92	0.372	X
PTR5	19.578	9	16.92	0.021	/
PTR6	27.186	9	16.92	0.001	/
PTR7	11.125	9	16.92	0.267	X
PTR8	19.461	6	12.59	0.003	/
PTR9	37.823	9	16.92	0.000	/
PTR10	23.780	6	12.59	0.001	/
PTR11	16.583	6	12.59	0.011	/
PTR12	26.760	9	16.92	0.002	/
PTR13	13.574	6	12.59	0.035	/
PTR14	20.105	9	16.92	0.017	/
PTR15	11.606	9	16.92	0.236	X
PTR16	12.912	9	16.92	0.167	X
PTR17	12.582	9	16.92	0.182	X
PTR18	13.797	9	16.92	0.130	X
PTR19	12.897	9	16.92	0.167	X

According to Table 5, eleven (11) out of nineteen (19) PT ridership attribute relationships are considered significant, while the remaining eight (8) are considered null. The PT ridership relationship attribute that established a significant relationship with the respondents' understanding of PT ridership were coded as PTR1, PTR2, PTR5, PTR6, PTR8, PTR9, PTR10, PTR11, PTR12,

PTR13, and PTR14. It can be concluded that both variables tested using the chi-square test of independence have equal numbers of significant findings, which are eleven (11) out of nineteen (19) attribute relationships. Table 6 shows the relationship between two (2) variables, namely (1) TOD attributes to enhance PT ridership and (2) a significant understanding of TOD and PT ridership. The highest levels of significant understanding were coded as PTR9, TOD10, TOD13, PTR6, PTR10, TOD2, and TD5. Meanwhile, the average levels of significant understanding were coded as PTR12, PTR8, TOD8, TOD14, PTR1, TOD11, and PTR11. Lastly, the lowest levels of significant understanding were coded as TOD6, PTR14, TOD19, TOD9, PTR5, PTR2, PTR13, and TOD7.

**Table 6:** Relationship Ranking Summary of TOD attribute in Enhancing PT Ridership

Level of Significance	Rank	TOD/PT Ridership Attribute Relationship Code	Chi-square Test			
			Value of $x^2$ (Observe Value)	df	Value of $x^2$ in Critical Value Table (Expected Value)	Value of $p$
High	1	PTR9	37.823	9	16.92	0.000
	2	TOD10	23.394	6	12.59	0.001
	3	TOD13	23.331	6	12.59	0.001
	4	PTR6	27.186	9	16.92	0.001
	5	PTR10	23.78	6	12.59	0.001
	6	TOD2	25.69	9	16.92	0.002
	7	TOD5	25.867	9	16.92	0.002
Average	8	PTR12	26.76	9	16.92	0.002
	9	PTR8	19.461	6	12.59	0.003
	10	TOD8	18.091	6	12.59	0.006
	11	TOD14	23.222	9	16.92	0.006
	12	PTR1	18.123	6	12.59	0.006
	13	TOD11	17.057	6	12.59	0.009
	14	PTR11	16.583	6	12.59	0.011
Low	15	TOD6	20.766	9	16.92	0.014
	16	PTR14	20.105	9	16.92	0.017
	17	TOD19	19.729	9	16.92	0.020
	18	TOD9	19.568	9	16.92	0.021
	19	PTR5	19.578	9	16.92	0.021
	20	PTR2	18.04	9	16.92	0.035

Level of Significance	Rank	TOD/PT Ridership Attribute Relationship Code	Chi-square Test			
			Value of $x^2$ (Observe Value)	df	Value of $x^2$ in Critical Value Table (Expected Value)	Value of $p$
	21	PTR13	13.574	6	12.59	0.035
	22	TOD7	17.147	9	16.92	0.046

## DISCUSSION

To assess the strength of each attribute relationship, the chi-square test of independence was tested in Tables 5 and 6 using the relationship between TOD and PT ridership to identify whether the data established a significant relationship. The results showed that twenty-two (22) relationship attributes created a significant result and were ranked in Table 4 as having high, average, and low levels of significant understanding. Further discussion on each significant relationship attribute is illustrated as follows.

According to the research, PTR9, which focuses on bikeability and signage, ranked the highest for every relationship attribute. This means that the respondents understood the importance of bikeable features and availability of signage in complementing public transportation (PT) ridership, thus improving passenger satisfaction. This finding is consistent with a study by Shelat et al. (2018), which emphasizes the need to focus on ridership growth through the combination of bicycle and transit modes. The research also showed that TOD10, which focuses on pedestrian-friendly developments and safety of PT services, was ranked as the second highest relationship attribute, indicating a high level of significance between pedestrian-friendly developments and the safety of PT services. This finding aligns with a study by Bossard et al. (2002), which highlights the importance of having walkways that connect various hubs to increase public transportation ridership. PTR12, which focuses on car ownership and information provision, and PTR8, which focuses on walkability and convenience, had a high average significance level. This suggests that respondents understood that reducing car ownership through adequate information provision on PT services would increase PT ridership. This finding is consistent with a study by Latif et al. (2016), which emphasizes the importance of reducing car ownership and changing public perception towards public transportation. PTR8, which focuses on walkability and convenience, had an average level of significant understanding, indicating that respondents moderately recognized the significance of understanding this relationship and its attribute to increase overall PT ridership. This finding aligns with a study by

Redman et al. (2013), which highlights the importance of ease of utilizing public services in increasing PT ridership. Finally, TOD6, which focuses on job opportunity and price, had a low level of significant understanding. The research indicates a weak relationship between TOD and increased job opportunities, but adjusting fare pricing for PT services may encourage higher passenger volume. This finding aligns with a study by Zimbabwe and Anderson (2011), which emphasizes the role of TOD in improving employment opportunities and driving innovation. Similarly, PTR14, which focuses on convenience and reliability, also showed a low level of significant understanding. This finding indicates that PT ridership leads to convenient travel and higher reliability on PT services, but with low significant results. This finding is consistent with a study by Gomez et al. (2019), which highlights the role of convenience and safety in increasing public transportation ridership.

## **CONCLUSION**

In conclusion, this study identified the attributes of TOD and explored the significance of the relationship understanding between TOD attributes towards public transportation ridership. The results showed that eleven (11) TOD attribute relationships and eleven (11) PT ridership attribute relationships were significant, while the remaining relationships were considered null. More than half of the findings were considered significant, indicating that TOD attributes to enhance PT ridership and a significant understanding of TOD and PT ridership were indeed related. This advocates the symbiotic relationship between well-designed transit-oriented communities and increased ridership as catalysts for creating transit-friendly environments that can attract and retain public transportation users. As cities grapple with the complex challenges of the 21st century, adopting TOD is a pivotal strategy for fostering liveable, resilient, and environmentally conscious urban spaces. The lessons learned from successful TOD implementations serve as valuable guideposts for future urban planning endeavours, hence reinforcing the importance of prioritising public transportation as a cornerstone of sustainable urban development. By embracing the principles of TOD, cities can enhance public transportation ridership and pave the way for a more interconnected, equitable, and vibrant urban future.

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## **THE FACTORS INFLUENCING THE SUCCESS OF BOUTIQUE HOTELS IN KLANG VALLEY, MALAYSIA**

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### **Abstract**

Boutique hotels, despite not matching the service level of 5-star counterparts, remain a flourishing presence in the hospitality industry, drawing a substantial influx of visitors. This study is dedicated to dissecting the contributory impact factors driving the triumph of boutique hotels in Malaysia. Delving into seven primary dimensions, these are further elaborated into a comprehensive framework of 28 sub-factors. Collated through a 210-strong questionnaire survey, the data collection was centred on patrons of boutique hotels situated in Malaysia's Klang Valley region. Employing inferential analysis techniques, the research probes the significance of these factors in shaping the fortunes of boutique hotels in the Malaysian context. The dataset underwent Chi-Square analysis to ascertain the noteworthy significance attached to each sub-factor. Notably, findings underscore that among the 28 scrutinised sub-factors, a notable set of 17 sub-factors establish a substantial correlation with visitor preferences, exerting a pivotal role in the overarching triumph of boutique hotels within Malaysia.

**Keywords:** Impact factors, Success, Boutique hotels, Visitor preference

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## **INTRODUCTION**

The success of a hotel's operations is generally determined by the number of guests who opt to stay in its rooms (Arifin et al, 2018). Generally, boutique hotels possess specific property characteristics, offering a relatively small number of room units while providing a moderate level of amenities akin to those found in 5-star hotels.

The absence of facilities and services comparable to those of 5-star hotels has been perceived as a drawback potentially challenging the sustainability of boutique hotels within the market. Indeed, a significant number of boutique hotels, particularly those situated in central business districts and pre-existing before the pandemic, have ceased their operations. Nevertheless, in specific regions like the Klang Valley, boutique hotels continue to function actively. This observation suggests the presence of specific factors that wield substantial influence over the triumph of boutique hotels in the market, even in the absence of 5-star services. Consequently, this study was undertaken to investigate the primary determinants underpinning the success of boutique hotels in the Klang Valley region.

## **LITERATURE REVIEW**

Boutique hotels fall under the category of small-scale establishments, characterised by independent management that prioritises the surrounding environment (Moraleda et al, 2019; Ahmad, 2017). These hotels are renowned for their elevated levels of design, ambience, and personalised service (Rogerson, 2010). Despite not providing services on par with 5-star hotels, boutique hotels continue to be favoured by visitors due to their gratifying environment. As highlighted by Mohajerani & Miremadi (2012), customer satisfaction hinges upon meeting or surpassing expectations, an essential factor for the hotel's sustainability (Franco et al, 2021). In general, sustainability plays a pivotal role in ensuring the smooth operation of the hotel property for investors (Basrah et al., 2021; Thiele, 2016). The concept of sustainability is reinforced by various property features that effortlessly attract visitors (Del Chiappa et al., 2016; Said et al, 2016, 2017, 2020, 2022). Hence, hotel management must gain a comprehensive understanding of the features that captivate guests and entice them to choose boutique hotels, despite their relative disparity in comparison to luxury establishments.

### **Location**

The location of a hotel has emerged as the primary and pivotal factor in influencing visitors' choice of accommodation (Anhar, 2001). As highlighted by Chick (2014), location remains a crucial element for leisure travellers. Consequently, hotels situated in close proximity to city centres (Yang et al, 2012),

popular attractions, and equipped with excellent facilities and amenities hold a significant appeal for visitors (Ahmad et al, 2017; Yang et al., 2012).

### **Room Rate**

According to Law (2017), price is identified as a crucial factor that impacts customers' decision-making process. Offering a reasonable rental price for hotel rooms within visitors' budgetary constraints has emerged as the primary motivation for selecting hotel accommodations (Mim et al., 2020; Yang et al., 2017). Additionally, providing a room rate that offers value for money also influences customers' inclination to stay at a particular establishment (Rajaguru & Rajesh, 2016).

### **Facilities provided**

Facilities play a crucial and multifaceted role in ensuring hotel sustainability, particularly in delivering exceptional services to guests. Yang et al. (2017) emphasises the significance of tangible elements that customers can visually perceive, physically experience, and interact with in hotel facilities. Moreover, since boutique hotels operate independently, owners have the flexibility to modify furnishings and upgrade facilities according to their discretion. In simpler terms, it is common for boutique hotels to not provide the full range of amenities typically found in standard and conventional hotels.

### **Rooms Condition**

Room condition serves as a primary enticing feature for hotel visitors. While boutique hotels typically offer smaller rooms that may not fully meet all visitor preferences, guests often prioritise other aspects such as wardrobe size, curtain colour, bed comfort, the presence of a desk, the availability of amenities like television and Wi-Fi connection, and the overall cleanliness level (Anastasiia, 2021; Almeida & Pelissari, 2019).

### **Hotel's appearance**

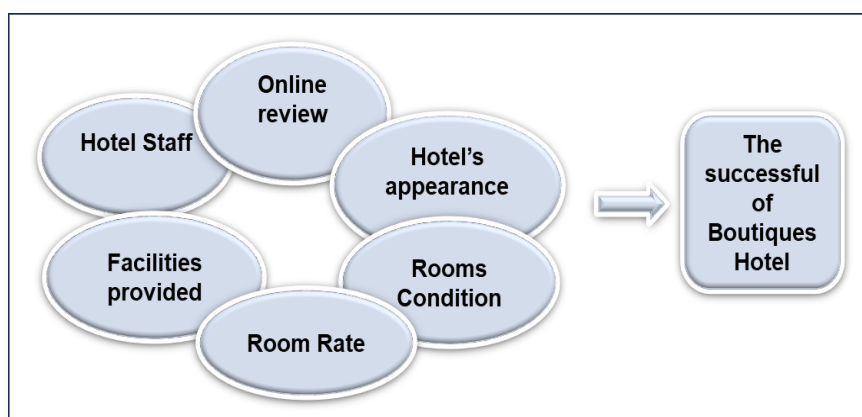
Ahmad et al. (2017) assert that boutique hotels specifically target visitors seeking a distinctive and exceptional experience throughout their stay, which revolves around the unique themes offered by each hotel. Noteworthy attributes of boutique hotels include elegant and one-of-a-kind architecture as well as original interior design, setting them apart from other establishments. Furthermore, the undeniable allure of boutique hotels lies in their aesthetic appeal, with emphasis on artistic elements, distinct interior design, and architectural concepts (Khosravi et al, 2014). These hotels create an ambience characterised by warmth, distinction, intimacy, and style, achieved through thoughtful design and architectural concepts (Ahmad et al., 2017).

### Hotel Staff

Personalised service plays a vital role in fostering customer appreciation, satisfaction, and loyalty (Zhang, 2018; Osunsanmi et al, 2020). As highlighted by Jonathan & Oct (2018), the recruitment of suitable and competent employees significantly enhances the quality of service offered to visitors, setting boutique hotels apart from their competitors. Establishing a positive rapport between hotel staff and guests is of utmost importance (Khosravi et al., 2014). When the right individuals are employed, with a shared vision for the hotel's operations and an entrepreneurial mindset, the service quality provided to guests is more likely to excel, thereby showcasing the distinctive level of service offered by boutique hotels (Jonathan & Oct, 2018). Thus, it is crucial to carefully select and hire personnel who contribute to the hotel's unique identity and operational ethos.

### Online review

Previous research has demonstrated the significant impact of online reviews on the decision-making process of hotel visitors (Chan et al., 2021). Furthermore, customers now have easy access to essential information such as service quality, reputation, star ratings, cleanliness, comfort, and security, enabling them to make informed decisions when selecting their preferred hotel accommodations (Kouzmal et al, 2020). Prospective visitors often rely on the perceptions and feedback shared by previous guests to evaluate the performance of a hotel (Lai, 2019). Additionally, both star ratings and online reviews hold sway over potential visitors, influencing their decision-making process. Based on the aforementioned discussion, it is evident that these seven factors play a crucial role in the success of boutique hotel operations in Malaysia. Consequently, a further in-depth investigation has been conducted to identify which factors hold the highest level of significance in the context of boutique hotels.



**Figure 1:** The Potential Impact Factors for the Success of Boutique Hotels in Malaysia

## RESEARCH METHODOLOGY

This research study employs a quantitative approach, utilising a questionnaire to gather data. A total of 210 respondents, selected through stratified random sampling, were surveyed from 14 trendy boutique hotels located in the Klang Valley area. The research instrument focuses on seven main factors, namely Location, Room Rate, Provided Facilities, Room Condition, Hotel Uniqueness, Hotel Staff, and Online Reviews by previous customers. These factors are further expanded into 28 sub-factors, highlighting their potential significance in determining the sustainability of boutique hotels in Malaysia. The choice of the Klang Valley as the case study area is attributed to its reputation for housing numerous operational boutique hotels in the industry. To ensure data reliability, a reliability test was conducted on all dependent variables. Data analysis involved the application of Pearson correlation to assess the extent to which these factors contribute to the success of boutique hotels in Malaysia.

## ANALYSIS AND DISCUSSION

Table 1 presents the profile characteristics of the respondents, encompassing five criteria: age, marital status, citizenship status, employment status, and monthly income. The majority of respondents fall within the age range of 25 –44 years old, accounting for over 50% of the total. Of the respondents, 53% are married. Malaysian citizens constitute 90% of the participant pool. In terms of employment status, 53.4% are currently employed, while only 0.5% are retired. Regarding monthly income, 28.1% of respondents earn less than RM2500 per month.

**Table 1:** Respondent Profile

		Male	Female	Overall
Age Group	Below 18	0.0%	1.9%	100%
	18 - 24	10.5%	12.9%	
	25 - 34	9.5%	17.6%	
	35 - 44	17.6%	9.5%	
	45 - 54	11.4%	2.4%	
	Above 54	2.9%	3.8%	
Marital Status	Single	19.5%	21.0%	100%
	Married	30.0%	23.3%	
	Divorced	0.5%	1.4%	
	Rather not to say	1.9%	2.4%	
Nationality	Malaysian	45.2%	44.8%	100%
	Non-Malaysian	6.7%	3.3%	
Occupation Status	Employed	31.0%	22.4%	100%
	Unemployed	0.5%	6.7%	
	Government Officer	1.4%	2.9%	

	Private Officer	0.0%	1.4%	
	Self-Employed	12.9%	4.8%	
	Retired	0.5%	0.0%	
	Student	3.3%	8.1%	
Current monthly income	Less than RM2,500	10.0%	18.0%	100%
	RM 2,500 - RM 5,000	13.8%	11.0%	
	RM 5,001 - RM 7,500	4.8%	2.9%	
	Rather not to say	23.3%	16.2%	
Reason for visitation	Family activities	15.2%	22.9%	100%
	Business activities	21.4%	13.3%	
	Education activities	2.9%	2.9%	
	Visiting friends/ relatives	12.4%	7.6%	
	Alumni activities	0.0%	1.4%	

Table 2 presents the results of the feasibility test conducted on the 28 sub-factors under study. The Cronbach's Alpha value obtained for these sub-factors was 0.89, surpassing the recommended threshold of 0.75. This indicates that all 28 aspects presented to the respondents were comprehensible and suitable for further analysis.

**Table 2:** Reliability Test

Reliability Statistics	
Cronbach's Alpha	N of Items
0.890	28

Table 3 displays that 17 of the 28 sub-factors studied present a significant status with an Asymptotic Significance (2-sided) value of 0.000 to 0.021, which is below 0.05. Seven (7) sub-factors, such as four (4) items from the room rate factor, one (1) item from facilities provided, four (4) items from Room Condition, and eight (8) items from hotel appearance and the hotel staff has significant on visitor visitation which has potential towards the successful of a boutique hotel.

Table 4 displays the 17 significant sub-factors that were further analysed using Pearson Correlation Analysis to determine their respective contributions to the success of boutique hotels in the hospitality industry. The Pearson Chi-Square Values for these sub-factors ranged from 16.535a (Hotel's staff) to 54.774a (Room Rate), reflecting the influence of these factors on visitors' decisions to stay at boutique hotels and the frequency of their choice in accommodation. Among the respondents, the majority (38%) indicated that they stayed at boutique hotels for family vacation purposes, while 36% visited for business-related reasons. Additionally, 20% chose boutique hotels to celebrate and socialize with friends, with only 1% visiting for alumni activities and 5% for

educational purposes. Notably, 47% of the respondents had their first experience staying at boutique hotels, and 36% planned to visit once a year, primarily during school holidays with their families.

**Table 3:** Significance of Sub-factors for Boutique Hotel Sustainability

Main Factors	No	Sub Factors	Asymptotic Significance (2 sided)
<b>Location</b>	1	The hotel is located in popular places	.041
	2	The hotel is close to the town	.156
	3	The hotel is located not far from other facilities	.196
	4	The hotel has easy access from the main road.	.220
<b>Room Rate</b>	5	<b>The room rate per night is a reasonable price</b>	<b>.000</b>
	6	<b>The room rate is within my budget</b>	<b>.000</b>
	7	<b>The room rate is value for my money.</b>	<b>.000</b>
<b>Facilities Provided</b>	8	<b>The hotel provides comfortable and safe facilities</b>	<b>.000</b>
	9	The hotel provides access to WI-FI internet	.130
	10	<b>The hotel provides a restaurant/ cafe</b>	<b>.000</b>
	11	The hotel provides a spacious number of car parking	.163
<b>Rooms Condition</b>	12	<b>Small and cosy place.</b>	<b>.005</b>
	13	<b>The room has offer various types</b>	<b>.019</b>
	14	<b>The room has been completed with good facilities.</b>	<b>.009</b>
	15	The room is in clean condition	.170
	16	<b>The room has equipped with good furniture</b>	<b>.004</b>
<b>Hotel's Appearance</b>	17	<b>The hotel has presented a good interior design</b>	<b>.017</b>
	18	<b>The hotel has presented nice decorations</b>	<b>.021</b>
	19	<b>The hotel has been painted with nice colour</b>	<b>.009</b>
	20	<b>The hotel has presented a nice theme.</b>	<b>.002</b>
<b>Hotel's Staff</b>	21	<b>The hotel provides an excellent personalized service</b>	<b>.011</b>
	22	<b>The hotel's staff are polite and</b>	<b>.000</b>

Main Factors	No	Sub Factors	Asymptotic Significance (2 sided)
	23	friendly	
	24	The hotel's staff are helpful	.000
		The hotel's staff responded promptly	.001
Online Review	25	The hotel had a good reputation	.913
	26	The hotel indicates a high rating star	.741
	27	The hotel presents pleasant accommodation	.109
	28	The feedback on the comfort stays of the hotel	.880

**Table 4:** Pearson Correlation Values for Sub-factors of Boutique Hotel Sustainability

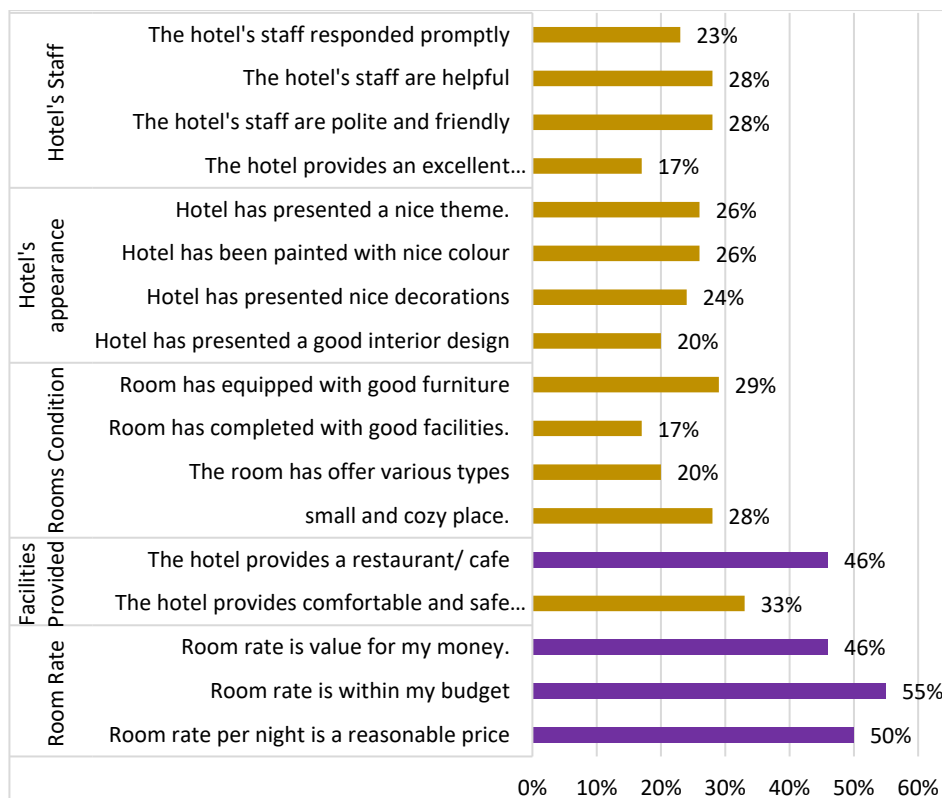
Main Factors	No	Sub Factors	Pearson Chi-Square Value
Room Rate	5	The room rate per night is a reasonable price	49.964 <sup>a</sup>
	6	The room rate is within my budget	54.774 <sup>a</sup>
	7	The room rate is value for my money.	45.719 <sup>a</sup>
Facilities Provided	8	The hotel provides comfortable and safe facilities	32.909 <sup>a</sup>
	10	The hotel provides a restaurant/ cafe	45.962 <sup>a</sup>
Rooms Condition	12	Small and cosy place.	28.455 <sup>a</sup>
	13	The room has offer various types	19.794 <sup>a</sup>
	14	The room has been completed with good facilities.	17.214 <sup>a</sup>
	16	The room has equipped with good furniture	29.274 <sup>a</sup>
Hotel's appearance	17	The hotel has presented a good interior design	20.106 <sup>a</sup>
	18	The hotel has presented nice decorations	23.917 <sup>a</sup>
	19	The hotel has been painted with nice colour	26.383 <sup>a</sup>
	20	The hotel has presented a nice theme.	25.750 <sup>a</sup>
Hotel's Staff	21	The hotel provides an excellent personalised service	16.535 <sup>a</sup>



Main Factors	Sub Factors	Pearson Chi-Square Value
	22 The hotel staff are polite and friendly	27.603 <sup>a</sup>
	23 The hotel staff are helpful	27.737 <sup>a</sup>
	24 The hotel staff responded promptly	22.615 <sup>a</sup>

Figure 2 illustrates the contribution rates of each studied aspect to the survival of Boutique Hotels within the hospitality industry. Among the seven factors examined, the room rate emerges as a crucial determinant in visitors' choice of these hotels. The three sub-factors analysed within this category demonstrate the highest percentage scores, ranging from 46% to 50%, indicating the importance of offering appropriate rental prices that align with visitors' budgets.

On the other hand, the remaining aspects, particularly those associated with hotel staff, hotel ambience, room conditions, and provided facilities, receive moderate scores ranging from 23% to 28%. Surprisingly, personalised service and superior facilities do not significantly contribute to visitors' preferences. However, the price factor, reflecting affordability for visitors, remains a crucial aspect that boutique hotels must consistently prioritise to retain their status as a preferred choice among hotel guests.

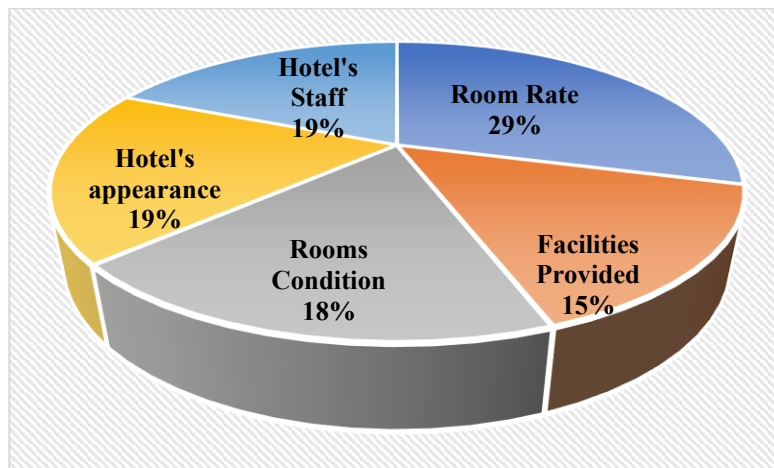


**Figure 2:** Contribution Rate of Subfactors to the Success of Boutique Hotels in Malaysia

Out of the 28 subfactors studied, only 17 were found to be significant in influencing visitors' choices regarding boutique hotels in Malaysia. Similarly, among the 7 main factors examined, only 5 displayed a positive impact on visitors at boutique hotels. These factors include hotel staff, room rate, hotel appearance, room conditions, and provided facilities. Notably, the room rate emerged as the high-impact factor, contributing significantly to the success of boutique hotels in Malaysia, with an impact rate of 29% (Figure 3).

This finding underscores the importance of the room rental rate offered by boutique hotels, as it serves as a key attraction for visitors. A lower rental rate enables customers to extend their stays and fully enjoy their activities, considering that most customers primarily utilise the hotel for overnight stays while engaging in work or other daytime commitments. Figure 2 highlights that a majority of visitors (54.8%) engage in business activities or visit friends, further reinforcing the significance of a reasonable room rate. This finding aligns with previous studies, which emphasise the influence of room rental rates on customers' choices (Law, 2017) and highlight it as a primary factor in visitors'

selection of boutique hotels as their preferred accommodations (Mim et al., 2020; Yang et al., 2017; Rajaguru & Rajesh, 2016).



**Figure 3:** Impact of Main Factors on the Success of Boutique Hotels in Malaysia

## CONCLUSION

In conclusion, the decision to stay in boutique hotels is influenced by a diverse range of factors contingent upon visitors' profiles. Despite not offering the most luxurious facilities, the significantly lower prices compared to upscale hotels are highly satisfying, particularly for middle-income earners. Interestingly, the location aspect, which is typically a priority for visitors, does not hold the same level of importance for boutique hotel guests, as their stays are usually for a specific period of time. If the operator emphasises other aspects such as, hotel's appearance and facility, it needs to be balanced with the rental rate that suits the visitor's preference. Therefore, in order to ensure the continued presence and stability of boutique hotels within the hospitality industry, the aspect of rental rates must be stressed as a crucial role in supporting their sustainability in Malaysia as stated by Mim et al., (2020) and Yang et al., (2017).

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## **HOUSING PURCHASING DECISION (HPD) FOR NEW TOD AREA IN KOTA KINABALU**

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### **Abstract**

Housing preference among urban dwellers in Kota Kinabalu's Transit Oriented Development area is an important issue since housing unit prices are often expensive nowadays. Urban dwellers face a wide range of problems, and as they have evolved into the primary segment of the housing market, they have been continuously confronted with housing decisions based on their preferences. Apart from that, preferences for features of the housing units and developments vary among different groups of urban dwellers based on their demographic profiles. This study aims to identify the most common preferences among urban dwellers that influence their housing purchasing decisions in Transit-Oriented Development (TOD) areas. The data was obtained through a questionnaire survey using a convenience sampling approach. Based on 105 working adult-age respondents, the findings indicated that based on the mean and ranking score, the preference aspect that influenced purchasing decisions the most was the neighbourhood and income factor at a 4.98 mean value.

**Keywords:** Housing Preferences, Housing Purchasing Decision, Transit Oriented Development

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## **INTRODUCTION**

A house is both an essential and fundamental need for individuals, as it holds a crucial role in their lives (Hassan et al., 2021). The process of gathering funds for a down payment often requires extensive and persistent efforts over an extended period. Malaysia has actively participated in various innovative advancements, particularly within the housing industry. Architects, designers, and developers consistently strive to create good quality buildings and designs that not only attract buyers but also offer a more holistic approach to the residential lifestyle.

The housing market in Kota Kinabalu as outlined by Chia et al, (2016) revealed significant gaps between developers' expectations and purchasers' capabilities to own or rent a house. These disparities between house buyers' expectations and attributes provided by developers result in consumer dissatisfaction and adversely affect developers' profit due to suboptimal selling prices. In addition, local housing developers in Sabah have not adequately conducted gap analyses to understand consumers and their actual needs, indicating a focus on developer convenience rather than consumer-centric practices.

In light of these issues, the study aims to determine the main factors contributing to the purchasing decisions of residents living in a Transit-Oriented Development (TOD) area. The outcome of this paper is the identification of the main factor that influences the purchasing decisions of urban dwellers in the study area.

## **LITERATURE REVIEW**

### **Concept of Transit-Oriented Development**

Transit-Oriented Development (TOD) is an advanced urban planning strategy that arranges living, commercial, and recreational spaces within walking distance of public transport. This transformative approach, rapidly gaining popularity, builds compact, pedestrian-friendly neighbourhoods centred around well-designed rail networks. TOD aims to reduce transportation stress, enhance safety, and decrease reliance on cars. It seamlessly integrates regional planning, urban rejuvenation and pedestrian-centric design. Celebrated as an ideal environment for living, working, and leisure, TOD has spurred real estate developers to meet the demand for high-quality urban areas near railways. Beyond immediate needs, TOD offers a practical solution to climate change and energy security by promoting denser, walkable communities that cut down on driving and energy consumption.

### **Principles of Transit-Oriented Development**

TOD is a nuanced urban planning strategy that revolves around several key principles, serving as a foundation for designing neighbourhoods that are not only accessible but also sustainable and vibrant. It is important to note that the

specifics of densities and designs within TOD are contingent upon a multitude of factors, such as location, land use, and the availability of redevelopment property among others. PLANMalaysia (2018), in its dedicated Transit-Oriented Development Guideline, has established four (4) criteria for defining a TOD area; i) the transit serves as an interchange station or transportation hub, ii) the area is designated as a rail transit in an urban or specialised area, iii) the location is free from natural disaster risks or pollution; and, iv) there is existing or planned infrastructure in the area. These principles act as a starting point for the development of specific local plans, involving collaborative efforts with the community to tailor the approach to the unique characteristics of each area. Each principle is briefly defined from previous research as follows:

#### ***Proximity to a Transit Station***

At the heart of TOD lies the principle of proximity to a transit station. Generally, TOD is planned to cover an area within a radius of 400 to 800 meters from a transit station. The 800-meter limit is considered the maximum distance for pedestrians to comfortably walk to a transit station (Abdullah et al, 2022; Khalid & Samsudin, 2023). This emphasis on proximity ensures that residents have easy access to public transportation, promoting the use of transit services.

#### ***Mixed Land Use***

A hallmark of successful TOD is the incorporation of mixed land use. This entails creating neighbourhoods that seamlessly blend residential units, commercial areas, places of employment and public amenities. The intention is to provide residents with the convenience of accessing a variety of services within walking distance, thereby reducing the need to drive to other neighbourhoods. This principle aligns with the idea that a diverse and integrated community fosters a more sustainable and liveable urban environment (Rosni et al, 2018; Ahmad et al, 2022).

#### ***Conduciveness to Transit***

The success of TOD is intricately linked to its ability to provide an environment conducive to transit usage. This involves not only the provision of efficient transit facilities but also the creation of an appealing atmosphere (Sabri et al, 2013). TOD achieves this by incorporating attractive landscaping, covered walkways, cycling paths, safety measures, and security features. By making the transit experience comfortable and pleasant, TOD endeavours to eliminate monotony for pedestrians and cyclists, ultimately encouraging more people to opt for transit services (Abdullah et al, 2022; Khalid & Samsudin, 2023).



### ***Pedestrian and Cyclist Friendly***

TOD is intentionally designed to be pedestrian and cyclist-friendly. The layout and infrastructure are developed to prioritise the convenience of those on foot or bicycles. This deliberate design choice aims to make walking or cycling to transit stations the preferred alternative to driving. The emphasis on pedestrian and cyclist infrastructure not only aligns with the principles of sustainability but also contributes to the overall health and well-being of the community (Ahmad et al, 2022).

### ***Integrated Transportation Hub***

Integral to the functionality of TOD is the creation of an integrated transportation hub. This involves co-locating terminals for all major transportation modes and ensuring seamless transfers between these different modes. Khalid & Samsudin (2023) explained that the integration of transportation facilities facilitates efficient connectivity, making it easier for residents to transition between various modes of transportation within the same vicinity.

### **Factors contributing to Housing Purchasing Decision (HPD)**

Housing Purchase Decision (HPD) can be explained as the buyer's comprehension of the reasons behind buying residential properties and their assessment of pertinent factors before making the decision (Syukor, 2021). Implicitly, deciding to purchase a residential property is tantamount to deciding to buy a house, provided that the chosen dwelling aligns with the buyer's needs and preferences. Hassan et al (2021) described housing preferences as an individual's evaluation of the essential characteristics to consider when searching for a home. Typically, an individual considers purchasing a home only after confirming that it satisfies criteria that are deemed crucial and align with their requirements.

### ***Housing Location***

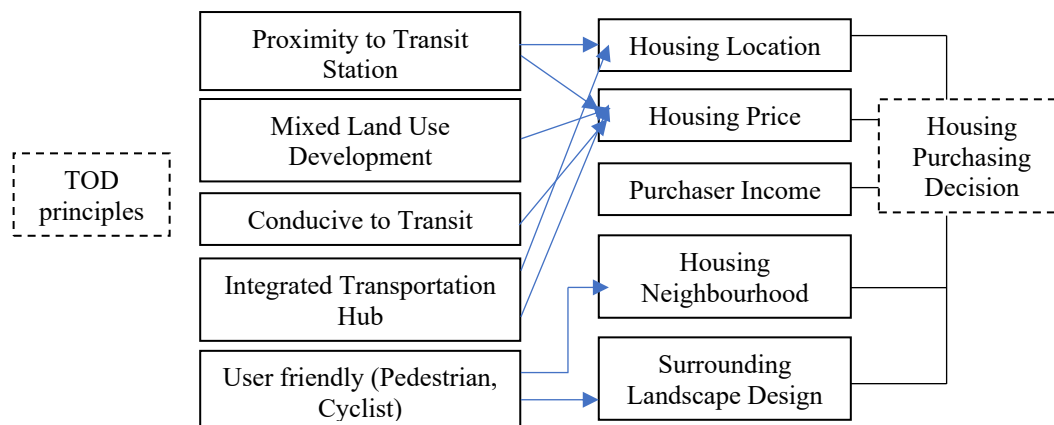
The location of a residential area stands as a crucial factor influencing housing purchasing decisions among homebuyers. The property's location is a pivotal factor as it carries long-term financial implications for the homebuyers (Thanaraju et al, 2019). Potential buyers reconsider their residential location when there is a misalignment between their housing consumption and needs. Dissatisfaction with both the residential unit and neighbourhood plays a significant role in shaping residential mobility intentions, reflecting individual housing preferences (Hassan et al, 2021). Individuals generally choose specific locations based on the presence of transit networks and a mix of land use, (Rosni et al, 2018) which shapes other important factors such as the living environment, as well as the availability and accessibility of services.

### ***Financial Capability***

In terms of housing prices, values are influenced by locational factors. A property in a suburban area tends to be priced lower than one in an urban area as a suburban development usually implies greater distance from schools, shops, malls and public transport (Sabri et al, 2013). House prices are closely linked to income as buyers allocate a large portion of their earnings to housing costs. The affordability of a house depends on income, debt-to-income ratio, and interest rates (Chia et al, 2016). Higher incomes enable the purchase of more expensive homes, while lower incomes limit buying power. Real estate markets consider median incomes and economic conditions in determining housing values and pricing.

### ***Housing Neighbourhood***

The neighbourhood significantly influences homebuyer decisions and is an important aspect in determining preferences, impacting housing prices and market trends. Quality neighbourhoods, emphasizing safety, comfort and cleanliness, are crucial in contemporary development layouts. Concepts like Safe City, Walkable City, and Green City have shaped residential areas, aligning with market demands (Rosni et al, 2018; Abdullah et al, 2022). Perry's Neighbourhood model emphasizes low-density planning with amenities catering to 5000-6000 people. Homebuyers value specific attributes, including safety, diverse access, delinquency protection, lower density, improved recreation access, and an appealing appearance (Din et al, 2023). Additionally, the rising preference for green spaces and urban parks is driven by their positive impact on community well-being and the local climate. Thus, parks and open spaces are crucial selling points for developers, serving as a tool to attract potential buyers. Significant investments in both softscape and hardscape elements in residential construction can elevate property value, leading to a higher selling price (Chai et al, 2023). Figure 1 shows the theoretical framework which highlights the TOD principles and factors influencing housing purchasing decisions.



**Figure 1: Theoretical Framework of TOD Principles and Factors Influencing Housing Purchasing Decision.**

*Source: Adapted from previous studies in related topics.*

## RESEARCH METHODOLOGY

### *Study Area*

The rationale for choosing the Aeropod site is rooted in its status as the inaugural Transit Oriented Development (TOD) area in Kota Kinabalu, Sabah. It stands out as the largest integrated development in the city spanning over 60 acres. Located 5 kilometers from the heart of Kota Kinabalu, and close to the airport, the Aeropod concept envisions the creation of Kota Kinabalu's integrated linear city, incorporating elements such as a retail mall, boutique retail offices, Small Office Versatile Offices (SOVOs), residential suites, high rise apartments, green parks, and recreational amenities. Since it was launched in 2020, the area has offered more living spaces in the form of SOVO service apartment types with a price range of RM350,000 to RM900,000. In addition, Kota Kinabalu holds the position of the second-lowest scoring city in the country according to the Malaysian Urban-Rural National Indicators Network (MURNInets) on Sustainable Development Happiness Index study in 2021. The selection of the site is motivated by the unique environment in Sabah and aims to investigate the preferences of urban dwellers in response to the novel setting focusing on housing preferences in the TOD area.

### *Method*

As this study focused on quantitative methods, a questionnaire survey was carried out among urban dwellers living in the Aeropod apartments in Kota Kinabalu. The design of a research method was formed following the research topic and objectives. This selection was made to provide better insight into the housing preference trends among city residents, consider the factors influencing these

preferences and identify how these factors affect the purchasing decision for their houses. The study used a quantitative approach with a structured questionnaire form using a convenience sampling method. It was conducted between September 2022 and October 2022, taking 5 weeks to complete. This research is limited to urban residents within the TOD area, restricting the sample size and respondents to this specific group. Descriptive analysis was performed in the form of mean rank and total average mean whilst Cross-tabulation analysis was used to show the relationship between chosen variables based on the scope of the study. A ranking score was applied which highlighted the five (5) factors derived from Table 2 using Radar values (which were generated manually from Excel) as an outcome of the study.

## **ANALYSIS AND DISCUSSION**

Table 1 shows the cross-tabulation analysis on demographic profiles including; i) income-housing ownership, ii) marital status-number of household, iii) income –profession and, iv) housing ownership – perception of difficulty in securing housing loan. The table shows that most of the respondents in the B40 income group were renters compared to those in the M40 income group, as respondents in the M40 group mostly owned the house. This finding is supported by Chia et al (2016) who claimed that those with strong income stability can buy properties that they prefer. In terms of marital status, most respondents had less than 3 household members, specifically married couples without children. Additionally, most respondents were from the M40 income group working in the government sector, followed by those working in private companies. This finding can be further supported by their perception of the difficulty of securing housing loans and their ownership status. Most respondents who rented their housing units stated that they had been renting instead of buying the unit due to their weak financial eligibility criteria that prevented them from applying for a loan. This finding is supported by Chai et al (2023) who claimed that income stability is an important aspect of housing purchasing decisions.

**Table 1:** Cross-tabulation Analysis on Demographic Profile of Residents

<b>Income</b>				
<b>Housing Ownership</b>	B40	M40	T20	<b>Total (N)</b>
Owner	9	28	0	37
Renter	41	27	0	68
<b>Total (N)</b>	50	55	0	105
<b>Marital Status</b>				
<b>No. of Household</b>	Single	Married	Divorced	<b>Total (N)</b>
1	39	0	0	39
2	29	33	0	62
3	0	2	0	2
4	0	2	0	2
<b>Total (N)</b>	68	37	0	105
<b>Income</b>				
<b>Profession</b>	B40	M40	T20	<b>Total (N)</b>
Government	20	32	0	52
Private Company	1	20	0	21
Government Linked Company	19	3	0	22
Student	10	0	0	10
<b>Total (N)</b>	50	55	0	105
<b>Difficult to secure housing loan</b>				
<b>Housing Ownership</b>	Agree	Moderate	Disagree	<b>Total (N)</b>
Owner	10	25	2	37
Renter	68	0	0	68
<b>Total (N)</b>	78	25	2	105

Meanwhile, Table 2 indicates the factors contributing to the purchasing decisions of residents living in the Aeropod area. The five (5) factors of focus in the study are price, income, location, neighbourhood and landscape design.

**Table 2:** Factors Contributing to Purchasing Decisions by Residents

<b>Preference Aspects that influence Purchasing Decision</b>	<b>N</b>	<b>Mean</b>	<b>Rank</b>	<b>Total Average Mean</b>
<b>Price</b>				
Price suitability with household income in the TOD area		1.37	5	
The preferred price for affordable housing in TOD		4.91	4	
Price suitability with the housing type offered	105	4.96	2	4.24
Availability of affordability initiatives, programme, and schemes		4.96	2	
Availability of housing choice		4.98	1	
<b>Income</b>				
Monthly high expenditure affected housing preference	105	4.99	1	

<b>Preference Aspects that influence Purchasing Decision</b>	<b>N</b>	<b>Mean</b>	<b>Rank</b>	<b>Total Average Mean</b>
The high cost of living affects their income eligibility to afford the housing unit		4.96	2	4.98
<b>Location</b>				
Strategic location within the Central Business District (CBD)		4.99	1	
Strategic location to community facilities		4.97	2	4.39
Strategic location to commercial or shop lots within walking distance	105	4.97	2	
Strategic location in relation to the workplace in the study area		2.63	4	
<b>Neighbourhood</b>				
Conducive neighbourhood with adequate provision of facilities		4.99	1	
Liveable and safe neighbourhood	105	4.98	2	4.98
Good accessibility and connectivity		4.97	3	
<b>Landscape Design</b>				
Pleasant landscaping for physical and mental wellbeing		4.98	1	
Provision of gated and guarded landscape		4.96	2	
Green space for sustainable residential area	105	4.95	3	
Street planting (buffer zone) for safety barrier		4.95	3	4.96

Note: Mean represents as 1-1.99 (Strongly dissatisfied), 2-2.99 (Dissatisfied), 3-3.99 (Moderate), 4-4.99 (Satisfied), 5- Strongly satisfied

### **Price**

The findings indicated that most of the respondents were satisfied with the availability of housing choices provided in the area with a mean value of 4.98. However, findings also showed that they were not satisfied with the price suitability in relation to their income with a mean value of 1.37. The majority of the B40 group with monthly incomes of less than RM4849 were renting rather than owning a house (Table 1). The current housing prices in the housing market are expensive for them and affect their income eligibility to secure a loan.

### **Income**

Most respondents believe that high expenditure will affect their purchasing decision in the area with a mean value of 4.99. This is also related to income eligibility to afford the housing unit, as it is affected by the high cost of living. This finding is supported by Thanaraju et al (2019) who argued that higher living costs significantly affect the decision to purchase a house.

### ***Location***

Proximity to public transportation, as part of the TOD principle, positively influences housing purchasing decisions. Housing in the TOD area tends to be more attractive to those who value easy access to public transit. This can be a key factor in the purchasing decision, especially for individuals who want to minimise their commuting time.

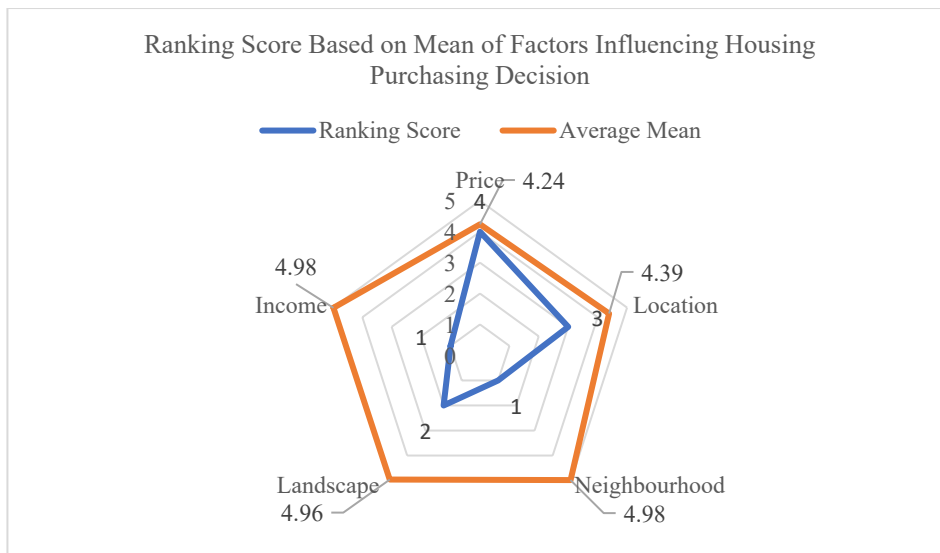
Based on Table 2, most respondents were satisfied that the area is strategically located within the Central Business District (CBD) with a mean value of 4.99. Meanwhile, in terms of its proximity to workplaces, most of them were not satisfied as it was not near their workplace with a mean value of 2.63. This is supported by Sabri et al (2013) and Abdullah et al (2022) in which it is claimed that residents prefer housing with easy access to public transportation and it will reflect on the affordability to own or rent the house.

### ***Neighbourhood***

Most respondents were satisfied with the surrounding neighbourhood, and the conducive neighbourhood with adequate provision of facilities affected their decision to own or rent the house (mean value of 4.99). Other than that, the liveable and safe neighbourhood also affected their purchasing decision to own the house (mean value of 4.98). This finding is supported by Rosni et al (2018) stating that planning for a mixed-use housing development with an inclusive neighbourhood design significantly contributes to providing better living environments for the residents.

### ***Landscape Design***

User-friendly landscaping design also influences housing purchasing decisions. TOD areas are often designed to be pedestrian-friendly with amenities within walking distance. This can be appealing to dwellers based on the convenience of having daily necessities nearby which consequently can influence housing purchase decisions. Based on the findings, respondents were satisfied with the pleasant landscaping for physical and mental well-being with a mean value of 4.98. This is supported by Din et al (2023), noting that appreciation of nature, through the provision of green living environments, may impact the quality of life of the residents. Figure 2 shows ranking scores based on the mean of each factor that influences housing purchasing decisions in Aeropod, Kota Kinabalu to summarise the findings. It showed that among the five (5) factors, income and neighbourhood factor was ranked 1<sup>st</sup> with a total average mean of 4.98 respectively. This is followed by landscape design with a total average mean of 4.96 (rank 2). Meanwhile location factor was ranked 3<sup>rd</sup> with a total average mean of 4.39 and the lowest rank score was the price factor with a recorded total average mean of 4.24.



**Figure 2:** Ranking Score Based on Mean of Each Factor Influencing Housing Purchasing Decision in Aeropod, Kota Kinabalu

## CONCLUSION

This study has determined the factors of housing purchasing decisions among urban dwellers in the TOD area in Kota Kinabalu. The primary determinant of residential ownership among inhabitants is their income, with salary emerging as the foremost factor influencing housing choices. This is closely followed by considerations such as the location, price, neighbourhood attributes, and design of the surrounding landscape. Notably, the focal point of attention in Aeropod is not solely the residential offerings but also the reconstruction of the Tanjung Ara railway station, which locals speculate is designed to accommodate a future MRT or monorail system in the area. Adhering to the recommended guideline that housing expenses should not exceed 30 percent of the buyer's salary, a minimum monthly income of RM4510 would be required to afford a unit in the project.

The findings of this study have the potential to stimulate broader discussion and analyses, particularly among developers on meeting the needs and preferences of potential house buyers in TOD areas. The ensuing debate is expected to be highly beneficial, extending its relevance to scholars engaged in similar fields of study. The insights derived from this analysis could prove invaluable to researchers and policymakers grappling with the scarcity of research on crucial factors and perspectives in the realm of housing in TOD areas.

In the context of Kota Kinabalu within the TOD area, where limited research has been conducted on these significant factors, the study emerges as a valuable resource. The dearth of comprehensive exploration in these areas underscores the potential usefulness of the study's findings for a wide array of



researchers and policymakers. Moreover, the understanding gained from the study regarding housing preferences could significantly contribute to the improvement of government campaigns and programmes targeted to different demographic groups. The significance of this study is to serve as a guideline for urban planners, developers and contractors to gain a better understanding of the actual housing needs of urban dwellers in the Kota Kinabalu market.

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## **IS COMMUNITY PARTICIPATION IN URBAN PLANNING IN ISKANDAR MALAYSIA EFFECTIVE ENOUGH? A QUALITATIVE EXPLORATION**

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### **Abstract**

This study aimed to evaluate the effectiveness of community participation in planning and operational decision-making in Iskandar Malaysia. The Iskandar Malaysia region consists of four local planning authorities who are responsible for planning and managing the spatial development in the region. Conceptually, effective community participation helps the local planning authority to make better decisions, hence, providing a sustainable and quality living environment. The study employed in-depth interviews to gather insights into the phenomenon from various key actors to address the questions. Following the 31 interviews performed, it is suggested that the effectiveness of community participation; and the incorporation of community interest in Iskandar Malaysia are substantially influenced by functional variables such as collaboration between stakeholders, community access to information and process, and intergovernmental relationships in planning. Structural and cultural variables include the skill and professionalism of public planners, the capability to influence, public awareness and knowledge, and community representation.

**Keywords:** community participation, urban planning, Iskandar Malaysia, qualitative research

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## **INTRODUCTION**

Community participation in urban planning provides a clear description of the decision-making process based on public preferences, leading to better decisions by incorporating the community's experiential knowledge into the process (Innes & Booher, 2004). Community participation is fundamental in achieving the agenda of sustainable development as it helps the government, as a decision-maker, to understand the community preferences, and thus make a better decision (Innes & Booher, 2004). Urbanisation has resulted in fast population growth and spatial development in the main urban territories, including Iskandar Malaysia (IM). As a result, it has instigated challenges to the local authorities in the metropolitan region to govern their local areas.

The local authorities in Johor Bahru and Kulai face a daunting challenge to govern urban development, together with providing effective community participation in the process (Ahmad *et al.*, 2013). Subsequently, the study anticipates addressing the questions, "To what extent do the current participatory platforms in Iskandar Malaysia offer a genuine opportunity to the community to effectively participate in both the development plan-making and development control?" and "What constitutes the effectiveness of community participation and the incorporation of community interest in the planning and operational decisions?"

In-depth interviews (IDI) and thematic analysis have been employed to collect and analyse the qualitative data. A total of 31 IDIs are conducted involving key informants, namely, local public planners, private developers' representatives, and community representatives. This paper aims to evaluate the effectiveness of current community participation in urban planning in Iskandar Malaysia. This study concludes that the improvement of the functional dimension of the participation process in urban planning in Iskandar Malaysia will potentially enhance the capability of the community to participate effectively, henceforth, incorporating their interest in the development plan-making and planning permission processes.

## **COMMUNITY PARTICIPATION IN URBAN PLANNING IN PENINSULAR MALAYSIA**

Urban planning in Peninsular Malaysia (excluding Kuala Lumpur) is guided by the Town and Country Planning Act 1976 (TCPA 1976) as the main legislative instrument (Ahmad *et al.*, 2013). Urban planning in Peninsular Malaysia is based on the relationship between the development plan-making and planning permission processes. According to Section 22 (2) (a) of TCPA 1976, it is obligatory for the local authority, as the local planning authority (LPA), to refer to the gazetted Local Plan (LP) in granting planning permission, ensuring that a proposed development complies with the LP (Town and Country Planning Act 1976). Therefore, this research focuses on evaluating the effectiveness of

community participation in both the development plan-making and planning permission processes.

Community participation in the development plan-making is underlined in several sections of TCPA 1976. The primary platform for community participation in the process is through public publicity, as stated under Sections 9 and 12A, with the former concerning the State Structure Plan (SSP) and the latter concerning the Local Plan (LP).

In addition to participating during the publicity stage, the community is also eligible to participate in decision-making. This is highlighted under Section 10(3)(a) and Section 13, where the former is related to objections made during the publicity of the drafted SSP, and the latter is related to objections made during the drafted LP. Both sections indicate that objectors can justify their concerns in front of the Public Inquiry and Hearing Committee.

Likewise, communities are eligible to participate in the planning permission process, which is the operational decision made by the LPA. According to Section 21(6), in the absence of a local plan, the LPA must inform the adjacent landowner about an application for planning approval. Following the notification by the LPA, the adjacent landowner has the right to object to the application. The applicant and objector are invited to justify their stance in a hearing session (Town and Country Planning Act 1976). Likewise, this research focuses on community participation in development plan-making and planning permission processes in IM. There are five (5) local authorities within IM, namely Majlis Bandaraya Johor Bahru, Majlis Bandaraya Iskandar Puteri, Majlis Bandaraya Pasir Gudang, Majlis Perbandaran Kulai, and Majlis Perbandaran Pontian. However, this research focuses only on the Johor Bahru and Kulai Districts, as they cover a significant portion of IM and experience more development growth compared to Pontian.

## **METHODOLOGY**

### ***Key Informants***

Various key informants have been selected using purposive sampling to gather their perceptions on the current state of community participation in both planning processes- development plan-making and planning permission in IM (**Table 1**). These key informants are selected based on their experiential knowledge of both processes, especially concerning the community's involvement. This is based on the understanding of the notion that the key informant is someone who has vast knowledge of a phenomenon, and thus is able to provide extensive insights into the phenomenon (Zanudin et al., 2022; Edward & Holland, 2013).

**Table 1: Profile of Key Informant**

<b>Profile of Key Informant</b>	<b>N</b>	<b>%</b>
Local Public Planner (Director of the department; Deputy Director; Head of the department; Officer; Assistant officer)	12	39
Private Developer's Representative (Project manager; Assistant manager)	7	22
Community Representative (Chairman; Secretary; Committee member)	12	39
<b>Total</b>	<b>31</b>	<b>100</b>

### **Data Collection**

A total of 31 IDIs are conducted which involve various key informants in order to gather qualitative data concerning the community participation in development plan-making and planning permission processes in IM. The application of IDI for data collection is because the method allows the researcher to gather a greater understanding of a phenomenon by interviewing a small number of respondents with experience and knowledge of a phenomenon (Guest *et al.*, 2006).

Furthermore, the IDIs conducted in the research are semi-structured to instil flexibility and fluidity in the process, especially the ways a question is being put out and answered. The semi-structured interview provides the interviewee more freedom to respond to each question, thus potentially leading to interesting findings (Edward & Holland, 2013). Before each interview, interviewees are briefed on the purpose of the study and assured that their confidentiality is guaranteed. The interviewee's permission for the interview to be recorded is also sought, although one of the respondents has disapproved.

### **Saturation of Data**

Scholars have employed data saturation to determine the sample size for qualitative research (Coenen *et al.*, 2012; Guest *et al.*, 2017; Guest *et al.*, 2006). Data saturation can be defined as when the data collection and analysis do not produce further information. According to several literature, it is suggested that data saturation in a phenomenological study can be achieved between 10 to 12 interviews. Subsequently, the researcher has estimated 12 IDIs for respective key informants (local public planner, private developer's representative and community representative) as the yardstick to reach saturation.

### **Data Analysis**

Thematic analysis has been employed to analyse the qualitative data that have been gathered following a series of IDIs, henceforth identifying several key themes concerning the research question, "To what extent does the current participatory platforms in Iskandar Malaysia offer a genuine opportunity to the community to effectively participate in both the development plan-making and development control?" and "What constitutes the effectiveness of community participation and the incorporation of community interest in the planning and operational decisions?"

### DATA SATURATION AND DEVELOPMENT OF THEMES

Eventually, 12 local public planners, 7 private developers' representatives, and 12 community representatives were interviewed to gather their perceptions about the effectiveness of community participation and the incorporation of community interest in the development plan-making and planning permission processes. The number of interviews (12 IDIs for each category of an actor) performed is predetermined based on the data saturation approach. Only seven out of the 12 private developers' representatives who have been approached have agreed to be interviewed.

Figure 1 displays the themes that emerge throughout the analysis of 12 IDIs with the local public planners in IM. A total of 37 themes have transpired from the 124 codes (statements). By the fourth interview, 94.5% of the themes have emerged. In other words, the saturation of data in this study is achieved in the fourth interview.

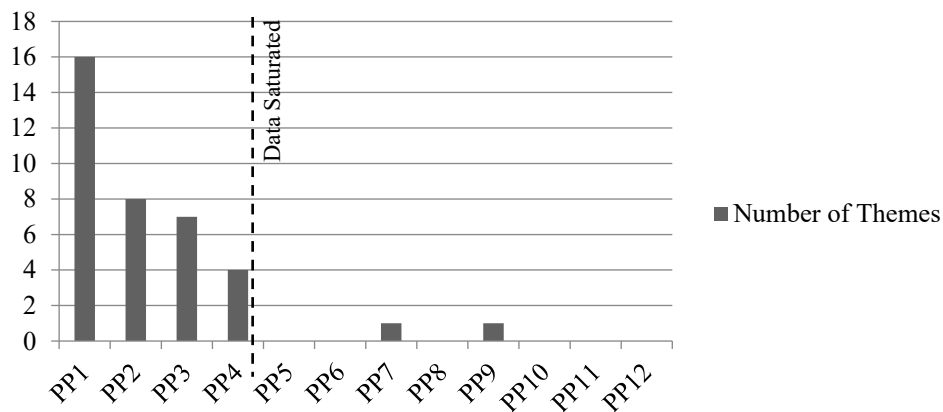
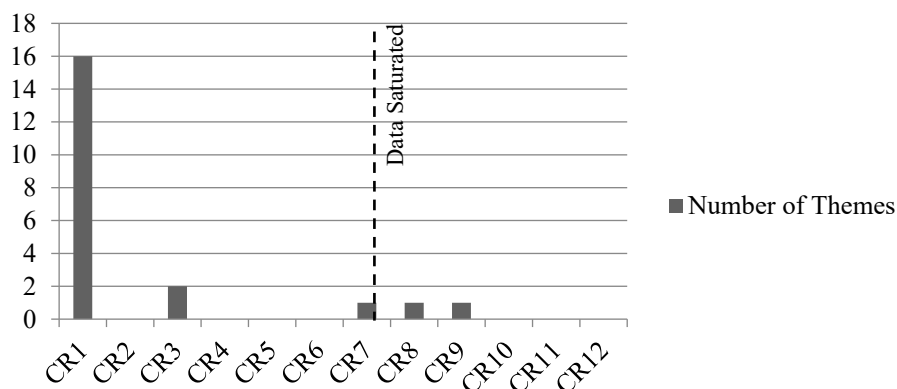


Figure 1: Themes that emerge during the analysis of 12 in-depth interviews with local public planners (PP)

Whereas, from the seven IDIs with the private developers' representatives, a total of 28 themes have transpired from 63 codes (statements) with 92.8% of the themes emerging in the first interview. No new theme emerges after the fourth interview, indicating that 100% data saturation is achieved. This is followed by 39 sub-themes that have been derived from the themes and codes.



**Figure 2:** Themes that emerge during the analysis of 12 in-depth interviews with community representatives (CR)

Meanwhile, **Figure 2** illustrates the themes that emerge following the analysis of 12 IDIs with the community representatives for low-cost apartments around IM. A total of 21 themes have transpired from 53 codes (statements), where 85.7% of the total themes have emerged by the third interview. Saturation is achieved at the seventh interview, with 90% of themes emerging. Thirty-five sub-themes are then derived from the themes and codes.

Following the analyses and data saturation, both themes and sub-themes are organised in tables (**Table 2 – Table 4**) based on three dimensions of the participation process, namely, functional, structural and cultural which is adapted from Mustapha *et al.* (2013) and Tosun (2000). The incidents of themes and sub-themes that have emerged in each interview are then divided into three impact levels which are low impact (1-4 incidents), medium impact (5-8 incidents), and high impact (9-12 incidents). The purpose is to determine which variable significantly impacts the effectiveness of community participation and incorporation of community interest in decision-making.

## RESULTS AND FINDINGS

The results indicate that LPAs in IM tend to use conventional methods within the TCPA 1976 framework for communication and engagement in development plan-making and planning permission. It is also suggested that informing neighbouring communities about planning permission is the responsibility of the local public planner, given the availability of local plans. Furthermore, the results highlight limitations in community knowledge, the technicality of the planning process, and restricted access to public documents, resulting in a lack of participation, particularly from the low-income segment.

The professionalism and judgment of public planners also appear to influence the effectiveness of community participation in development plan-



making and planning permission. The reluctance of public planners to engage continuously with the community, especially the low-income segment, may affect the LPA's ability to incorporate community interests in planning and operational decisions. Nonetheless, both public planners and community representatives agree on the role of local councillors in bridging communication between authorities and communities.

Based on the analysis, both development plan-making and planning permission processes in IM need to consider the technical aspect. The lack of collaboration between stakeholders has potentially resulted in decisions that primarily benefit specific stakeholders.

According to the findings, community participation and the incorporation of community interests in planning and operational decisions are substantially influenced by community access to planning information and processes. LPAs in IM appear to rely on conventional methods for communication and engagement with the community, thus hindering efforts to provide comprehensive information and opportunities for participation to all community segments. Additionally, the community is legislatively excluded from the planning permission process for Johor Bahru and Kulai districts due to the existence of LP.

Moreover, it is implied that community awareness and knowledge of the planning process are associated with property ownership, thus resulting in gaps in participation between community segments. The technicality of planning documents and processes has eventually marginalized the community, especially the low-income segment, from participating in development plan-making and planning permission.

The findings also suggest that effective community participation depends on the skill and attitude of a public planner in handling the process. The public planner should be more thoughtful and go the extra mile in delivering information and implementing the participation process.

As the local councillor has the capacity to influence the decision on planning permission due to their involvement in the One-Stop Centre's committee meetings, the local councillor should regularly share information and engage with their community. Furthermore, there is a possibility that political influence is incorporated into the decision-making following the affiliation between the local councillor and the State Chief Minister. Finally, the incorporation of community interest in planning and operational decision-making in IM is also influenced by the intergovernmental relationship between planning authorities. This is demonstrated by translating the national development strategy into state and local development plans.

**Table 2:** Results of an in-depth interview with the local public planners (PP)

Category	Variable	Theme	Sub-theme	PP1	PP2	PP3	PP4	PP5	PP6	PP7	PP8	PP9	PP10	PP11	PP12	
<b>Functional</b>	Intergovernmental relationship in planning	Translation of development strategy	Top-down approach	•	•	•	•	•	•	•	•	•	•	•	•	
			Top-down & bottom-up approach	•					•							
	Relationship between authorities	In decision-making	Intervention in decision-making		•											
			Technical factor	•	•	•	•	•	•	•	•	•	•	•	•	•
	Coordination & collaboration between stakeholders	Factors considered in making decision	Political factor	•	•	•	•	•	•	•	•	•	•	•	•	•
			Market factor	•												
		Incorporate community interest	Statutory instrument	•	•	•	•	•	•	•	•	•	•	•	•	•
			Through engagement	•	•	•	•	•	•	•	•	•	•	•	•	•
	Collaboration between stakeholders	LPA's initiative	Planning platform	•	•	•	•	•	•	•	•	•	•	•	•	•
			Non-planning platform	•	•	•	•	•	•	•	•	•	•	•	•	•
Access to information		Limited medium	•	•	•	•	•	•	•	•	•	•	•	•	•	
		Role of Community Representative	•													
Access to information & information process	Access to the planning process	Knowledge related access	•	•	•	•	•	•	•	•	•	•	•	•	•	
		Selected location	•													
	The capacity of local authority	Technicality of document	•	•	•	•	•	•	•	•	•	•	•	•	•	
		Administration capacity	•													
<b>Structural</b>	Skill & attitude of a public officer	Financial capacity	•	•	•	•	•	•	•	•	•	•	•	•	•	
		Treatment of community participation	•	•	•	•	•	•	•	•	•	•	•	•	•	
	Public officer professionalism & skill	Development plan-making	•	•	•	•	•	•	•	•	•	•	•	•	•	
		Planning permission	•													
	LPA's perception	Public officer professionalism & skill	•	•	•	•	•	•	•	•	•	•	•	•	•	
		Public planner's initiative	•													
LPA's perception	Participation is time-consuming	•	•	•	•	•	•	•	•	•	•	•	•	•		
	Participation is associated with knowledge.	•														



Category	Variable	Theme	Sub-theme	PP1	PP2	PP3	PP4	PP5	PP6	PP7	PP8	PP9	PP10	PP11	PP12		
	Initiative to improve knowledge and awareness	Cultivate the community	Diversity and constant public engagement	•	•	•	•	•	•	•	•	•	•	•	•		
			Extensive and constant information sharing	•	•	•	•	•	•	•	•	•	•	•	•	•	
			Define the target group	•	•	•	•	•	•	•	•	•	•	•	•	•	•
			Instrument to perform	•	•	•	•	•	•	•	•	•	•	•	•	•	•
			The attitude of local councillor	•	•	•	•	•	•	•	•	•	•	•	•	•	•
			Proficient in the planning procedure	•	•	•	•	•	•	•	•	•	•	•	•	•	•
			Equitable in representation	•	•	•	•	•	•	•	•	•	•	•	•	•	•
			In strategic planning	•	•	•	•	•	•	•	•	•	•	•	•	•	•
			In operational planning	•	•	•	•	•	•	•	•	•	•	•	•	•	•
			As mediator	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Community representation	Role of local councillor	Local councillor background	•	•	•	•	•	•	•	•	•	•	•	•	•		
		An initiative by local councillor	•	•	•	•	•	•	•	•	•	•	•	•	•		
		Facilitate information & process	•	•	•	•	•	•	•	•	•	•	•	•	•		
Residents committee	Role of the residents committee	n/a	•	•	•	•	•	•	•	•	•	•	•	•			
Theme/ Sub-theme that has a high impact	Theme/ Sub-theme that has a high impact but did not address the research question																

Table 3: Results of an in-depth interview with the private developer's representatives (DP)

Category	Variable	Theme	Sub-theme	DP1	DP2	DP3	DP4	DP5	DP6	DP7		
Functional	Intergovernmental relationship in planning & access to information & process	Relationship between authorities	In decision-making	•								
			Information Sharing	Before approval	•	•	•	•	•	•	•	
				After approval	•				•			•
	Coordination & collaboration between stakeholders	Engagement with community	Associate with community interest	•	•	•	•	•	•	•	•	
			Associate with local authority requirement		•	•	•	•	•	•	•	
			Through community representative	•			•	•	•	•	•	
			Willingness to acknowledge	•					•	•	•	
	Functional	Treatment of community engagement	Engagement with community	Reluctant to cooperate		•						
				A balance between market and community interests	•			•	•	•	•	
				Financial factor	•	•	•	•	•	•	•	•
Technical factor						•	•	•	•	•	•	
Social factor				•					•			
Through engagement				•					•		•	
Statutory instruments at the state and local level				•	•	•	•	•	•	•	•	
Skill & attitude of a public officer	Engagement with authority	Incorporating community interest	Planning platform	•	•	•	•	•	•	•		
			Non-planning platform									
			Public officer's professionalism and skill	•	•	•	•	•	•	•	•	
	The efficiency of the appeal board	Role of a private consultant	Did not involve	•	•	•	•	•	•	•	•	
			Involved									
			As mediator	•	•	•	•	•	•	•	•	
	Structural	Influencing capability	Developer's perception	On the planning procedure	•	•	•	•	•	•	•	
				Willingness to engage with the community	•	•	•	•	•	•	•	•
				Towards community	•	•	•	•	•	•	•	•
				Challenge associate to community engagement	•	•	•	•	•	•	•	•
On low-cost housing provision				•	•	•	•	•	•	•	•	
In relation to community				•	•	•	•	•	•	•	•	
In relation to statutory instrument				•	•	•	•	•	•	•	•	
Developer's attitude	Developer's influence	In relation to low-cost housing	•	•	•	•	•	•	•	•		
		n/a	•	•	•	•	•	•	•	•		
Relationship with authority	Relationship with authority	n/a	•	•	•	•	•	•	•	•		
		n/a	•	•	•	•	•	•	•	•		

Category	Variable	Theme	Sub-theme	DP1	DP2	DP3	DP4	DP5	DP6	DP7
		Relationship with local councillor	n/a	•	•	•	•	•	•	•
		Political influence	n/a	•						
	Legislative framework	Planning law and guideline	Current practices	•	•	•	•	•	•	•
	Transparency & accountability	Incorporate transparency	Community involvement in decision-making	•	•	•	•	•	•	•
	Participatory method	Initiative to increase participation	Consultation with community	•	•	•	•	•	•	•
		Awareness & knowledge level	Medium for information sharing	•	•					
			Community knowledge level	•	•	•	•	•	•	•
	Public awareness & knowledge	Initiative to improve knowledge and awareness	Consultation with community	•	•	•	•	•	•	•
		Community Background	n/a	•						
<b>Cultural</b>	Residents committee	The type of issue raised	During planning process	•	•					
			During construction	•						
		Role of local councillor	Mediator between community and local authority	•	•	•	•	•	•	•
	Community representation	Local councillor background	Appointment of local councillor	•						
		Efficiency of local councillor	Attitude of local councillor	•						
		Theme/ Sub-theme that has a high impact	Theme/ Sub-theme that has a high impact but did not address the research question							

**Table 4 Results for in-depth interview with community representative (CR)**

Category	Variable	Theme	Sub-theme	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR8	CR9	CR10	CR11	CR12
	Access to information & process	Access to the planning process	Absence of planning program near the community	•	•	•	•	•	•	•	•	•	•	•	•
		Access to information	Access to planning information	•	•	•	•	•	•	•	•	•	•	•	•
<b>Functional</b>	Coordination & collaboration between stakeholders	Collaboration between stakeholders	The initiative by the residents' committee	•	•	•	•	•	•	•	•	•	•	•	•
	Capacity of local authority	Capacity of local authority	The initiative by the local authority	•	•	•	•	•	•	•	•	•	•	•	•
			n/a												
<b>Structural</b>	Skill & attitude of a public officer	Public officer professionalism & skill	Public officer professionalism	•	•	•	•	•	•	•	•	•	•	•	•
		Efficiency of public officer	Efficiency of public officer	•	•	•	•	•	•	•	•	•	•	•	•
	Influencing capability	Empower the community to influence	Through Association								•				

Category	Variable	Theme	Sub-theme	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR8	CR9	CR10	CR11	CR12	
Participatory method	Initiative to increase participation	Diversify platform for public engagement		•	•	•	•	•	•	•	•	•	•	•	•	
		Promote collaboration		•	•	•	•	•	•	•	•	•	•	•	•	•
	Public awareness & knowledge	Community Background	Low-income segment		•	•	•	•	•	•	•	•	•	•	•	•
		Affitude of community	As community member		•	•	•	•	•	•	•	•	•	•	•	•
		Awareness & knowledge level	Community knowledge level		•	•	•	•	•	•	•	•	•	•	•	•
			Related to interest		•	•	•	•	•	•	•	•	•	•	•	•
			Associate with the psychological factor		•	•	•	•	•	•	•	•	•	•	•	•
			Low level of participation		•	•	•	•	•	•	•	•	•	•	•	•
			Participation increasing		•	•	•	•	•	•	•	•	•	•	•	•
			Extensive and constant information sharing		•	•	•	•	•	•	•	•	•	•	•	•
Cultural	Initiative to improve knowledge and awareness	Stage of information sharing		•	•	•	•	•	•	•	•	•	•	•	•	
		Responsive & accountability		•	•	•	•	•	•	•	•	•	•	•	•	
	Efficiency of residents' committee	Knowledgeable & informative		•	•	•	•	•	•	•	•	•	•	•	•	
		Constant engage		•	•	•	•	•	•	•	•	•	•	•	•	
	The type of issue raised	Better living environment		•	•	•	•	•	•	•	•	•	•	•	•	
		Residents' committee & local councillor		•	•	•	•	•	•	•	•	•	•	•	•	
	The current state of engagement	Residents' committee & local authority		•	•	•	•	•	•	•	•	•	•	•	•	
		To increase participation		•	•	•	•	•	•	•	•	•	•	•	•	
	The initiative of residents' committee	To improve the living environment.		•	•	•	•	•	•	•	•	•	•	•	•	
		To increase engagement with authorities		•	•	•	•	•	•	•	•	•	•	•	•	
Role of residents' committee	Mediator between community & local councillor		•	•	•	•	•	•	•	•	•	•	•	•		
			•	•	•	•	•	•	•	•	•	•	•	•		

Category	Variable	Theme	Sub-theme	CR1	CR2	CR3	CR4	CR5	CR6	CR7	CR8	CR9	CR10	CR11	CR12
			Promote community value			•								•	•
		Initiative by local councillor	Regularly engage with the community	•	•	•	•	•	•	•	•	•	•	•	•
		Role of local councillor	Deliver information to the community	•					•						•
		Community representation	Mediator between community & local authority	•	•	•	•	•	•	•	•	•	•	•	•
			Responsive & constantly engage			•	•	•	•	•	•	•	•		•
		Efficiency of local councillor	Correspondence in representation								•			•	
			Knowledgeable & informative												•
		Theme/ Sub-theme that has a high impact	Theme/ Sub-theme that has a high impact but did not address the research question												



## CONCLUSION

The study anticipates the continuous debate on the effectiveness of community participation in urban planning to instigate community interest in planning and operational decisions. The researcher has derived the factors that constitute the effectiveness of community participation in IM, which is based on the perception of public planners, private developers' representatives, community representatives, and local councillors.

It was recommended that effective community participation and the incorporation of community interest are greatly influenced by functional variables such as the collaboration between stakeholders, the community's access to information and processes, and intergovernmental relationships in planning. These variables are followed by structural and cultural variables, namely, the skill and attitude of public planners, capability to influence, public awareness and knowledge, and community representation.

It is safe to conclude that the improvement of the functional dimension of the participation process will prospectively improve the process's structural and cultural aspects in the long term. This will improve the capability of the community, predominantly the low-income segment, to participate effectively, incorporating their interests in both the planning and operational decisions.

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## **SPATIAL ENVIRONMENTAL IMPACT OF THE LRT3 DEVELOPMENT PROJECT: A PERCEPTION STUDY IN SEKSYEN 7 SHAH ALAM**

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### **Abstract**

This study aimed to examine the perceptions of the local community in Seksyen 7, Shah Alam, regarding the environmental impact of the LRT3 construction project. The objectives were to identify the environmental impact on the community and evaluate the state of environmental pollution in the area. Based on several factors, a questionnaire was selected as the data collection instrument. The LRT3 project's highest percentage of respondents, 66.8%, identified air pollution as a concern, indicating perceived negative impacts on air quality in the vicinity. Approximately 60.6% of respondents attributed increased traffic congestion to the project, suggesting disruptions caused by construction activities and changes in road infrastructure. Furthermore, 51.6% of respondents identified noise pollution as a concern from the LRT3 project, possibly due to construction-related noise and machinery operation. A smaller percentage, 20%, expressed concerns about potential health issues associated with the project, while 19.8% mentioned water pollution. The research highlights the importance of tackling air pollution, traffic congestion, noise pollution, health issues, and water pollution to alleviate the adverse environmental effects. This study's findings have the potential to provide valuable insights for spatial decision-makers involved in the implementation of specific strategies and promoting the overall well-being of the community throughout the construction and operation phases.

**Keywords:** Environment Impact, Construction Project, LRT3, Perception Study

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## **INTRODUCTION**

Spatial environmental impacts can be considered a disturbance to the natural and built environment, which causes adverse effects on the air, land, water, wildlife, and the ecosystem's inhabitants. An environmental impact is pollution, contamination, or damage that occurs due to an action and can have either short-term or long-term consequences (Abdallah, 2017). Biodiversity and healthy ecosystems are essential to human well-being. All of the activities that humans have carried out have impacted ecosystems. Some activities have caused irreversible environmental effects, including environmental pollution, the extinction of animal species, resource depletion, and habitat loss (MAPRE, 2020). The construction industry is a well-known sector that can significantly impact the surrounding environment.

Since the Industrial Revolution, construction activities have drastically altered our environment. Tall skyscrapers tower over our streets; mines delve deep into the earth's crust; valleys are raised to allow dam construction; and slopes are flattened to accommodate housing developments. All these activities have the potential to degrade and pollute the environment. This has also been agreed upon by Ling et al. (2020): a city or town with more industrial and transportation land uses with fewer greens was more polluted than the area with fewer industrial and transportation land uses with more greens. Project managers, environmental health and safety experts, and site managers must understand the environmental implications of construction projects and how these impacts can be mitigated and decreased. Construction is one of the industries that contributes significantly to the growth of the nation's infrastructure and facilities.

This research specifically focuses on the construction area of LRT3, located at Seksyen 7, Shah Alam, as the project's construction process might negatively impact the environment. Rail systems in Malaysia, such as the Light Rail Transit (LRT) system, are used for transporting passengers in urban areas. This system can carry large numbers of people efficiently and forms the backbone of a city's public transportation network. Moreover, public transportation is a government measure to reduce carbon emissions and protect environmental quality, especially in cities. It is agreed by Sultan et al. (2016) that green mobility has emerged as the best approach for promoting sustainable and environmentally friendly transportation in modern cities. However, the construction and operation of the LRT might adversely impact the surrounding physical environment with contaminants such as air pollution, water pollution, vibration, and traffic congestion.

## **LITERATURE REVIEW**

### **Environmental Issues in Railway Construction**

Construction projects are purported to have an increasingly negative influence on the environment. The effects include air pollution and other sorts of pollution,

such as noise, water chemicals, and various others familiar in many construction projects. Furthermore, air pollution problems significantly influence the surrounding ecosystem simply because people are staying in these locations. Air pollution induced by construction activities on building sites or projects can negatively affect living beings regarding their health, and economic and social difficulties.

Furthermore, air pollution issues are severe because increased air pollutant levels from all of these anthropogenic sources are typically found in environments where serious harm to human health and well-being is much more likely to arise in densely populated urban areas such as Klang Valley, Kuala Lumpur, and Shah Alam (Zawawi & Ghani, 2018). The standard practice by contractors is to consider environmental concerns from a business perspective where the concern lies in the protection of construction materials, activities, or resources from environmental harm. This is primarily due to the practice that construction project management work considers just three factors: cost, schedule, and quality. As environmental concerns receive much attention from all groups in society, the historical paradigm is less applicable to the success of future projects (Pandit & Yadav, 2014).

Nevertheless, construction is frequently associated with environmental issues because of the nature of its activities which have both beneficial and harmful effects on the environment. Consequently, this research focuses on the negative environmental implications (Asmawi, 2010) and the issues are as follows:

i. Environment Degradation

Even though construction is essential to the country's physical, economic, and social development, it is also linked to environmental issues such as the increased extraction of raw materials from the environment's resources, the deterioration of water quality, and the degradation of land which is a valuable resource. The building industry impacts a sixth of the world's freshwater, a quarter of its timber harvest, and a quarter of its material and energy flow (Asmawi, 2010). According to the fifth Malaysia Plan (1986-1990), more than 30% of Peninsular Malaysia land has been developed, whereby only 10% of the area is covered with rich, diversified natural forests (Asmawi, 2010).

ii. Environment Stress

The production of dust particles, hazardous substances, and other construction debris exacerbates the environmental impact of building operations. These wastes in the atmosphere are regarded as possible health risks. During construction operations, the vibration on construction sites is a critical environmental stressor that can lead to seismic activity. According to Asmawi (2010), large-scale engineering buildings have impacted the area's ecological environment and

altered its ecological balance. Other factors include increased solar energy received and increased precipitation intensity, which leads to floods (Asmawi, 2010).

### iii. Loss of Habitats

Numerous habitat types have been lost as a result of urbanisation (Liu, Liu, Li, Li, Liu, & Zhao, 2023) which showed that extensive urbanisation significantly affects the environment both directly and indirectly. This is relevant directly through the expansion of newly urbanised land and indirectly through an increase in environmental loads and changes in consumption as more people move into cities. For example, development is reported to cause wetland habitat loss, water quality decline, and sedimentation. Construction in ecologically sensitive locations, such as wetlands, causes a substantial build-up of sediments in the wetland areas and water channels.

### iv. Environmental Pollution

According to data from the World Green Building Council's Bringing Embodied Carbon Upfront, buildings and construction account for 39% of global carbon emissions, of which 28% are attributable to energy use and 11% to construction materials. Buildings use energy mostly when they need to be heated or cooled, particularly if their ventilation and insulation systems are inadequate. The construction process produces embodied carbon at similar levels of construction materials that are manufactured and supplied.

### v. Impacts on Climate Change

Constructing new buildings will add to the carbon (CO<sub>2</sub>) emissions already present (Ahmed, Abdel-Hamid, Abd El-Razik, & El-Dash, 2021). For example, about 50% of the UK's CO<sub>2</sub> emissions come from building use, and another 7% come from construction. The government's estimates of how energy-efficient houses are way too low regarding how much CO<sub>2</sub> could be saved by building more energy-efficient buildings. Most of the CO<sub>2</sub> savings can be made in the thermal performance of the building shell, which is the main base performance criterion for energy-efficient buildings (Asmawi, 2010).

### vi. Waste Problem

Construction waste is a significant issue that when not managed properly, can have negative environmental and health consequences. The problems associated with construction waste include the generation of large volumes of waste, such as soil and concrete, which can be hard to dispose of and can lead to environmental pollution (Napier, 2016). Hazardous waste like chemicals is also produced during construction, posing risks to both human health and the environment if not handled correctly. Proper disposal can be challenging, often

necessitating specialised equipment and facilities; improper disposal can result in environmental pollution and health risks. It is a fact of the matter that the construction industry generates the most waste.

vii. **Impact of Railway Construction**

Among various modes of transportation, rail transport is widely acknowledged as the most energy-efficient and environmentally friendly form of motorised transportation. Compared to other modes of transportation, the growth in the appeal of railways for both passengers and freight can be attributed to the development of trans-European transport networks and the enhancement of interoperability among neighbouring countries, particularly in Europe. Nevertheless, the construction phase's environmental impact is often disregarded, focusing primarily on the operational phase's environmental performance, specifically concerning greenhouse gas (GHG) emissions (Damián, 2022).

**The LRT3 Construction in Malaysia: Current Issue, Challenges and Solutions**

The Shah Alam Line LRT, also called LRT 3, was previously named the Bandar Utama-Klang LRT, Bandar Utama-Johan Setia Line LRT, or Johan Setia Line LRT. It is a light rapid transit (LRT) line designed to accommodate medium capacity and is set to commence operations. The Shah Alam and Klang regions are located in Malaysia's western part of the Klang Valley. The upcoming addition to the Klang Valley region's transport infrastructure will mark the establishment of the third Light Rail Transit (LRT) line and the fourth fully automated and driverless train system in the area. The line operation will be carried out within the framework of the RapidKL system, overseen by Rapid Rail, a subsidiary of Prasarana Malaysia. On April 24, 2013, an announcement was made by Prasarana Malaysia (Contributors, 2023).

The present concern about the LRT3 project in Malaysia pertains to the prospective environmental consequences on the neighbouring communities. Large-scale infrastructure projects, such as the LRT3, can impact the neighbouring communities differently, encompassing both advantageous and detrimental aspects. The community is subject to environmental consequences that arise from various factors, including noise, vibrations, potential land acquisition, and the potential displacement of residents or businesses. The above impacts can have significant social and economic consequences for the affected communities.

The current issues of the projects are noise and vibration impacts, negative social impacts, and changes to the landscape. For noise and vibration impacts, the construction and operation of the LRT3 project in Malaysia are anticipated to result in the impacts. These impacts can arise from various activities associated with the project's construction and operation phases. During

the construction phase, noise and vibration levels can significantly increase due to the utilisation of heavy machinery, construction equipment, and related activities. Moreover, resilient track systems or vibration isolation measures can minimise vibrations transferred to nearby structures (Ismail, 2015). Aside from that, there is no other way to get to this minor route; it can only be reached from the main road, which is frequently congested during peak hours.

## RESEARCH METHODOLOGY

Seksyen 7 in Shah Alam, the study area, is a well-established residential and commercial area (Figure 1). It features a mix of residential properties, commercial establishments, and various amenities. The area will likely have a diverse population, including residents, businesses, and other stakeholders who may be directly or indirectly interested in the LRT3 construction project and its environmental impact. Seksyen 7, as part of the LRT3 construction line, would likely be directly affected by the construction activities. Seksyen 7 Shah Alam was selected as a case study due to its variety of populations. There is a higher number of institutional, commercial, and residential types of respondents. This might provide different and interesting feedback on the environmental impacts caused by the construction phase.

This study employed a quantitative approach to research. Quantitative data can be used to investigate cause-and-effect relationships and create predictions. A more significant, randomly selected sample also increases the likelihood that the quantitative findings may be extrapolated to an entire population or subpopulation (Rahman, 2016). A stratified sampling method was employed to ensure a representative and diverse research sample. The population in Seksyen 7, comprising a mix of landed properties, apartments, and condominiums, encompasses families, working professionals, students, and individuals from different age groups.



Figure 1: Seksyen 7 map and LRT3 line Bandar Utama- Klang (Slainthayer, 2023)



Stratification was done by dividing the population into distinct strata based on relevant characteristics such as residential property types and demographics. From each stratum, a sample size proportional to its representation in the population was randomly selected using methods like simple random sampling or probability proportional to size sampling. This approach ensured that the research sample adequately represented the various segments of the Seksyen 7 community. By incorporating stratified sampling, the study captures the nuanced perspectives and experiences of different strata within Seksyen 7, enhancing the generalizability and depth of the research findings.

## **Data Collection**

### ***Questionnaire***

The questionnaire was chosen as the instrument for data collection due to its ability to be developed in less time, its capacity to collect data from many respondents, its capacity to allow multiple questions about a subject, its extensive flexibility in data analysis, and its cost-effectiveness (USIM, 2023). The questionnaire will include questions such as the age of the respondent, respondent's status, monthly household income, types of premises, satisfaction with the existing neighbourhood, environmental satisfaction, perception of the LRT3 project, awareness of the LRT3 project, issues arising from the LRT3 project, perception of the environmental impact of the LRT3 project, and factors that contribute to the pollution. Data was collected within a month based on the researcher's observations, random interviews, and distributed questionnaire links to the public community using Google Forms. The data collection started in April and ended in May 2023. This study involved communities in Seksyen 7 with residential, commercial, and public institutions. The survey was sent out to the selected sample. The total sample that answered the questionnaire was 804 people.

Besides that, observations at the case study site were carried out to understand the type of pollution that occurred, the factors that cause pollution in the area, and the impact of pollution on the surroundings. The result of the received responses was automatically generated by the Google Forms engine for the questionnaire survey. The result for each question can be easily abstracted from the Google Form website as a list, chart, or graph. The result was also converted into a spreadsheet file, which allowed for more detailed viewing of the results. Hence, the results of the questionnaire were categorised and analysed according to the research questions. A table can be used to explicitly display the result.

## **ANALYSIS AND DISCUSSION**

The study's discussion is focused on three sections based on the questionnaire analysis: the respondents' demographic information analysis, the perception

analysis of environmental impacts, and the residents' awareness analysis of the construction of the LRT3 projects.

### The Demographic Information Analysis of the Respondents

This section examines the demographic information, which includes four (4) categories: age of respondents, employment status of respondents, monthly household income, and types of premises. A descriptive analysis is carried out to demonstrate the frequency and percentage distribution of the demographic information. The percentage and frequency of respondents who participated by age show that the number of respondents aged 18–24 is more significant than others. Figure 2 shows the percentage and frequency of respondents who participated by employment status.

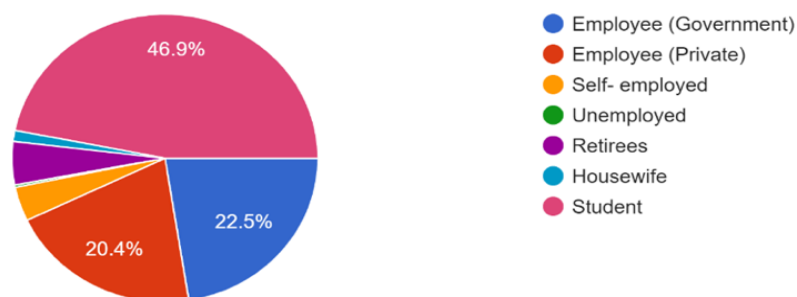
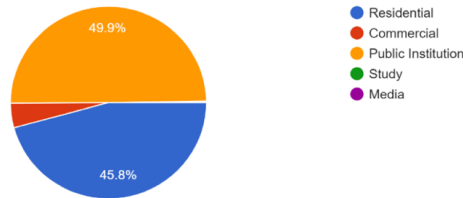


Figure 2: Respondent's employment status

The percentage and frequency of respondents who participated by monthly household income show that the number of respondents with a salary lower than RM2,000 is higher than the others. This proves that in terms of the percentage and frequency of respondents who participated by type of premises, the Seksyen 7 area has many residents from the B40 group. Figure 3 shows that the number of respondents from public institutions is higher than others. The Seksyen 7 area is home to two public institutions, UiTM and Unisel. In addition, many students stay in rented houses around that area; they also contribute to the B40 group.

### The Perception Analysis of Environmental Impacts

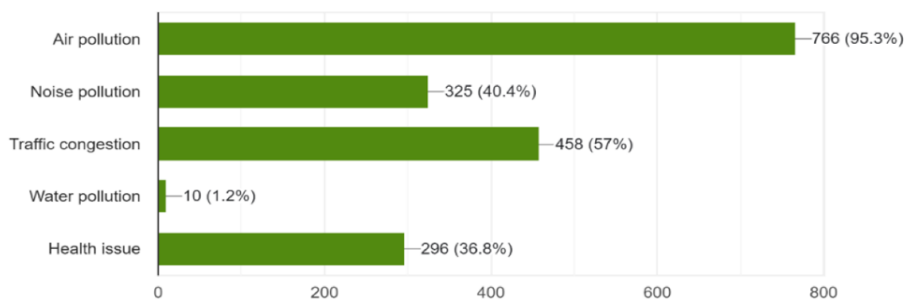
This section is related to the perception study on environmental impacts in Seksyen 7 Shah Alam due to the LRT3 construction project. This section consists of Likert scale questions to obtain data from the respondents.



**Figure 3:** Respondent’s type of premises

To investigate neighbourhood satisfaction further, five factors were used to assess respondents' perceptions of the extent of the environment in their neighbourhood. These five factors are typically associated with significant urban road or rail development, particularly during the construction phase. Based on the provided data on current environmental issues in Seksyen 7, Shah Alam, the respondents' voting distribution is shown in Figure 4. According to the data, air pollution is the most prominent concern among the respondents in Seksyen 7, with an overwhelming majority of 95.3% voting for it.

This suggests that air pollution is a significant and widely recognised problem. The second-highest vote goes to traffic congestion, with 57% of respondents expressing it as a concern. This indicates that the volume of traffic and associated congestion is a substantial issue affecting the residents of Seksyen 7. Noise pollution received the third highest vote at 40.4%, suggesting that excessive noise from various sources is a notable problem in the area. Health issues garnered a vote of 36.8%, making it the second-last highest concern among the respondents. This suggests concerns about the potential health impacts arising from the environmental conditions in Seksyen 7. Water pollution received the lowest vote at 1.2%, indicating that it is perceived as the least significant issue among the listed environmental concerns. The data highlights that air pollution, traffic congestion, noise pollution, and health issues are the most pressing environmental concerns in Seksyen 7.



**Figure 4:** Percentage of current environmental issue

Based on the data in Figure 5, the highest number of respondents, 761, agreed that community activities contribute to air pollution. This suggests that community activities, such as burning waste or outdoor events, are considered significant sources of air pollution in the area. The second-highest number of respondents, 661 in total, agreed that construction work is a contributing factor to air pollution. This indicates that emissions from construction sites, such as dust and pollutants from machinery, are seen as a significant source of air pollution in Seksyen 7.

A total of 572 respondents agreed that vehicles contribute to noise pollution. This highlights the impact of vehicle-related noise, including engine noise, honking, and traffic noise, on the acoustic environment in Seksyen 7. A total of 562 respondents agreed that construction work contributes to noise pollution. This indicates that the noise generated by construction activities, such as machinery, drilling, and construction-related activities, is seen as a notable source of noise pollution in the area. A total of 100 respondents agreed that waste management contributes to noise pollution. This suggests that activities related to waste management, such as waste collection or disposal, may generate noise and contribute to the overall noise pollution in Seksyen 7.

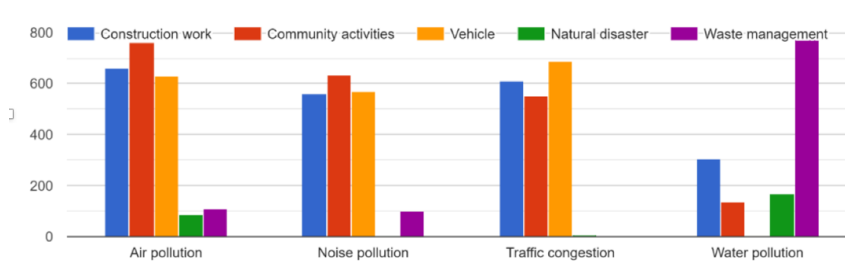


Figure 5: Factors of pollution

Table 2: Number of respondents

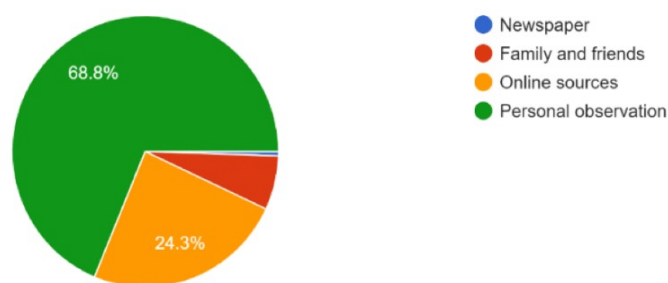
Factor	Number of respondents
Community activities	635
Vehicles	572
Construction work	562
Waste management	100

### The Residents' Awareness Analysis of the LRT3 Construction Projects

This section aims to identify the residents' awareness of the construction of the LRT3 in Seksyen 7, Shah Alam, and the environmental impact caused by the LRT3.

Based on the respondent's knowledge of the project, as indicated in Figure 6, 68.8% of the respondents stated that they became aware of the LRT3 project through personal observation. This means they likely noticed the

construction or other related activities related to the project in their surroundings. 24.3% of the respondents reported obtaining information about the LRT3 project online. This could include websites, social media platforms, news articles, or official project updates available on the internet. 6.5% of the respondents mentioned learning about the LRT3 project through family and friends. This suggests they received information or discussions about the project from their network. A small percentage, 0.5% of the respondents, said they learned about the LRT3 project through newspapers. This indicates that traditional print media played a minor role in their awareness.

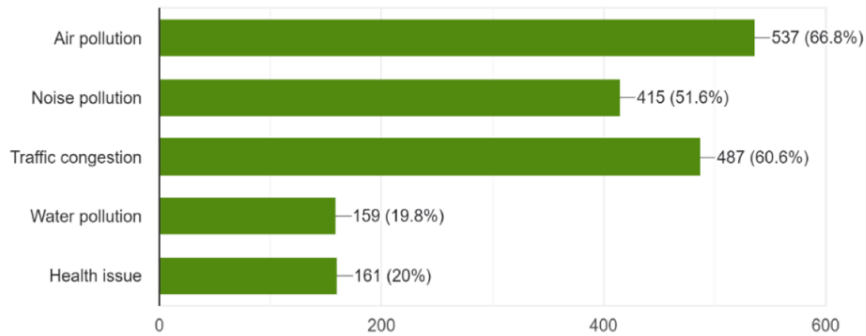


**Figure 6:** Respondent's source of knowledge about the LRT3 project

The respondents have also responded to the project's effects on the environment (Figure 7). The data indicates that a majority of respondents (73.4%) in Seksyen 7, Shah Alam, agreed that the LRT3 project significantly impacts the environment. On the other hand, a smaller percentage (26.6%) of respondents disagreed with this perspective, suggesting they believe it has a lesser or no significant impact on the environment. The study also addresses the main issues raised by the LRT3 project (Figure 8). The highest percentage of respondents, 66.8%, identified air pollution as an issue resulting from the LRT3 project. This suggests that the project's construction or operation negatively impacts air quality in the surrounding area. This can be due to emissions from construction machinery, increased traffic during construction, or the operation of the LRT system itself.

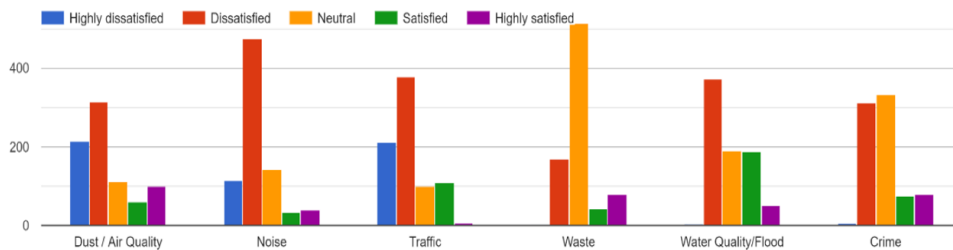
Approximately 60.6% of respondents identified traffic congestion as an issue arising from the LRT3 project. This implies that they believe the construction activities or changes to road infrastructure associated with the project have led to increased traffic congestion in the area. This can occur due to lane closures, traffic rerouting, or construction activity disruptions. About 51.6% of respondents mentioned noise pollution as an issue resulting from the LRT3 project—construction activities, including the operation of heavy machinery and construction increases, contribute to increased noise levels in the vicinity. A smaller percentage includes concerns about health issues (20%) and water

pollution (19.8%). It is important to note that these perceptions and concerns expressed by the respondents may or may not reflect actual impacts or issues related to the LRT3 project. It would be necessary to conduct further studies and assessments to evaluate the validity and extent of these concerns.



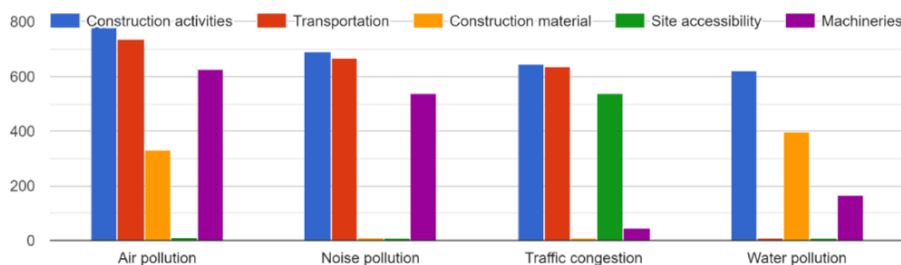
**Figure 7** Issue arises from the LRT3 project.

The study also analyses satisfaction with the LRT3 project issue. Figure 8 shows that the respondents were given options ranging from highly dissatisfied to highly satisfied, and their preferences were recorded accordingly. In terms of satisfaction with air quality, out of the total respondents, 216 individuals expressed being highly dissatisfied with the air quality related to construction activities. Additionally, 315 respondents stated that they were generally dissatisfied. This indicates that a significant number of people are unhappy with the air quality in their vicinity due to construction. The others only reported a neutral stance (112 respondents), being satisfied (61 respondents), and being highly satisfied (100 respondents). These findings highlight the need for measures to address the air quality concerns caused by construction. It may be essential to evaluate and implement strategies to minimise dust, pollutants, and other harmful emissions during construction projects to improve the overall air quality and mitigate the dissatisfaction expressed by many respondents.



**Figure 8:** Respondent's satisfaction with the LRT3 project issue

The data provided useful insight into construction issues and their impact on crime. Out of the total respondents, only a small number of individuals, precisely five respondents, expressed being highly dissatisfied with the crime situation related to construction activities. This indicates that the construction projects have not significantly contributed to increased criminal activity or have successfully managed potential security concerns. A more significant proportion of respondents, 311, reported dissatisfaction with the crime situation. This suggests that there are perceived issues or concerns related to criminal activities near construction sites. These concerns could include theft, vandalism, trespassing, or other crimes that may occur during or as a result of construction activities.



**Figure 9:** Factors that contribute to the pollution.

These findings underscore the importance of maintaining adequate security measures and addressing any potential security risks associated with construction activities. It is critical to implement appropriate safety protocols, such as securing construction sites, installing surveillance systems, and fostering collaboration with local law enforcement, to minimise the occurrence of criminal incidents and create a safe environment for workers and nearby residents.

The data in Figure 9 indicates various factors contributing to the traffic congestion associated with constructing the LRT3. Most respondents (645 individuals) identified construction activities as a significant contributor to traffic congestion. This can include road closures, lane reductions, and detours due to construction work. Transportation related to the construction also emerged as a prominent factor, with 635 respondents highlighting it as a contributor to traffic congestion. This likely refers to the movement of construction vehicles and trucks, which can add to the existing traffic load. While the impact of construction material and machinery on traffic congestion was relatively low with 9 and 46 respondents, respectively, site accessibility was highlighted by 540 respondents as a significant factor. This suggests that difficulties in accessing the construction site, such as limited entry points or disruptions to regular traffic flow, contribute to the overall congestion in the area. These findings underscore the importance of efficient traffic management strategies, coordination with local authorities, and

proper planning of construction activities to minimise traffic congestion during the construction of the LRT3.

The data reveals several factors that contribute to the water pollution associated with constructing the LRT3. Most respondents (624 individuals) identified construction activities as a significant factor contributing to water pollution. This could include runoff from construction sites carrying sediment, debris, and other pollutants into nearby water bodies. Construction material was also identified by 395 respondents as a contributing factor, suggesting that the materials used in the construction process may leach pollutants into the surrounding water sources. While transportation and site accessibility had relatively low impacts (9 and 8 respondents, respectively), machinery used in construction activities was highlighted by 167 respondents as a contributing factor to water pollution.

## CONCLUSION

Air and noise pollution can cause long-term health effects in humans and animals. The construction industry is regarded as one of the world's leading environmental polluters. The widespread development projects in Shah Alam burden the local ecosystem and produce various pollutants. Most of the LRT3 construction project activities are located in areas with a high population density. These activities can be particularly harmful to the health of people who are already susceptible to the effects of construction dust. The findings also highlighted the potential sources of air pollution, including emissions from construction machinery, increased traffic during construction, and the operation of the LRT system itself. Additionally, noise pollution was identified as a significant issue, indicating that the community is apprehensive about the potential disruptions caused by construction activities and the subsequent operation of the LRT system. The community members' limited availability and time constraints to participate in the study must be enhanced for future significant studies. The findings can inform spatial-based policy decisions, improve construction practices, and contribute to sustainable development in the transportation sector.

## ACKNOWLEDGMENT

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## **KEY HOUSING CONDITIONS THAT DIMINISH HEALTHY HOMES AMONG ABORIGINAL COMMUNITIES IN ROYAL BELUM PARK MALAYSIA**

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### **Abstract**

Research on healthy homes has been carried out relatively little in Malaysia. The aim of this paper is to establish the relationship between key architectural elements of Aboriginal homes in Sungai Kejar, the Royal Belum State Park, and their potential health risks. The data were drawn through naturalistic observation, unstructured interviews and semi-structured interviews. Despite their green features, many Aboriginal homes lack water-tight measures, sanitation facilities and proper flooring - making the people more susceptible to diseases like Leptospirosis and Malaria. Due to their nomadic lifestyle, the people construct temporary homes using green materials like bamboo and leaves. The government-provided wooden and brick houses did not meet most of their preferences primarily due to their lifestyle, culture and belief system. These underlying issues necessitate a thorough evaluation and research to propose optimal construction methods that meet the bare minimum criteria for healthy homes while also accommodating their lifestyle and preserving cultural heritage. This could include introducing brick flooring, portable rainwater harvesting for clean water supply and healthy homes awareness campaigns.

**Keywords:** Aboriginal, Architectural Elements, Health, Healthy Homes, Safety

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## **INTRODUCTION**

Recent empirical studies have examined Aboriginal home conditions and their impacts on health outcomes (e.g.: Caldas et al., 2023; Lansbury, Hoy, & Shaw, 2023; Mashford-Pringle, Fu, & Stutz, 2023; Memmott et al., 2022; Perreault, Dufresne, Potvin, & Riva, 2023). These studies have shed insight into the health inequities among Aboriginal communities, which are typically associated to inadequate access to resources. The resources encompass provisions for water supply, sewage infrastructure, electricity and architectural elements. Australian Institute of Health and Welfare (2022) reported that Aboriginal people live in an environment with a lower standard of housing quality and services than non-Aboriginal households. This group has higher poverty rates and lower mental and physical well-being than other groups, owing primarily to unhealthy living conditions that make them more susceptible to long term chronic diseases. Mental health issues, asthma, malaria, and skin morbidity are some of the diseases associated with unhealthy Aboriginal homes. Whilst healthy homes concept has been widely utilised in Western countries as a way of assisting rural communities in developing a highly healthy systems, studies on healthy homes, especially for the Aboriginal people in Malaysia remain limited. Many studies focus primarily on indoor air quality or space, rather than the overall elements of healthy homes.

The Royal Belum State Park is one of the world's oldest rainforests, believed to have existed for more than 130 million years old (Tourism Malaysia, 2023). The Park which is managed by the Perak State Parks Corporation (PSPC) is commonly peopled by the Jahai tribe, the original settlers - living along Sungai Tiang and Sungai Kejar areas (Bernama, 2023). An initiative undertaken by the government to support the Aboriginal people in Sungai Tiang involved the provision of permanent housing. Despite this effort, numerous traditional bamboo houses in the area still lack basic utilities such as water and electricity (Mohamad, 2015). However, there is a dearth of comprehensive documentation regarding the housing condition and architectural elements of the Aboriginal houses in the Royal Belum State Park. PSPC has identified this research as the pioneering investigation into the construction of the houses, with a specific focus on the architectural elements that pose health and safety risks to the Aboriginal people in Sungai Kejar.

Ensuring that homes are healthy is not a luxury; it is an essential element of promoting optimal physical and mental health for all individuals, including the Aboriginal people. Improving housing conditions can significantly reduce social inequalities that impact the rates of illness across all demographics within the overall community, particularly individuals from lower socioeconomic backgrounds who often encounter additional challenges when seeking adequate healthcare services. Consequently, these individuals face escalating risks over time due to limited access to affordable preventive treatments, if available at all.

## **CAUSES OF ABORIGINAL UNHEALTHY HOMES**

Homes serve as vital spaces, encompassing both physical and psychological aspects, fostering the development and nurturing of intimacy and providing people with the opportunity to express their true selves (Bonney, 2007). A healthy home provides conducive facilities, spaces and elements that promote the physical, mental and social well-being of people within the household and its vicinity (Nasir et al., 2021). Poor living conditions in houses and communities tend to cluster together, thereby amplifying the probability of adverse health consequences in the future (Arshad et al., 2022; Khalid et al., 2022; Miller et al., 2011). There are numerous and diverse factors that contribute to the unhealthy homes. The factors can originate from both internal and external environments, including unsanitary bathrooms, polluted water, poor waste management, insufficient air flow, overcrowding and improper space design (Vanhoutteghem et al., 2015).

Ali et al. (2018) conducted a comprehensive narrative literature review to identify the role of housing in the transmission of infectious disease among Aboriginal people in Australia. They highlighted that various factors contribute to disease, including the hygiene practices of the people, the cleanliness of clothes and bedding, the handling of wastewater, spaces for storage and cooking, overcrowding, the presence of animals, insects and vermin, the accumulation of dust, temperature conditions, the functionality of sanitary hardware, electrical supply management, sewage and maintenance. The aforementioned factors are also among the elements that the (World Health Organization, 2019) highlighted as crucial components for healthy homes.

In addition to the aforementioned factors, Wheeler et al. (2016) offers various architectural components that contribute to healthy homes. These include materials, lighting, spaciousness, comfort, durability, sensory features, bedrooms, colour schemes, security measures, storage options, flourishing elements, kitchen amenities, sound insulation, living areas and windows. According to Wheeler et al. (2016) numerous factors, ranging from indoor air quality, the amount of accessible space and light, and the quantity of available storage space, can significantly impact the health and well-being of people. In addition, the selection of construction materials, the installation of equipment or the size and design of individual homes can all contribute to various health problems (Bonney, 2007; Latif et al., 2022).

Ali et al. (2018) discovered that the majority of studies indicate that Aboriginal people have elevated rates of infectious diseases affecting intestines, skin, eyes and respiratory system, which are mainly associated with overcrowding. Windi & Whittaker (2012) indicated that the limited number of doors and windows in Aboriginal homes, along with the presence of indoor air pollution caused by internal fires, lead to a compromised respiratory health due

to the inadequate ventilation. Not only that, indoor air pollution is also linked to cardiovascular health issues and can trigger allergies (World Health Organization, 2018). Ahmed et al. (2011) emphasised that living in temporary homes with dirt or earth flooring, poor sanitation, and poor water provision are contributing factors that heighten the susceptibility to soil-transmitted helminths among Aboriginal people. Adu-Gyamfi et al. (2023) affirmed that the absence of proper sanitation in Aboriginal communities led to the spread of cholera and dysentery. Kaur (2009) found an association between the presence of malaria disease and bamboo-walled homes with gaps that allow mosquitoes to enter, specifically among Aboriginal people.

These elements are essential for evaluating Aboriginal homes and they serve as crucial criteria for this study. The aim of this paper is to establish the relationship between key architectural elements of Aboriginal homes in Sungai Kejar, the Royal Belum State Park and their potential health risks.

## **RESEARCH METHODOLOGY**

A qualitative research methodology was used to investigate home conditions and their relationship to possible health issues. Qualitative methods are appropriate for uncovering and comprehending previously unexplored issues in a poorly understood context (Strauss & Corbin, 1990). This research was approved by the ethics committee of Universiti Teknologi MARA. As this research involved the Aboriginal people, permission was also obtained from the Department of Orang Asli Development (JAKOA) and Gerik District Council. Subsequently, the permission letters were presented to the PSCP in order to obtain an entry permit for the state park. This permit was essential for hiring a licenced boatman and allowing the boat to pass through the Royal Malaysian Army checkpoint, enabling the research teams to access the Aboriginal communities.

Data collection commenced with a semi-structured group interview involving three PSCP staff members. The purpose of this interview was to gain a comprehensive understanding of the various aspects related to the Aboriginal communities within the state park. This understanding was sought prior to the researchers' visit to these communities. The decision to centre on Sungai Kejar was based on its relatively underdeveloped condition compared to Sungai Tiang. Data was gathered from six villages in Sungai Kejar, specifically Jerai 1, Jerai 2, Jerai 3, Bongor, Terapong/Terapong Darat and Tan Hain.

Naturalistic observations were conducted in all villages, as they immerse the researchers in real-world settings and yield extensive data that are unlikely to be obtained through surveys. Concurrently, the researchers conducted unstructured interviews with all the village heads except Jerai 3 for being unavailable. With the assistance of two PSCP staff and two boatmen, the researchers managed to gain the trust of the people to engage in conversations.

Additionally, unstructured interviews were conducted with people who either approached us first or were willing to engage in a conversation when we approached them.

Recording was permitted; therefore, the interviews, photographs and video footages were captured using the iPhone 7 Plus, Samsung A52 and Samsung Galaxy S23. Note-taking was essential when participating in group conversations as voice recordings may become indistinct at certain intervals. Likewise, unstructured interviews were conducted with the boatmen and two PSCP staff who were also there, in order to gain a deeper understanding of certain situations.

## **FINDINGS AND DISCUSSIONS**

The aboriginal population in Sungai Kejar, Royal Belum in majority, erected temporary homes due to their nomadic or semi-nomadic lifestyle. The design of their homes was influenced by the architectural styles they encountered while travelling and the environments they were accustomed to inhabiting. Typically, their homes were erected with identical designs, materials and construction techniques as shown in the pictures below.



**Figure 1:** The villages situated along Sungai Kejar

### ***Aboriginal homes made from environmentally friendly materials***

The structural components, specifically the posts and roof framework of the homes were erected using various types of suitable timber sourced from available locations. Although green, the structure of Aboriginal homes is susceptible to damage by elephants due to their lack of strength, posing a significant safety risk. In Tan Hain, the footprints and destruction on the plantation caused by a female elephant searching for food the previous night in close proximity to a home with children were observed. The people were busy building new homes on the opposite side of the river due to the apprehension of fatal trampling by elephants.

According to the people and PSCP, elephants were the primary wildlife species in Royal Belum Park, causing issues and even fatalities among the Aboriginal people. The risks of wild animal attacks are high, which are also encountered by other tribal communities (see: Brumm, 2022).

With regards of the roof of Aboriginal homes, the thatched roof made from *Cucuh* leaves were well-suited for hot and humid climate of Malaysia's tropical region. The thatched roof's layers were meticulously folded, tied and arranged in a neat stack. This method aided the preservation of a comfortable indoor climate during hot weather conditions and offered insulation to prevent heat loss at night. Nevertheless, these materials are highly susceptible to fire, as evidenced by a burnt house in Jerai 2. This has the potential to spread fire, endangering the safety of the occupants and nearby Aboriginal people, and posing a life-threatening situation (Gilbert et al., 2006).

The wall finishes in each village were found to differ slightly, ranging from the use of bamboo to layers of *Cucuh* leaves. The arrangement of these materials created gaps that naturally facilitate ventilation, improved air flow and natural lighting, particularly in the case of the small type of bamboo, which was predominantly utilised. These natural materials and methods contributed to the preservation of a pleasant and energy-efficient and healthy homes environment.

While natural sources for the aboriginal home construction were easily available, sustainable, provided natural insulation properties and environmentally friendly, they did possess certain disadvantages. The gaps in the roof and wall enabled the flow of rainwater into the homes, contributing to the dampening of certain parts of the house and causing a higher moisture level. Consequently, numerous houses were discovered to improve their roofs and walls by adding canvas, metal decks or zinc sheets as shown in Figure 2 (a) and (b).



a) Canvas we used on the wall; Raised floor using bamboo

b) Canvas and zinc sheet used on the wall and roof; Dirt flooring, no floor finishes

**Figure 2:** The general roof, wall and floor elements of aboriginal houses



The presence of water had enabled the proliferation of mould and moss on certain walls and structures. Potential health risks linked to dampness include respiratory issues, sleep disturbances, skin irritation, fungal infections (Tiesler et al., 2015) and rhinitis (Jaakkola et al., 2013).

The aboriginal homes were discovered to be either erected directly on the ground without any floor finishes (Figure 2b) or suspended using bamboo as the flooring material (Figure 2a). The homes on the ground that had dirt floors had a small section of raised bed made of wood or bamboo for the sleeping area. The occupants did not sleep on the ground, which reduced their health risks. However, coming into direct contact with dirt floors, particularly when walking barefoot, is associated with the presence of parasites and bacteria. This can lead to serious health issues, including parasitic infections, respiratory problems and helminths as highlighted by (Ahmed et al. (2011). Meanwhile, the suspended bamboo-flooring exhibited gaps. Aside from water, the gaps in the walls, floors and roofs allowed the ingress of mosquitoes, birds, insects and rodents. Some individuals in Jerai 2 Village had pointed out the presence of rats. The health risks to this encompass vector-borne diseases such as malaria (Kaur, 2009) and leptospirosis, which can be transmitted by mosquitoes, birds and other primates. According to the Research Officer of PSPC:

*“Malaria, it is a kind (of disease with) high-profile cases... Human interact with the primates, then it will spread... I know there are quite a few cases, even among our staff (had) leptospirosis. Leptospirosis, it's called [rat's urine] but a lot of the other animals could be the carriers as well, even the deer... It could be in the water, river water, yes.”*

Certain houses had apparent windows, while others had hidden windows and some omitted windows entirely. Those without windows showed a lack of natural lighting and air flow, although there were gaps between the bamboo materials. They decided not to have the windows due to their dislike of them. This resulted in poor air flow, especially when the fire was lit. And this could lead to respiratory, cardiovascular and allergic problems (Windi & Whittaker, 2012; World Health Organization, 2018).

*“[What is the window for? This is not a wooden house. I don't like wooden houses, stone houses. I really don't like living in it. I only want this (bamboo) house. My father, mother and grandmother lived in this (type of) house. I don't want a modern house... There is no toilet; I want to go into the river. I don't want a toilet, I want a normal way, it's not difficult]” (Woman 1, Jerai 2).*

The Aboriginal people utilised windows to enhance airflow, natural light and visual access, particularly for the purpose of ensuring safety. This corroborates with Walls et al. (2012) who asserted that widows facilitate optimal visual and auditory engagement with the surroundings while also enabling ample airflow and sunlight for effective ventilation and natural lighting. The hidden windows used *Cucuh* leaves, which were evident mostly in Terapong Darat. From a distance, it was observed that there were wide-opened windows (see Figure 3a), but upon reaching the village, both the windows and the inhabitants became invisible. This signifies the desire of the people for security and safety.



**Figure 3:** Examples of several types of windows and doors

The doors and windows were primarily used to safeguard against outsiders and wildlife, rather than individuals within their community. This is due to the absence of reported criminal offences in their communities. The people inhabited a small community and were acquainted with one another. In the event of conflicts, they would relocate and establish a new settlement. Door clearance is crucial for facilitating movement and preventing the entry of vermin (Walls et al., 2012).

Regarding space utilisation, it was ascertained that no more than five individuals occupied each house, with an average of two adults per household. The houses featured an open-concept layout, with no separate kitchen area, despite the presence of cooking activities within the house. The newly married couples were relocated to a residence in close proximity. The Aboriginal people in Sungai Kejar maintained a low population density, with each village typically comprising fewer than 10 homes, except for Bongor and Tan Hain, which had slightly more than 10. In Tan Hain, children of a specific age were allocated to reside together in separate homes rather than living with their parents. This prevents the transmission of diseases linked to overcrowding, as indicated by previous studies conducted in various tribal communities.

Several of the houses that were granted entry (see Figure 4a) exhibited traces of ash in the vicinity of the sleeping areas, affirming the use of fire for nocturnal heating and mosquito-repelling. The fire possesses the capacity to incinerate the house constructed from green materials, while the smoke exacerbates indoor air pollution and heightens the susceptibility to respiratory health complications as stated by (Windi & Whittaker, 2012). Moreover, it was discovered that mosquito nets were used among them, indicating the people's desire for safety and health by being aware of a simple solution to prevent mosquitoes.



a) The use of a mosquito net, traces of ash, rice scattered on the bamboo floor, a dirty nappy and faecal matter.

b) Absence of sanitation facilities, reliance on the river for all water-related needs including bathing, washing, brushing teeth and fishing.

**Figure 4:** The cleanliness issues among the Aboriginal people

A number of Aboriginal people were found to have a lack of cleanliness awareness, which may attract rodents to their homes through the easily accessible gaps. The absence of water supply and sanitation facilities exacerbates the issue of cleanliness, where the people rely entirely on the same river (Sungai Kejar) for their daily needs (see Figure 4b). An unsanitary lifestyle endangers the Aboriginal people's health because it raises the risk of vector or water-borne disease transmission (Adu-Gyamfi et al., 2023).

#### ***Government housing initiatives***

In Jerai 1, a wooden house constructed by the government remained in a state of disrepair, exhibiting signs of serious decay, as shown in Figure 5. The sole occupant of the house was an elderly man. According to the occupant, the interior of the house becomes excessively warm during the daytime. The villagers clarified that the man spent most of himself at the veranda. The house did not have a water supply, the timbers were seriously decayed, and bathroom space remained unused.

The people who lived in the vicinity of the wooden house continued to utilise the common aboriginal house made from bamboo, *Cucuh* leaves and rattan. They claimed that the Aboriginal homes were better suited to their lifestyle, with cooler temperatures and more comfortable to live in.



**Figure 5:** The condition of a wooden house initiative by the government in Jerai 1 Village

In Bongor village, the Malaysian government had built brick houses to help the Aboriginal people achieve a more comfortable and enhanced lifestyle. Brick houses may also help to protect the people from wild animal attacks because the structure is more durable.



**Figure 6:** The condition of brick houses initiative by the government in Bongor

Nevertheless, not many Aboriginal people were fond of these wooden or brick houses due to several reasons: (1) the construction materials such as the sense timber, cement render flooring and metal deck roof tend to retain heat; (2) insufficient air circulation and ventilation in the permanent house; (3) the absence of electricity prevented the use of mechanical fans, which could have aided artificial ventilation and lowered indoor temperatures; (4) the absence of water

supply and sanitation facilities made the bathroom unusable; (5) due to their *Karei* belief system, the Aboriginal people refrained from living in homes where someone had died, resulting in the presence of unoccupied houses; (6) despite being allocated a house, the people persist in living a nomadic lifestyle, often shifting to different places, with the intention of eventually coming back; they lack ownership of any property; (7) the newly married couple required a separate living area, thus necessitating their relocation. Constructing Aboriginal bamboo homes was thus regarded as the best option, particularly in terms of cost, duration and ease of relocation or modification, and; (8) permanent houses were difficult to construct and expensive to build and maintain.

Similar to the wooden house in Jerai 1, the people of Bongor continued using the traditional aboriginal houses built adjacent to the brick houses. In fact, the vast majority of the aboriginal people from the six villages harboured a strong aversion towards wooden or brick houses due to the aforementioned reasons. This helps to maintain a comfortable and energy-efficient environment. They are a renewable resource and harvested by a small population in each village and can last for a year or so. The harvested trees were not harmed and they are biodegradable, suitable for a nomadic lifestyle and can reduce the impact on the environment.

## **CONCLUSIONS**

The homes and facilities found in Aboriginal villages in Sugai Kejar were immensely different from those in rural settings. Aboriginal people constructed their own homes using natural resources while taking into consideration how to best protect themselves against external threats. This enables the creation of healthier living environments that could be tailored to meet the people's specific needs and preferences. Nevertheless, the disadvantages of Aboriginal homes outweigh the benefits, particularly in terms of disease susceptibility and safety risks.

Homes are supposed to be shelters to protect the Aboriginal people. For this reason, the government has put initiatives in place such as constructing wooden and brick houses; however, these houses and their designs were less suited to the nomadic lifestyle, belief system, requirements, preferences and comfort. Moreover, the Aboriginal population living in the Royal Belum State Park appeared to be low-income and impoverished. They obtained metal decks from abandoned locations in order to seal the gaps in their homes. The transportation costs involved in delivering the materials further increase the price of building wooden and brick houses. Therefore, it is recommended that JAKOA and the state government explore alternative methods to improve the healthy homes criteria of Aboriginal homes, while simultaneously preserving their cultural heritage. For instance, installing a rainwater harvesting system,

promoting the utilisation of mosquito nets, encouraging suspended floors, preserving bamboo naturally, introducing thin brick flooring as well as creating an electric gate or a comparable device may serve as means to prevent the elephant's access. Essentially, Aboriginal homes must be adjusted to accommodate their culture and Royal Belum State Park environment, thereby enhancing the people's overall health conditions and safety.

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## **URBAN AGRICULTURE ACTIVITIES SCENARIO IN RELATION TO FOOD SECURITY: DELVE INTO URBAN FARMING PRACTICE**

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### **Abstract**

Urban agriculture is an alternative source of food for the urban population to achieve food security. The Department of Agriculture (DOA) Malaysia under the Community Agricultural Development Program targeted 8,800 metric tonnes of urban agriculture products by the year 2025. To understand the current state, this research aims to investigate the urban agricultural activities scenario in Malaysia through the role and responsibilities carried out by the government agencies to facilitate urban farmers and increase agricultural productivity. A qualitative approach was adopted by means of a desktop study to review journals and reports, as well as content analysis on multilevel government policies, and acts related to urban agriculture. Also conducted were in-depth interviews with government agencies officials and farmers, and a fieldwork. The findings indicate that (1) all three-tier governments have specific roles and responsibilities in facilitating urban agriculture through policies, instruments, incentives, and monitoring that cascade down from the federal to the local level; and (2) the need to improve coordination between agencies to optimise resources and monitoring. In conclusion, coordination between related government agencies and farmers is the key enabler to ensure food security for the urban population.

**Keywords:** Food Security, Urban Agriculture, Government Agency's Roles and Responsibilities

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## **INTRODUCTION**

There will be a gap between the supply and demand of food due to the exponential growth of the human population, which is expected to reach 9 billion people by 2050 (Zaman et al., 2018). The demand for food production rises along with population expansion, placing more strain on food quality and availability. Nearly 9 percent of people worldwide suffer from hunger, and by 2030, 840 million people are expected to experience food insecurity, according to the United Nations. In recent years, the topic of food security has gained significant attention at both national and international levels. There is more to food security than just having enough to eat; it also has to do with the food's quality and the dependability of international supply chains. In the year 2023, Malaysia ranked 41<sup>st</sup> in the Global Food Security Index with an overall score of only 69.9 (The Economic Group, 2024), and remains vulnerable to food insecurity due to being reliant on imports for maintaining its food supply, particularly for rice. Imports account for about 25% of Malaysia's food supply, and almost two-thirds of common ingredients like chilli (commonly used in most Malaysian dishes) are imported from Thailand. The value of food imports is predicted to increase this year and surpass the record of RM63 billion in 2021 (Ministry of Agriculture and Food Industries, 2021).

Households are estimated to spend nearly 70% of their budgets on food, which means that a systematic approach is required to ensure the population's food needs are met (Ahmad et al., 2020; Kh'ng et al., 2022). Producing food while maintaining its quality becomes more challenging due to frequent disaster events such as floods, which highly impact agricultural activities (Joakim & Wismer, 2015; Lindell & Prater, 2003). Natural disasters, drought, floods, pest attacks, plant disease, and changes in the time crop cycle have adversely impacted Malaysia's agriculture and its productivity (Md. Mahmudul Alam et.al., 2011).

Urban agriculture is an alternative food source that contributes to the food security of a country (Hafizah Binti Yusoff et al., 2017; Ramaloo et al., 2018). In Malaysia, the urban farming programme has been implemented for almost a decade, starting in 2014 and was initiated by the DOA (Chandra & Diehl, 2019; Nowysz et al., 2022; Rozhan Abu Dardhak & Rasmuna Mazwan Muhammad, 2021a).

## **LITERATURE REVIEW**

### **Urban Farming Activities and Food Security Policy in Malaysia**

Malaysia rectified Sustainable Development Goals (Goals 2 Zero Hunger and Goal 12 Responsible Consumption and Production) and New Urban Agenda—the two policies targeting for sustainable future where everyone will have equal benefits and access to stable and secure food resources. The Ministry of Agriculture and Food Security has launched Dasar Agromakanan Negara 2021–2030 (DAN2.0) and National Food Security Action Plan 2021–2025, which

outlines the initiatives towards a sustainable food system that focuses on availability, access, consumption, and stability. DOA Malaysia is the leading government agency in implementing the policy and overseeing the technical aspects of agriculture (planting method and training), including urban agriculture. The Community Agricultural Development Program has identified urban farming as an alternative food source that can also benefit farmers by reducing the cost of living from RM1,296.00 in 2021 to RM1,680.00 in 2025 (Department of Agriculture, 2024). However, the DOA is concerned with the urban land required to be allocated for urban agriculture and the policies and legal matters in spatial planning to support urban agriculture (Rozhan Abu Dardhak & Rasmuna Mazwan Muhammad, 2021).

From the spatial/physical planning perspective, food security matters have been highlighted in National Physical Plan 4 launched in 2021 but is not focused on urban agriculture. Back in 2012, the Department of Town and Country Planning launched the Green Neighbourhood Guidelines and community farming is one of the two elements of a green environment. The areas allowed for community farming are reserve land and open space, or Tenaga Nasional Berhad (TNB) leased land only (Jabatan Perancangan Bandar dan Desa Semenanjung Malaysia., 2012).

### **Urban Farming Contribution to Food Security in Malaysia**

Urban agriculture has the potential to contribute towards urban food security in Malaysia in terms of availability, accessibility, utilisation, affordability and stability of the food system (Lang & Barling, 2012; The Economic Group, 2024). In terms of availability, urban agriculture may not be able to fully fulfil the demand for food in Malaysia but is still valuable in terms of fulfilling perishable food production (Orsini et al., 2013). This type of production is highly encouraged as perishable fruits and vegetables that come from rural areas may lose their freshness along the way, hence lowering their nutritional value (Kader, 2005; Moustier and Danso, 2006). Therefore, the production of perishable goods locally is beneficial as the quality of produce can be preserved and the price can be lowered. For the farmers, accessibility to food can be assumed to be increased through the increase in the proximity of agricultural fields (as food-producing sources) to their homes. For the city, urban farming also increases access to local production of food, thus saving costs and transport time. The costs of supplying and distributing food from rural areas to urban areas, or importing food from overseas, are rising continuously, and distribution within the cities is uneven. Without local production of food, urban food insecurity will increase (Chandra & Diehl, 2019). Regarding utilisation, most of the produce, such as vegetables and fruits, can provide only part of a complete diet whenever self-consumed. There is also a focus on growing or rearing crops and animals which require only small spaces (Chandra & Diehl, 2019). The final benefit is

affordability and stability: urban farming generates significant income for the practitioners (Rozhan Abu Dardhak & Rasmuna Mazwan Muhammad, 2021), which allows the farmers to purchase other types of food to complement the lack of other nutrition values. Based on the supply and utilisation account selected agricultural commodities year 2018–2022, Malaysia achieved SSR for 23 selected agricultural items, which surpassed 100 per cent. As shown in Table 1, the following six (6) items required further strategies and action to increase their SSR value and thus provide enough for the country: (1) mutton; (2) beef; (3) ginger; (4) chilli; (5) mango; and (6) round cabbage.

**Table 1:** Self-Sufficiency Ration (SSR) year 2022

Commodities	SSR percentage (%)		
<i>Less than 50 per cent</i>			
Round Cabbage (45.6)	Ginger (15.9)		
Mango (32.0)	Beef (14.7)		
Chilli (29.7)	Mutton (8.7)		
<i>50 to 99.99 per cent</i>			
Fresh Milk (57.3)	Torpedo scads (91.6)		
Rice (62.6)	Chicken Meat (93.3)		
Coconut (71.6)	Mustard (95.9)		
Sardine (72.1)	Shrimp (96.5)		
Sweet Potato (73.5)	Rambutan (96.6)		
Cuttlefish (73.6)	Tilapia (97.3)		
Lime (75.9)	Crab (97.8)		
Mackerel (78.2)	Guava (98.0)		
Stingray (79.7)	Banana (99.3)		
Pork (84.6)	Threadfin Bream (99.3)		
Mangosteen (90.5)			
<i>100 per cent and above</i>			
Sugar Cane	Papaya	Watermelon	Duck Meat
Starfruit	Tomato	Seabass	Jackfruit
Cucumber	Spinach	Chicken/Duck Egg	Durian
Sweet Corn	Lettuce	Long Bean	Brinjal
Lady's Finger	Pineapple	Freshwater Catfish	Langsat
Tuna	Cassava	River Catfish	

Source: DOSM, 2023

***Initiative and incentive under Department of agricultural Malaysia, Ministry of Agriculture and Food Security for urban farming activities***

DOA under the Ministry of Agriculture and Food Security launched the *Garis Panduan Pelaksanaan Program Pembangunan Pertanian Komuniti (PPPK)* in the year 2022 (Department of Agriculture, 2022). The document provides details on the project implementation concept, project implementation mechanism, monitoring and reporting and termination of the project. As shown in Table 2,

four (4) groups were targeted in the implementation of the urban farming and incentives fund for project start-up.

**Table 2:** Project Category and Incentive for Project Start-Up (RM)

Category	Incentives (RM)
Individual	500.00/person
Community	20,000.00
School	20,000.00
Institution	10,000.00

Source: Division of Urban Farming, Department of Agriculture, 2023

### ***Urban Area Land Use Zoning according to District Local Plan***

As reinforced by Amat Jani, N.H. (2020) and Wahab et.al. (2018), urban growth has hindered the development of agricultural activity in urban areas and increased the dependency towards food sources and agricultural products from the rural area. The Ministry of Agriculture and Food Security sees the integration of agriculture in urban planning and development as important for the sustainable development of various aspects of life and the needs of urban life, including food supply, environmental greening, urban waste and waste management, education and leisure (Amat Janji, 2020). Despite, urban farming is still a potential initiative due to the existence of idle lands in urban areas is alarming. MBSA is very proactive in promoting urban farming activities by allowing the activity under the open space and recreation land use in the MBSA Local Plan 2035 (Shah Alam City Council, 2023).

## **RESEARCH METHODOLOGY**

An inductive approach was adopted towards achieving the following research objectives: (1) to investigate the current policies and practices of the government agencies related to urban farming activities; and (2) to identify the role and responsibilities of the government agencies in facilitating urban farmers. The flow of the data collection is as follows:

### ***Content Analysis***

Extract the content from all documents related to urban farming policy and guidelines from national, state, and local authority levels, including the provision acts and guidelines.

### ***Face-to-face semi-structured interview***

Interviews were carried out with the urban farmers and government officials to confirm/validate the related policies and to gather input. The government agencies including DOA, PLANMalaysia, MBSA, MBPJ, Petaling District Land

Office, and ten (10) farmers (urban farming that is still active within MBSA jurisdiction).

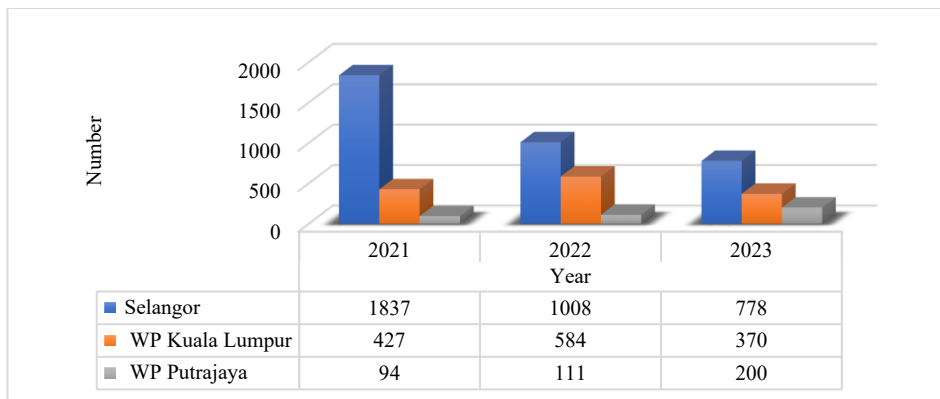
### ***Fieldwork***

SWMaps is a GIS mobile mapping app used for fieldwork data collection in urban farming areas under MBSA. Meanwhile, the fieldwork is also supported with a checklist of inventory forms for site verification and commodities. The direction to the urban farming location was prepared in the form of a QR code for easy observation of the actual practice and experience on site.

## **URBAN FARMING ACTIVITIES SCENARIO MALAYSIA HIGHLY POPULATED URBAN AREA**

Urban activities such as commercial, housing, industry, and transportation have taken up land in urban areas and there is no more land allocated to agriculture in the local plan (Diehl et al., 2020; Wahab et al., 2018). In that sense, town planners shall find ways to accommodate urban farming activities to achieve 8,800 metric tonnes of urban farming production by the year 2025, as targeted by DOA. A review of the urban farming project provided by the DOA indicates a long list of projects all over Malaysia's urban area. A discussion was held between researchers and officials in DOA and based on the data recorded since the implementation of community farming back in 2008. The experience among DOA officials and three (3) states/federal territories have been identified to have the highest number of urban farming project, namely (i) Selangor, (ii) Federal Territory of Kuala Lumpur, and (iii) Federal Territory of Putrajaya.

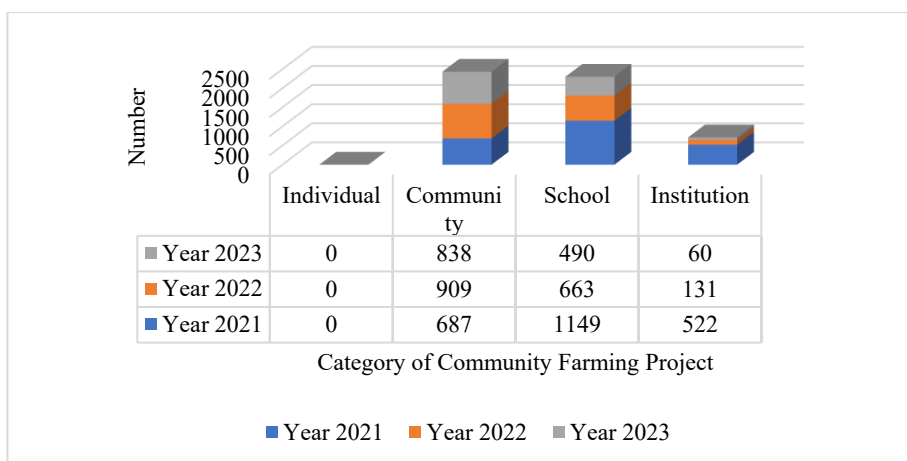
Figure 3 shows the total number of community farming projects in the three chosen states of Selangor, the Federal Territory of Kuala Lumpur and the Federal Territory of Putrajaya. Although the data for the year 2023 is only up until Mac 2023(1<sup>st</sup> quarter), it shows that the number has the potential to surpass the total number of projects in the previous year. This indicates that urban farming has become urban dwellers' strategy and practice to produce their own need for vegetables.



**Figure 1:** Total number of urban farming projects in the State of Selangor, Federal Territory of Kuala Lumpur and Federal Territory of Putrajaya in the year 2021 to 2023 (as of March 2023).

Source: DOA, 2023

Based on the four (4) categories of urban farming by the Department of Agricultural Malaysia, the community category has the highest number of 2,434 in total compared to the school category of 2,303 and the institution of 713 (see Figure 4). School and institution urban farming activities Therefore, this study will focus on community urban farming.



**Figure 2:** Total number of urban farming projects in the State of Selangor in the year 2021 to 2023 (as of March 2023).

Source: DOA, 2023

Further study on the location of the highest urban farming activities in Selangor indicates that Petaling District has the highest number of 427 between the year 2021 and 2023 (March) (Table 3):

**Table 3:** Urban Community Farming Activity in the State of Selangor based on District in the year 2021 – 2023.

District	Year		Total	Unit
	2021	2022	2023	
<b>1. Petaling</b>	<b>107</b>	<b>112</b>	<b>208</b>	<b>427</b>
2. Hulu Langat	164	10	60	234
3. Klang	50	50	97	197
4. Gombak	10	126	40	176
5. Kuala Langat	50	70	53	173
6. Sepang	20	40	20	80
7. Kuala Selangor	-	60	50	110
8. Hulu Selangor	100	50	60	210
9. Sabak Bernam	-	50	60	110

*Source: Division of Urban Farming, Department of Agriculture, 2023*

Petaling District is administrated by 3 local authorities, namely (1) Petaling Jaya City Council (MBPJ); (2) Subang Jaya City Council (MBSJ); and (3) Shah Alam City Council (MBSA). However, for this research, the case study area included only the areas under MBSA and MBPJ jurisdictions due to a lack of data from MBSJ.

Preliminary data collection on the approval granted for urban farming activities in these three (3) local authorities. Three (3) different processes and procedures for urban farming activities were identified: (1) Community urban farming activities approved by the Department of Landscape; (2) Commercialise urban farming activities approved by the Department of Planning; and (3) City Food Valley Program under the Selangor State Agricultural Development Corporation (PKPS) and MBPJ.

## ANALYSIS AND DISCUSSION

The analysis focuses only on (1) the community urban farming activities approved by the Department of Landscape, MBSA; and (2) the City Food Valley Program due to the available complete data provided by MBSA and MBPJ. However, the City Food Valley Program is still in progress and yet to be finalised and executed including the appointment of farmers, the analysis focusing on the land use zoning, and the execution plan by PKPS. As for commercialise urban farming activities that need to acquire planning permission approval by MBPJ under the Town and Country Planning Act 1976 (Act 172) will not be further analysed and discussed due to the lack of data such as the number of applications and approval, type of crops cultivation and production.

### *Overlapping urban farming activity with the current land use*

There are 33 community urban farming that have been approved by MBSA in Year 2021 up until 2023 (March). The fieldwork revealed that only ten (10) sites



remain active and producing crops for local consumption. The boundaries of all ten (10) community urban farming sites were carefully marked using SW Maps. GIS overlaying analysis shows that the current urban farming activities are being carried out on various land uses (Table 4).

**Table 4:** The list of 33 community urban farming sites approved by MBSA within the Jurisdiction Area.

NO	SECTION	LOCATION	LAND STATUS	AREA (acre)	LAND USE
1	Section 7	Jalan Jasper 7/15	Kawasan Hijau	3.0	Recreational Areas and Open Space
2	Section 8	Jalan Jaluran 8/3 (Fasa 2)	TNB	5.0	Infrastructure and Utility
3	Section 8	Jalan Jaluran 8/3 (Fasa 2)	TNB	5.0	Infrastructure and Utility
4	Section 16	Jalan Mat Raji, Padang Jawa	Recreational Area	0.4	Commercial, Vacant Lot
5	Section 20	Jln Tuntung Satu 20/11A	MBSA	2.0	Vacant Lot
6	Section 24	Jln Kangkung Puteri 24/7	Buffer Zone	0.3	Recreational Areas and Open Space
7	Section 27	Flat Proton	Buffer Zone	0.3	Recreational Areas and Open Space
8	Section U11	Rezab JPS	JPS Reserve	1.0	Infrastructure and Utility
9	Section U11	Mosque Site Perumahan Farnese	Mosque Site	0.5	Vacant Lot
10	Section U16	Pangsapuri Melati	Buffer Zone	0.6	Housing

*Source: MBSA and Fieldwork, 2023*

Referring to the Green Neighbourhood Guidelines and community farming, the area that allows for community farming is reserve land and open space or Tenaga Nasional Berhad (TNB) leased land only. Despite all ten (10) community urban farming sites carried out on various land uses such as commercial and infrastructure and utility (not only TNB), fieldwork also found that the activities do not cause nuisance to neighbouring lots and activities in terms of traffic and environmental.

***Type of agriculture crops produce by urban farming***

The surveys each of the urban farming sites indicate that there are no other livestock or fisheries on the farm due to restrictions imposed by the local authority to ensure the cleanliness and welfare of the surrounding area. Only vegetables and fruits are allowed, as shown in Table 5.

**Table 5:** Type of Crops according to Farms

NO	SECTION	LOCATION	TYPE OF CROPS
1	Section 7	Jalan Jasper 7/15	<b>Chilli</b> , Mustard, Long Bean
2	Section 7	Jalan Lekuk Keluli	Banana, Herbs, Flowers
3	Section 8	Jalan Jaluran 8/3 (Fasa 2)	Mustard, Spinach, Water Spinach, Flower, Long Bean
4	Section 17	Jalan Mat Raji, Padang Jawa	<b>Chilli</b> , Spinach, Long Bean, Herbs
5	Section 20	Jln Tuntung Satu 20/11A	<b>Chilli</b> , Eggplant, Spinach, Turmeric, Cucumber
6	Section 24	Jln Kangkung Puteri 24/7	Mustard, Spinach, Long Bean
7	Section 27	Flat Proton	<b>Chilli</b> , Mustard, Banana
8	Section U11	Rezab JPS	<b>Chilli, Ginger</b> , Corn, Turmeric, Long Bean, Cucumber, Lady Finger, Lettuce, Mustard, Banana, Papaya, Bitter Gourd
9	Section U11	Tapak Masjid Perumahan Farnese	Eggplant, Spinach, Water Spinach, Mustard
10	Section U16	Pangsapuri Melatih	<b>Chilli</b> , Banana, Papaya, Lemongrass, Tapioca

*Source: Fieldwork, 2023*

As for the type of crop to cultivate, farmers are to decide based on the market price (the higher the price, the more income can be generated by the farmers) and short-cycle crops (to harvest in less than a month). There are no restrictions or guidelines by the authority to control and ensure the contribution towards food security.

Referring back to the Self Sufficiency Ratio (SSR), the six (6) items with the lowest SSR are (1) mutton (8.7); (2) beef (14.7); (3) ginger (15.9); (4) chilli (29.7); (5) mango (32.0); and (6) round cabbage (45.6). As highlighted in Table 5, the current urban farming activities do contribute to the SSR in terms of producing chilli and ginger for the local market. However, no amount of produce was recorded in each of the cases studied. The produce of vegetables and fruits is only for the local market, and all of the produce is sold weekly to the local communities.

### ***City Food Valley Program***

The City Food Valley Program was initiated by the Ministry of Economics at the federal level, the Selangor State Agricultural Development Corporation (PKPS) at the state level, and the Petaling Jaya City Council (MBPJ). A total of 80 acres of land (located under the TNB transmission line) was identified by MBPJ. This project targeted to involve 40 farmers (among B40) for the first 10 acres in Phase 1 to produce 25,600kg of chilli a year (Ministry of Economic, 2023; Petaling Jaya City Council, 2023). This project is still under approval and implementation and is yet to contribute to the urban agricultural yield. Analysis of the project plan and implementation showed that this project does not involve DOA for any technical aspect such as planting method and training. As DOA has the technical resources that can optimise agricultural production, there is a need for coordination among agencies.

### **CONCLUSION AND RECOMMENDATIONS**

In conclusion, three (3) categories of urban farming have been practiced under MBSA and MBPJ jurisdiction, namely (1) community urban farming activities, which are under the responsibilities of the Department of Landscape; (2) commercial urban farming, which is under the Department of Town Planning; and (3) Urban Farming (Food Valley), which is under the Department of Town Planning and collaboration with other agencies, such as the state corporation and federal ministry.

The current practices also show that the community urban farmers are to decide the type of crops for cultivation, and the production was not recorded to contribute to the 8,800 metric tonnes of urban farming produced by the year 2025. This shortcoming necessitates coordination between DOA and the local authorities to carry out monitoring measures. Meanwhile, for the City Food Valley programme which was initiated by the government, a more holistic approach in engaging with related agencies must be carried out to ensure the optimisation of government resources in policy, initiative, and programme implementation.

### **ACKNOWLEDGMENT**

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## **PROJECT MANAGEMENT CHALLENGES AND CRITICAL SUCCESS FACTORS IN THE REHABILITATION OF ABANDONED HOUSING PROJECTS**

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### **Abstract**

Abandoned housing projects (AHPs) lead to economic losses, social issues, and damage the reputation of responsible authorities. Effective rehabilitation project management is crucial for sustainable urban development. This study explores the challenges and critical success factors (CSFs) throughout the AHP rehabilitation life cycle using qualitative thematic analysis of semi-structured interviews. Identified challenges include communication gaps, inadequate planning and preparedness, deficient risk management, competency issues, documentation problems, and lack of accountability. Key CSFs are effective decision-making, time management, team management, and the role of project managers. The findings provide guidance for policymakers, liquidators, and receivers to improve the implementation of the Housing Development Act for assessing rehabilitation contractors. Addressing these challenges and focusing on the CSFs is essential for successful AHP rehabilitation, mitigating losses, resolving issues, and enhancing the reputation of the authorities.

**Keywords:** Abandoned Housing Project, Project Management, Critical Success factors, White Knights

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## **INTRODUCTION**

The construction industry, particularly in the housing development sector, has played a crucial role in the country's economic growth. The housing development sector is responsible for enhancing the quality of life and is an essential aspect of national development. However, the sector faces significant challenges, with Abandoned Housing Projects (AHPs) standing out as a pressing issue (Abdul-Razak, 2016). As of July 2022, there were 117 abandoned projects, a 48% increase from September 2021, with 102 projects (19,077 units) under rehabilitation and 15 projects (5,210 units) being restored. Selangor had the highest numbers, with 37 rehabilitation projects (15,044 units) and 10 restoration projects (3,914 units). In total, these AHPs impacted 23,562 units and 14,003 buyers nationwide (National Housing Department, 2022).

As part of the mitigation measures, the Ministry of Housing and Local Government (MHLG) established the Abandoned Project Rehabilitation Division (APRD) in 2009. The APRD has been initiating and monitoring affected stakeholder participation throughout the rehabilitation process. It plays a central role in managing stakeholders to collaborate effectively during the revival of the projects.

In the rehabilitation of AHPs, various stakeholders play significant roles. These stakeholders include home buyers who often bear the financial burden during the project abandonment. Landowners, involved through joint venture agreements with developers, may also be impacted. Creditors, such as banks, contractors, suppliers, and professional service providers, have financial interests in the project. The MHLG plays an important role in guaranteeing homebuyer's rights and coordinating rehabilitation efforts. Liquidators or receivers are appointed to manage and settle the affairs of the developer. Lastly, experienced contractors or property developers, referred to as 'White Knights (WK),' are appointed by the liquidator, receiver, or MHLG to carry out the rehabilitation process (Dahlan, 2011; Rahman et al., 2013).

Limited literature exists on the effective project management practices of WK in the rehabilitation of AHPs (Watson, 2009; Rahman et al., 2013; Doraisamy, Akasah and Khamis, 2016; Doraisamy and Akasah, 2016). Previous research has primarily focused on the causes and effects of AHPs in Malaysia and other countries. While there are studies that examine rehabilitation projects in general, including factors contributing to restoration and various issues during rehabilitation, little effort has been made to address project management practices in this specific context.

Therefore, there is a need to identify the best practices by the White Knights Contractor (WKC) in revitalising the AHPs. This study aims to explore the critical success factors of effective project management practices in revitalising AHPs by G7 contractors in Malaysia. Qualitative research was

conducted via administering semi-structured interviews with contractors who successfully delivered the project aka – the white knight. The output was analysed and constructed as a successful determinant for contractor to revitalize AHP. The anticipated outcomes will address the void in research on project success factors and offer valuable insights and actionable recommendations to contractors regarding project execution practices.

## **LITERATURE REVIEW**

### **Abandoned Housing Project: A Persistent Challenge**

To achieve high-income economy status, Malaysia's housing sector must adapt and cater to the demands of medium and low-income groups (Osman et al., 2017). Thus, the sector has made strides in reviving abandoned housing projects by prioritising affordable housing construction over the past decade (EPU, 2015). However, abandoned housing projects (AHPs) remain a pressing challenge plaguing the industry (Abdul-Razak, 2016). An AHP is defined as an incomplete housing development project that is not ready for occupancy (Abdul-Rahman et al., 2016). The National Housing Department (NHD) deems a project abandoned if it is not completed within the stipulated time in the Sales and Purchase Agreement, the developer acknowledges their inability to complete it, or there has been no construction activity for six consecutive months or more.

There are several factors influencing the abandonment of building projects in developing countries. Extensive research has identified diverse factors contributing to AHP abandonment in developing countries like Malaysia, with causes becoming increasingly complex due to modernisation (Hussin & Omran, 2011; Abdul-Rahman et al., 2015; Abdul-Razak, 2016; Doraisamy & Akasah, 2016; Yahya & Komar, 2016; Ariffin et al., 2018; Hilal & Dahlan, 2021). Yahya and Komar (2016) categorised these causes into contributory factors, such as financial problems, unfavorable economic conditions, and policies impacting developers, as well as project management factors stemming from incompetent planning, control issues, poor safety practices, and communication challenges.

### **Multifaceted Impacts of AHPs**

Ariffin et al. (2018) grouped the causes of AHPs in Selangor into environmental impacts (e.g., unexpected ground conditions, pollution), law-related causes (e.g., contract breaches, disputes, legal changes), and financial crises (e.g., late payments, budget overruns, bankruptcies). As of the NHD's records, 109 abandoned projects have impacted 21,000 housing units nationwide. AHPs not only affect purchasers and stakeholders but also have environmental and socio-economic repercussions (Hilal & Dahlan, 2021). Purchasers face loan repayments for unfinished homes, while stakeholders (landlords, contractors, financiers, purchasers, developers) grapple with legal consequences, dishonest practices, and



complicated rehabilitation efforts. Both defaulting and rehabilitating developers struggle with funding and unsold units, hampering cash flow restoration. The issue tarnishes the Malaysian housing industry's reputation, creating negative perceptions among potential buyers and investors.

Hussin and Omran (2011) discuss the socio-economic impacts of AHPs, including attracting criminal activities, negatively impacting visual aesthetics, landscape modification, decreased biodiversity, and uncontrolled pollution due to unsupervised waste disposal and lack of sewage treatment. Abdul-Rahman et al. (2015) noted that AHPs disrupt surrounding utilities, road systems, and drainage, contributing to the proliferation of "white elephant" projects – large-scale, impractical, and underutilised undertakings that become burdensome liabilities. However, the concept of "white knights" emerges as a potential solution, referring to companies or individuals who rescue troubled projects, particularly AHPs, by taking on the responsibility of revitalising and ensuring their successful completion (Nana-Addy et al., 2022).

#### **Rehabilitation of AHPs.**

Rehabilitation is a process taken by several parties to resume construction work and complete an abandoned project or site (Kaur, 2018). It involves multiple stakeholders, each playing a vital role in ensuring the successful revival of the project. The rehabilitation process brings together new or original developers, contractors, consultants, creditors, liquidators (who assume the role of the original developers after project termination), the Malaysian Department of Insolvency (MDI), homebuyers or their associations, local authorities, and the Ministry of Housing and Local Government (MHLG) (Md. Dahlan, 2011). The MHLG acts as a facilitator, coordinating between these parties.

For the rehabilitating contractor or 'white knight', identifying and addressing project risks throughout the rehabilitation process is vital, as it can significantly impact the successful completion of the remaining construction work (Abdul-Rahman et al., 2016). Syarikat Perumahan Negara Berhad (SPNB), a national housing development company owned by the Ministry of Finance (MOF), encountered the following risks:

- Lack of collaboration among developers, consultants, and government authorities;
- Inability of developers to activate or transfer their bridging loans to the salvage developer;
- Problems related to land ownership;
- Unsettled legal actions among the stakeholders of AHPs;
- Lack of necessary information about the projects;
- Challenges arising during the resubmission of project approval documents.

The successful completion of AHPs cannot always be guaranteed, as reaching a consensus among all parties involved takes significant time due to the high stakes. It is essential for contractors and local authorities to allocate additional resources and prioritise the development of effective project management practices across all aspects of AHPs (Abdul-Rahman et al., 2016).

### **Effective Project Management.**

Successful rehabilitation of abandoned housing projects (AHPs) requires a strong emphasis on effective project management practices. Project management encompasses the practical application of knowledge, processes, skills, methods, and experience to achieve specific project objectives within defined parameters (Murray-Webster & Dalcher, 2019). Competent project managers play a vital role in the successful management of AHPs, overseeing activities throughout the project's life cycle. The Project Management Body of Knowledge (PMBoK) defines the project life cycle as the phases a project goes through from initiation to completion (Project Management Institute, 2017). To successfully carry out rehabilitation works, a team of trained professionals should be involved (Doraisamy et al., 2015b). The RehabiMed (2007) provides a structured approach to rehabilitation projects, consisting of several crucial stages: knowledge acquisition, reflection and diagnosis, project drafting, work execution, and life span maintenance. These stages ensure precise rehabilitation, preservation of building values, and adaptation to client needs.

However, there is still a gap between what researchers need to know about construction project management for AHP rehabilitation and what is currently being practiced. This gap is often influenced by social, economic, and political developments that shape the unique challenges and constraints faced by construction projects in different regions or countries (Abidin & Hassan, 2023). Therefore, this study conceptualises five phases to measure an effective project management approach for AHP rehabilitation, tailored to the specific context and situation: Feasibility, Decision Making, Rehabilitation, Maintenance, and Closing. By bridging the gap between theoretical knowledge and practical reality, and adapting international standards to the local context, the construction industry can improve project outcomes, meet stakeholder expectations, and contribute to the successful rehabilitation of abandoned housing projects in the country.

## **RESEARCH METHODOLOGY**

The nature of this research is exploratory, aiming to gain a deeper understanding of the practices of the white knight contractor (Ebekoziem, Abdul-Aziz and Jaafar, 2022). The research aims to explore the challenges and practices of the contractors in revitalising the AHPs. This research approach on the two steps namely, reviews of the literature on the effective project management practices

for rehabilitating AHPs and developing the research instruments to administer the interview session.

The research instruments of semi-structured interview were developed based on the following procedure:

- Stage 1: Establishing the ethical guidelines
- Stage 2: Crafting the interview protocol
- Stage 3: Scheduling then conduct the interview
- Stage 4: Analysing and establishing data saturation point
- Stage 5: Summarising the findings.

The interview process has the advantage of flexibility to ask detailed and enhanced questions beyond the initial plan (Adhabi & Anozie, 2017). Individual interviews provide an opportunity for in-depth exploration of specific topics and addressing personal challenges. However, a potential disadvantage is the time-consuming nature of interviews. To optimise efficiency, deploying predefined questions can shorten the duration while still generating valuable data that offer insights into the participants' experiences, perceptions, or opinions (Peters & Halcomb, 2015). Therefore, an in-depth interview approach is the most suitable data collection method for the current research.

The semi-structured questions adapt protocol suggested by Chen, Partington and Wang (2008) as listed in Table 1. For the data analysis, several methods including descriptive analysis by using frequency are presented in this paper. Each analysis and discussion are based on data collected throughout the Peninsular of Malaysia including two Federal Territories (WP), the WP Kuala Lumpur and WP Labuan as reported and published by the KPKT.

**Table 1:** Semi-structured questions.

<b>Interview questions</b>
<b>Warm up questions:</b>
- Can you describe your last rehabilitation project?
- Can you describe the typical project lifecycle of a rehabilitation project?
<b>Principal questions:</b>
- What was the organizational structure/culture in your previous rehabilitation project?
- Where are the common challenges when managing AHPs?
- What kind of project management methodologies do you employ (i.e., standards, tools, and techniques)?
- Based on your experience, what are the key criteria to a successful project management practice in a rehabilitation project?
<b>Follow up questions:</b>
- Could you further explain it?
- Can you give an example?
- What do you mean by that?

**Alternatives questions:**

- In your opinion, what are the major project management mistakes throughout the project life cycle of a rehabilitation project?
- How do you manage technical challenges during rehabilitation work?
- How do you manage the project costing and budgeting?
- How do you manage legal and regulatory aspect of the project?
- How do you assure quality during rehabilitation work?

**End Questions:**

- Is there anything that you would like to add?
- What is the most enjoyable feeling about your work? Why and give example.

Five respondents, all CIDB G7 class contractors actively engaged in rehabilitating AHPs in the Klang Valley, were chosen from a pool of ten potential candidates provided by the APRD. Selection criteria included their successful track record in AHP rehabilitation projects and their availability for interviews. Each interview session lasted one to two hours, and Table 2 below provides a summary of the respondent's backgrounds.

**Table 2:** The respondent's backgrounds.

Code	Position in the Organisation	Industry Experience (Year)	Experience Rehab. Of AHP (Year)	No. of AHP Completed	Location of Last AHP
R1	Project Director	40	10	5	Hulu Langat
R2	Project Director	21	11	3	Serdang
R3	Managing Director	40	15	3	Gombak
R4	Project Manager	30	10	2	Puchong
R5	Project Manager	20	10	2	Sepang

The study used thematic analysis to examine qualitative data by identifying, describing, and establishing connections between themes through coding (Braun & Clarke, 2006). A deductive approach was employed, utilizing existing theories to guide the analysis and interpretation (Braun et al., 2015). The analysis process involved examining, categorizing, and combining data to address the research objectives. Patterns in the raw data were identified, coded into categories, and developed into comprehensive themes to capture the depth of the original data (Seers, 2012). The aim was to draw out challenges and best practices for managing abandoned housing projects (AHPs).

To validate the identified themes, professionals in construction project management specialising in rehabilitation work were consulted through in-depth interviews. The deductive thematic analysis stages included familiarising with

the data, generating initial codes, searching for themes across the data, reviewing themes, and producing the final report.

## ANALYSIS AND DISCUSSION

The discussion of the study’s findings is divided into two main sections. The first section addresses the challenges associated with rehabilitation projects throughout the project lifecycle. The second section focuses on the Critical Success Factors (CSFs). The findings reveal that the challenges occurring throughout the lifecycle of AHP rehabilitation projects are unique. Table 3 highlights the themes and clusters of these challenges.

**Table 3:** Challenges codes throughout project lifecycle for AHPs

Phases	Emerging Themes on Challenges	RESPONDENT					Cluster of challenges
		R1	R2	R3	R4	R5	
Planning And Feasibility Studies	Lack of Information	/	/	/	/	/	1. Communication 2. Planning and preparedness 3. Risk Management 4. Competency and Expertise 5. Documentation and Accountability
	Poor prediction,			/			
	Inexperience,		/		/		
	Underestimation,	/				/	
	Lack of Legal Understanding	/					
Reflection And Decision-Making Process	Unqualified Decision-Making,	/					
	Lack Review of Challenges,				/		
	Prolonged Decision- Making,			/			
	Overanalysing,			/			
	Downplaying Probabilities ,	/					
	Incomplete Information,					/	
	Third-Party’s Involvement		/				
Rehabilitation Phases	Poor Site Management			/	/	/	
	Inattentiveness	/					
	Material Sourcing		/				
	Unqualified Contractors			/			
Maintenance And Project Closing	Poor Time Management,	/			/	/	
	Not Follow Requirement,			/	/		
	Insufficient Manpower,	/					
	Poor Construction quality,		/				
	Lack Documentation Review				/		

### ***Communication***

Inadequate or ineffective communication channels and practices can contribute to all the clusters. This includes issues such as poor information dissemination, lack of coordination, miscommunication between stakeholders, and insufficient sharing of project requirements and expectations.

### ***Planning and Preparedness***

Insufficient planning and preparation can be a common issue across all clusters. This involves aspects such as inadequate research, lack of thorough analysis and assessment, failure to anticipate challenges, and underestimation of project complexities.

### ***Risk Management***

Inadequate risk management practices are connected to several clusters. This includes issues such as poor prediction and evaluation of risks, downplaying probabilities, insufficient consideration of legal implications, and lack of proactive measures to mitigate risks.

### ***Competence and Expertise***

A lack of competence and expertise is evident in multiple clusters. This encompasses issues like inexperience, unqualified decision-making, unqualified contractors, poor construction quality, and insufficient manpower. It highlights the importance of having skilled and knowledgeable individuals involved in project management.

### ***Documentation and Accountability***

Insufficient documentation and lack of accountability are common threads. This includes inadequate record-keeping, failure to follow requirements, poor site management, and a lack of comprehensive documentation throughout the project lifecycle.

Addressing these overarching issues will help mitigate the specific challenges highlighted within each cluster. By improving communication, enhancing planning and preparedness, implementing effective risk management strategies, promoting competence and expertise, and emphasising documentation and accountability, projects can become more successful and better equipped to handle various challenges.

### ***Critical success factor for Effective project management practices***

Rehabilitation of abandoned projects is a complex and uncertain undertaking. However, these challenges are not insurmountable (Listokin & Crossney, 2006). The success of a project is determined by its ability to be completed within the

specified timeframe, within budgetary constraints, and meeting the client's expectations (Akinsiku et al., 2014). The completion of a project involves collaboration from various stakeholders, including the client, project team, parent organization, producer, and end user (Tabish and Jha, 2013). Ultimately, the project manager plays an important role in efficiently achieving the goals and objectives of the rehabilitation. In relation to successful project management practices, Table 4 identified ten (10) criteria that ensure success.

**Table 4:** Critical success factor for effective project management practices.

Respondent	Quotation	Emerging themes
R1	<i>"I think strong planning..."</i>	Good Planning
R5	<i>"By having a good planning. You will not fail if your planning is good."</i>	
R3	<i>"You also must have experience in rehab projects."</i>	Experience in doing Rehabilitation work.
R5	<i>"...top management's continuous support."</i>	Top Management Support
R3	<i>"The same as getting good consultants and contractors with experience."</i>	Experienced Professionals
R3	<i>"It all comes back the guideline from the ministry and everything about good governance."</i>	Regulations/ Guidelines
R1	<i>"...always have clear communication."</i>	Clear Communication
R1	<i>"It helps also with having a good knowledge in ISO for quality control."</i>	Quality Practices
R5	<i>"Also, you must have a good team all around with..."</i>	Team Support
R4	<i>"It's important for me to show good leadership. If the PM is a good leader, your team will follow and support you throughout the project."</i>	Good Leadership
R2	<i>"You must capture the form list of all the legal challenges or technical challenges, quality challenges that you're going to focus on."</i>	Generate Checklist of Challenges for references

Findings show human-related factors like competent project team, management support, coordination, communication, and relevant experience, as well as external factors like effective authority guidelines and regulations, significantly impact rehabilitation project success. A tailored project management approach considering internal and external factors is crucial (Khattak and Mustafa, 2019). Interviews identified effective time, team, decision-making, and communication skills as important critical success factors.

**a) Effective time management.**

Effective time management is vital for the success of a rehabilitation project. It involves planning and sequencing activities to ensure timely completion. Failure

to manage time properly can result in delays, cost overruns, disputes, potential litigation, and even project abandonment. Based on the interview findings, effective time management in rehabilitation projects requires managing critical tasks with flexible thinking, efficient float management, and the ability to adapt to changes. Additionally, the influence of regulatory processes on the project management team's ability to adhere to the specified timeframe should be considered. Implementing project control techniques is crucial for minimizing the risk of project delays and ensuring completion within the allocated budget and required specifications (Chin and Hamid, 2015). By recognising and implementing these techniques, the risk of project delays can be reduced, thereby facilitating the timely completion of the rehabilitation project.

***b) Effective project team management.***

The competency of the project team plays a vital role in the success of project rehabilitation. It is widely acknowledged that projects require intelligent, well-trained, and motivated individuals. However, limited research has focused on identifying the specific performance-based competencies that contribute to project success (Skumolski, 2005). Based on the findings, four (4) criteria have been identified for ensuring the competency of team members. These criteria include conducting team assessments, performing ISO audits on team members, specialisation of team member tasks, and continuous team training. Organisations need to prioritise these solutions to ensure they have an efficient workforce and retain competent employees. Employee commitment, along with a competent workforce, is seen as important for organisations to compete in terms of quality and adapt to changes (Tripathi & Agrawal, 2014).

***c) Effective decision making.***

Effective decision-making is critical in project management, as even the best planning and tools cannot make up for poor decisions (Morfin, 2004). To make an informed decision, project managers must gather relevant information and identify potential solutions to mitigate risks. The finding suggests that effective decision-making in project rehabilitation requires specific tools such as coordination meetings with brainstorming sessions to address key issues, tracking planned schedules, and maintaining regular communication among team members. This is because decisions are critical in every project phase and should be approached carefully with sufficient time allocated for research and evaluating alternatives.

***d) Effective Communication Skills for Project Managers.***

The project manager and their team are responsible for achieving project goals through cost-effective and efficient measures (Levin and Rad, 2004). Effective



communication is essential for clear understanding among team members. Key qualities of an effective project manager include being calm, a good listener, a problem solver, adept at team coordination, result-oriented, reasonable, and clear in communication. Communication is vital for selling ideas, changing behaviors, and providing updates (Fox, 2001). Ensuring successful communication within the project environment is essential, and professional communication skills significantly support project success (Mohd Fateh et al., 2023). Table 5 summarised the CSFs emerging themes derived from the interview sessions.

**Table 5:** Summary of Critical Success Factors from the interview sessions

Critical Success Factors (CSFs)	Emerging Themes on Best practices	RESPONDENT				
		R1	R2	R3	R4	R5
Effective Time Management	Identification of Critical Task	/				
	Flexible Thinking		/			
	Familiar with Authority Regulatory Processes			/		
	Manage Floats				/	
	Ability to adapt with Changes					/
Effective Project Team Management	Conduct Regular Team Assessment		/			/
	Having ISO Auditing system					/
	Create a specialisation			/		
	Continuous Team Training	/				
Effective Decision Making	Conduct Coordination Meeting		/	/		
	Flexible Thinking			/		
	Tracking skills	/				
	Keep Regular Communication				/	
Effective Communication skills for Project Manager	Remain Calm	/				
	Be a Good Listener	/				
	Problem Solver	/				
	Good Team Coordination		/			
	Performer			/		
	Reasonable				/	
	Clarity in giving information					/

## **DISCUSSION**

Interviews with respondents revealed that the organisations involved in project rehabilitation have a strong track record, particularly in the Klang Valley area. These organisations, classified as "white knight" contractors, hold important certifications such as CIDB G7 and ISO 9001:2015, which validate their quality and operational capabilities. The respondents demonstrated a clear understanding of the rehabilitation project lifecycle and effectively implemented strategies to meet the objectives of each phase.

The findings indicate a strong link between the financial status and constructability of abandoned projects during the feasibility phase. Conducting comprehensive stakeholder analyses and risk assessments can enhance decision-making. Developing a clear decision-making strategy, which includes adequate project information, risk solutions, technical assessments, experienced input, and collaboration with relevant authorities like the National Housing Department (NHD), is vital for addressing complex issues beyond the control of contractors.

During the rehabilitation phase, two distinct stages were identified: the authority stage and the physical work stage. Compliance with authority requirements and regulations often posed challenges, impacting the rehabilitation process. Respondents relied on experienced professionals and sought assistance from the NHD to navigate these challenges. Robust quality control measures throughout the rehabilitation process demonstrated the respondent's ability to manage project quality effectively.

The maintenance phase is vital for maintaining the overall quality of the rehabilitated project. A dedicated maintenance team and efficient checklist approaches were emphasised. Strict quality control during the rehabilitation phase minimises the need for costly maintenance post-completion. This approach ensures a smooth transition to the project's closure phase, which involves finalising accounts, meeting quality requirements, fulfilling contractual obligations, obtaining necessary certifications, and meeting conditions set by relevant authorities and project owners. The findings highlight the importance of a functional organisational structure and a strong organisational culture characterised by process-driven approaches, effective time management, teamwork, and a focus on quality.

## **CONCLUSION**

This research highlights the challenges and Critical Success Factors (CSFs) from White Knight Contractors (WKC) views in rehabilitating Abandoned Housing Projects (AHPs). The findings emphasise the need for a unique project management approach due to uncertainties related to the history of abandonment, stakeholder involvement, and the rehabilitation process itself.

The study identifies challenges and success factors related to effective project management practices by WKC. Insights from this research offer valuable perspectives and solutions for successful AHP rehabilitation. Project managers are central players in aligning projects with strategic goals and driving organizational success.

Effective project management requires strong leadership, management traits, and a comprehensive risk management strategy throughout the project lifecycle. The findings highlight the importance of identifying weaknesses in project management practices and addressing potential threats. Support from top management and a conducive organisational culture are vital for high-performance project delivery.

The factors developed from these findings serve as a valuable guide for G7 contractors, property developers, and lower-class contractors involved in AHPs. The research provides practical insights and recommendations for improved project planning, quality management, time management, risk management, and personnel skills. These findings contribute to the body of knowledge on effective project management practices in AHPs and will benefit stakeholders and future research in navigating the complexities of AHP rehabilitation, leading to successful project outcomes.

This research contributes to the body of knowledge on effective project management practices in AHPs. The findings will be beneficial for stakeholders and future research, helping them navigate the complexities of AHP rehabilitation effectively and achieve successful project outcomes.

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## **A COMPREHENSIVE BIBLIOMETRIC ANALYSIS OF SCIENTIFIC RESEARCH (1975-2023) ON FACTORS INFLUENCING SAFETY PERFORMANCE IN THE CONSTRUCTION INDUSTRY**

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### **Abstract**

This extensive bibliometric analysis delves into the dynamic and evolving landscape of research on safety performance factors within the construction industry. This study examines 468 academic articles to monitor the progression of research trends in the construction industry. There is a significant rise in academic endeavours that align with the swift advancements in technology in this domain. Notably, this analysis highlights the pivotal role of influential publication sources as primary repositories of knowledge dissemination. Furthermore, recurring keywords such as “construction industry” and “safety performance” illuminate the multifaceted nature of safety research, emphasising its holistic approach. High-impact works, especially those exploring safety culture and climate, have a strong influence on shaping the discussion and directing industry practices in the field. Academic institutions have also made substantial contributions, actively participating in shaping the conversation on safety performance. Hence, the in-depth analysis offers valuable insights for stakeholders committed to advancing safety practices in the industry, underscoring the sector’s steadfast dedication to fostering safer, more resilient, and socially responsible construction endeavours.

**Keywords:** Bibliometrics, Safety Performance, Citation Analysis, Knowledge Mapping, Safety Factors.

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## **INTRODUCTION**

Safety performance is a critical aspect in various industries, playing a vital role in safeguarding the well-being of workers and ensuring the overall success of organisations. Gaining insight into the variables that impact safety performance is crucial for efficient safety administration and the mitigation of workplace accidents. The factors that influence safety performance are crucial areas that require continuous attention and meticulous management to sustain a safe working environment (Buniya et al., 2023; Y. Li et al., 2018; Tezel et al., 2021).

In contemporary project management, determining the critical measures that guarantee successful safety performance for all stakeholders is a significant challenge (Sultana et al., 2019). It is essential to identify the factors that influence safety performance and develop strategies to measure, monitor, and improve safety outcomes (Lu et al., 2020; Nævestad et al., 2018, 2021). This article provides a comprehensive bibliometric analysis of scientific research conducted between 2012 and 2022 to contribute to the knowledge and advancement of research on factors influencing safety performance. The analysis is specifically focused on factors affecting safety performance and aims to identify research trends, collaboration networks, and gaps in the existing literature.

This study intends to employ bibliometric analysis to analyse the research landscape, assess the distribution and effect of publications, identify significant contributors, and research clusters, and track the evolution of research trends over time. Using the Scopus Database as the primary source of data, this study employs statistical and content analysis techniques, including the use of VOSviewer software, Excel sheets, and the WordArt website, to examine and evaluate relevant publications. The analysis will delve into various aspects, such as the publication output, most influential authors and institutions, citation patterns, co-authorship networks, and the thematic content of the publications.

## **LITERATURE REVIEW**

### **Concepts of Factors Affecting Safety Performance in the Construction Industry**

Safety performance pertains to an organisation's capacity to proficiently handle and reduce hazards to guarantee the welfare and security of its personnel, stakeholders, and the surrounding environment. It encompasses the implementation of strategies, policies, procedures, and practices aimed at preventing accidents, injuries, and occupational hazards within the workplace (Ghosh, 2021; Jääskeläinen et al., 2022a; Safety Management International Collaboration Group, 2013). Factors affecting safety performance in the context of safety performance are specific elements or factors that significantly influence the success or failure of safety initiatives within an organisation (Machfudiyanto



et al., 2019a). These variables are crucial for developing a strong safety culture, enhancing safety outcomes, and attaining organisational safety objectives (Buniya et al., 2023; Y. Li et al., 2018).

### **Bibliometric Study on the Factors Affecting Safety Performance in the Construction Industry**

Between 2012 and 2023, there have been comprehensive bibliometric studies on the construction industry found in the Scopus database. These studies (Akram et al., 2019; Chellappa et al., 2021; Ghaleb et al., 2022; J. Li et al., 2022; X. Liu et al., 2023; Malakoutikhah et al., 2022; Management, 2021; Newaz et al., 2023; Tao et al., 2020; Wang et al., 2019) all explored the landscape of scientific research on safety performance in the construction industry. They examined prominent publications, research patterns, and discoveries pertaining to the various aspects that impact safety performance.

The studies' findings have provided valuable insights on safety performance, emphasising the necessity for further investigation in this field which emphasise the importance of exploring factors affecting safety performance in the construction industry. Such research would not only augment the scientific knowledge repository but also yield practical implications, enabling the formulation of evidence-based approaches to increase safety performance within organisations. By addressing the factors affecting safety performance, organisations can better understand and implement measures that promote a safer work environment and prevent accidents and injuries.

### **Research Gap**

Several review-based studies have explored various facets of construction safety management (CSM), such as advanced technologies, construction equipment safety, safety culture, and accident causation models (Chen, K. 2020; Guo et al., 2017; Levitt & Samelson, 1993; Liang et al., 2020; Park & Kim, 2013). Nonetheless, there is a significant lack of research that specifically examines the elements that influence safety performance in the construction industry (Bhagwat & Delhi, 2022; Haupt et al., 2019; Kazan, 2013).

Existing studies have primarily concentrated on specific factors influencing safety performance within individual projects, with limited attention given to synthesising the broader body of knowledge or adopting a comprehensive approach (Clarke, 2006; Griffin & Neal, 2000; Jääskeläinen et al., 2022a, 2022b; Y. Li et al., 2018; Machfudiyanto et al., 2019b; Nævestad et al., 2018, 2021). As a result, there is a dearth of thorough comprehension of the aspects that have a substantial influence on safety performance in building projects. Hence, it is imperative to conduct a comprehensive review that

systematically explores and analyses the factors affecting safety performance in the construction industry, considering various dimensions and contexts.

## **RESEARCH METHODOLOGY**

This study employs a qualitative methodology that is well-suited for investigating open-ended inquiries, unexplored areas, and unknown frontiers (Aspers & Corte, 2019; Ensslin & Vianna, 2008; Kaiser, 2014). It is highly suitable for addressing problems that involve multiple stakeholders, settings, and processes, making it an advanced approach that transcends the limitations of purely qualitative or quantitative methods. This approach proves particularly useful in exploratory studies where initial knowledge of the problem and its boundaries is limited.

This study sequentially employs a science mapping approach from the bibliometrics to examine the elements that influence safety performance in the construction industry. The process has three primary stages: conducting a bibliometric search, performing scientometric analysis, and conducting content analysis. The objective is to create visual networks that depict research domains associated with safety performance. This approach improves understanding and contributes to evidence-based interventions for enhanced safety outcomes in the industry.

Bibliometrics, as described by Amadeu Dutra Moresi et al. (2021) and Donthu et al. (2021), applies mathematical and statistical methods to analyse literary works and measure texts and information. Common methods include citation and content analysis (Alryalat et al., 2019; Ninkov et al., 2022). For bibliometric analysis, the user-friendly VOSviewer software was employed to explore uncharted domains of knowledge, enabling researchers to visualise knowledge networks, uncover hidden connections, and identify trends (Shah et al., 2020; Xie et al., 2020). The VOSviewer software that is crucial for creating and displaying bibliometric maps and creating two types of mapping: bibliographic and textual data (Caputo & Kargina, 2022; Kirby, 2023). This software highlights several aspects, demonstrating the interaction between publications, authors, keywords, and citations. The analysed data was arranged by the co-occurrence and frequency of a minimum of 85 keywords, which accounted for 51% of all instances.

## **ANALYSIS AND DISCUSSION**

To perform the analysis efficiently, a sequential method is crucial. Initially, the process commences by establishing the parameters of the population and subsequently choosing an appropriate sample. Following the process of data codification, a comprehensive analysis and interpretation of the results. This systematic approach ensures that the necessary stages are methodically executed to attain the desired outcomes.

Rigorous filters were applied to curate documents that aligned with the research objectives. This involved setting a publication year range (1975–2023), which yielded 773 documents. To maintain relevance, non-engineering materials were excluded, leaving 607 pertinent documents. Emphasis on specific document types, such as articles and conference papers, resulted in 568 selections, while book chapters and reviews were excluded. Further filtering for final-stage publications generated 558 documents. Incorporating keywords like “safety performance,” “construction industry,” “construction safety,” and “safety factors” retained 497 documents. Diverse source types were included without specific exclusions, totalling 476 documents. The final selection only considered English-language documents, resulting in a dataset of 468 documents after the exclusion of nine documents in other languages. These stringent criteria ensured a focused dataset that aligned with the research objectives, as detailed in Table 4.

**Table 4:** Selection and Exclusion Criteria Findings

Criteria	Selection Criteria	Exclusion Criteria	No of document found
Publication Year	1975– 2023	No Exclusion	773
Subject Area	Engineering	No relationship with the engineering field	607
Document Type	Articles, Conference papers	Book chapters, Reviews Conference reviews	568
Publication Stage	Only the final stage	Articles in press	558
Keywords: Safety performance, construction industry, construction safety, safety factors	Presence of or some proximity with safety performance, construction industry, and factors	No relationship with safety performance, construction industry, and factors	497
Source type	Journals, Conference proceedings	Book series, Trade journals, Undefined	476
Language	English Language Only	Chinese, Japanese, Italian, Lithuanian	468

### ***Analysis***

Following a thorough examination of the titles, keywords, and abstracts of individual studies, 468 articles that had been published in prominent international journals were chosen for inclusion in the proposed bibliographic review for this study. In the context of safety performance factors, content analysis extended its application to delve into a myriad of elements influencing safety performance within the construction industry. Numerous authors in specialised literature have explored this subject across various thematic areas. On the other hand, a comprehensive review of major journals dedicated to research on safety

performance within the construction industry was systematically conducted. The primary aim was to identify the key factors that exert an influence on safety performance. A total of 468 research articles were identified, collectively encapsulating the principal viewpoints of several authors on the factors that shape safety performance.

Based on the findings of this bibliometric analysis, it appears that studies on safety performance factors in construction have been published since 1983. As these factors evolved and gained prominence over the years, the number of studies has continued to grow steadily. While there were relatively few studies in the 1990s, the research area garnered significant attention in the last decade, resulting in a noticeable upward trend in the number of research studies, as illustrated in Figure 1. This increasing trend can be attributed to the concurrent development and adoption of technologies in the construction industry. In total, the bibliometric analysis included 468 documents. Most of these documents consisted of articles (341), with conference and proceedings papers (127) being the next most common type.

Prominent individuals in the academic study field are perfect examples of knowledge and intellectual competence. A thorough and comprehensive examination of the Scopus database reveals a definitive list of the top 10 luminaries working in this extremely specialised study field (as depicted in Figure 2). Chan, A.P.C., distinguishes himself from other experts with an impressive collection of 22 scholarly documents. In addition, A.J. Al-Bayati has produced 14 notable contributions to this field, garnering significant attention. Similarly, Chen, Y., and McCabe, B., have individually authored 11 notable articles that demonstrate their academic relevance.

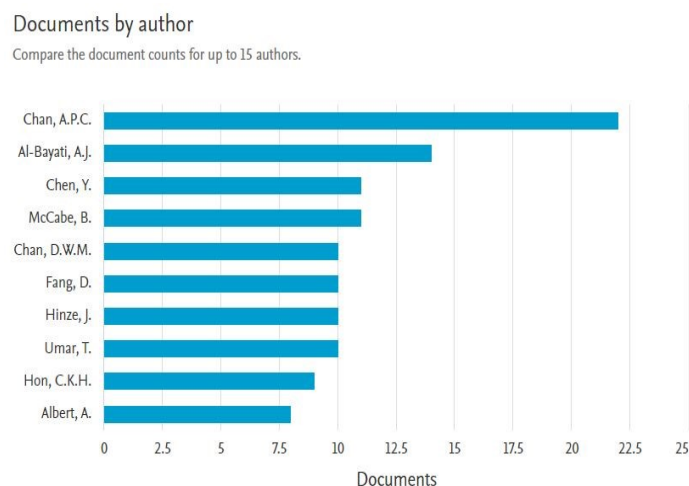
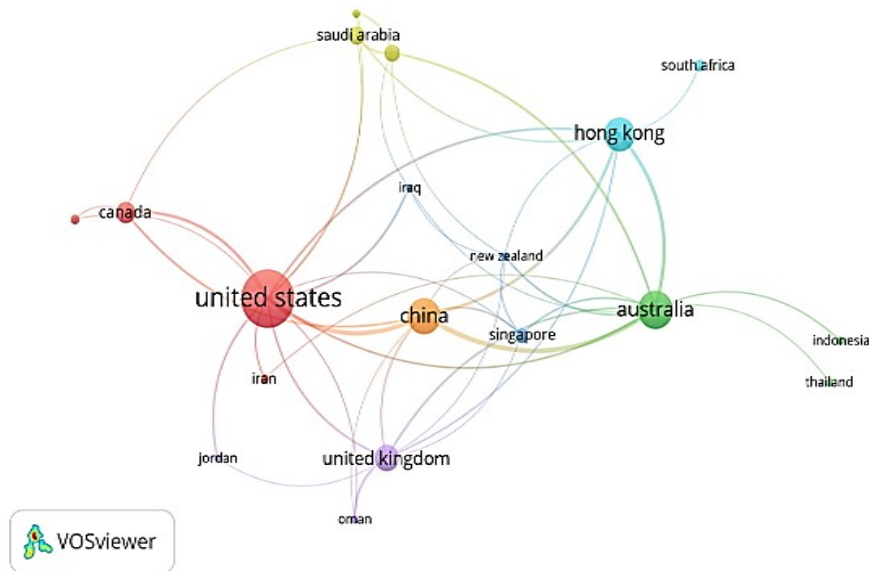


Figure 3: Documents by Author



**Figure 3:** VOSViewer Analysis of Countries

Apart from that, Figure 3 above indicates the bibliometric analysis of countries, which is divided into seven distinct clusters, each represented by a unique colour. The colour-coded map further elucidates this by showcasing the volume of scholarly documents generated by each country. Collaborative links between countries are depicted by the overlapping of the two colours between the respective elements. Together, this analysis provides a comprehensive and illuminating perspective on the intricate relationships and research contributions among countries, offering valuable insights into the dynamics of the global research landscape.

### ***Discussion***

This bibliometric analysis revealed the evolving research patterns concerning safety performance variables in the construction industry, indicating the sector's ability to adapt to emerging issues.

The identification of prominent publication sources, including the Journal of Construction Engineering and Management, Safety Science, and Construction Management and Economics, underscores the critical role of specialised platforms in knowledge dissemination. These journals serve as repositories of evidence-based practices, facilitating the exchange of ideas and insights among researchers, practitioners, and policymakers. Their influence extends beyond academic boundaries, shaping industry practices and regulatory

frameworks. As these sources continue to thrive, they are poised to play an instrumental role in shaping the future discourse on safety performance factors.

The highly cited research documents identified in this analysis represent the cornerstone of safety performance research. These studies have made substantial contributions to theoretical frameworks and have also offered practical insights that are relevant to the industry's stakeholders. For instance, the seminal work by Choudhry et al. (2007) on safety culture serves as a roadmap for organisations seeking to cultivate a safety-centric culture. Siu et al.'s (2004) exploration of safety climate and psychological strains offers valuable perspectives on the psychological aspects of safety performance. Aksorn and Hadikusumo's (2008) study on critical success factors provides actionable insights for project managers and stakeholders, emphasising the role of employee involvement and management commitment. The impact of these documents extends beyond academia, permeating the construction industry and influencing decision-making processes.

Although this bibliometric analysis provides valuable insights, it is crucial to acknowledge its limitations. The dependence on existing literature restricts the exploration of emerging issues and gaps in empirical research. Potential areas for future research could involve a more thorough investigation of emerging technologies, such as the Internet of Things (IoT) and artificial intelligence, and their impact on safety performance. The integration of these technologies into construction processes offers opportunities for real-time monitoring, predictive analytics, and proactive risk management. Furthermore, comparative studies that assess safety practices and outcomes across different regions and construction contexts can contribute to the development of context-specific strategies.

In short, this bibliometric analysis serves as a foundational resource for researchers, practitioners, and policymakers invested in enhancing safety performance in the construction industry. As the construction industry continues to evolve, embracing technological innovations and sustainability imperatives, safety performance research remains an essential compass, guiding the sector towards safer, more resilient, and more socially responsible practices.

## **CONCLUSION**

In the realm of construction industry safety, the comprehensive bibliometric analysis conducted herein has offered a valuable lens through which to scrutinise the multifaceted terrain of safety performance research. The trajectory of safety performance research has, over the years, revealed the sector's remarkable adaptability and resilience in the face of evolving challenges. It thus illuminates the profound commitment of both academic and industrial stakeholders to proactively address safety concerns.

In synthesis, this bibliometric analysis stands as an invaluable resource, catering to the needs of researchers, practitioners, and policymakers who are highly committed to improving safety performance within the construction industry. It serves as an illuminating guidepost, charting the evolutionary trajectory of safety research, delineating the dominant agents of influence, and elucidating the significance of international collaboration. As the construction industry continues its evolutionary trajectory, marked by the assimilation of technological innovations and the embrace of sustainability imperatives, safety performance research remains an indispensable compass—a guiding light steering the sector towards practices that are inherently safer, more resilient, and imbued with social responsibility.

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## **THE EFFECT OF AN OVERNIGHT POLICY RATE (OPR) HIKE ON HOME LOAN IN MALAYSIA**

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### **Abstract**

Bank Negara Malaysia (BNM) has employed numerous monetary policies to reduce inflation and ensure financial stability. It includes the change in the Overnight Policy Rate (OPR), which is the benchmark interest rate at which banks borrow and lend cash overnight. The purpose of this research was to explore the implementation of OPR and the effect of OPR hike towards home loans. This was achieved through a qualitative research design involving interviews with representatives (bankers) from Bank Negara Malaysia as well as conventional and Islamic banks. The results revealed that OPR implementation is conducted by Bank Negara Malaysia through the Monetary Policy Committee (MPC), which is in charge of developing policies for conducting monetary activities. While the OPR hike inflicts an impact on the interest rates of home loans, statistics from BNM showed an increase of home loan borrowers during the third quarter of this year compared to the second quarter across both conventional and Islamic banks. These findings offer critical insights into the effects of OPR increase on Malaysian home loans. Therefore, financial institutions should establish risk management measures while simultaneously providing home buyers with reasonable and accessible financing choices.

**Keywords:** Overnight Policy Rate (OPR), Home Loan.

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## **INTRODUCTION**

A home loan is an amount of money borrowed by an individual from a financial institution to finance the purchase of a house or invest in real estate. The individual who owns the property (the borrower) gives a title to the lender with the understanding that it will be returned to the owner once the last loan payment is completed and all other mortgage terms are satisfied (Julia, 2022). Often, a home loan is the largest loan that most individuals would subscribe to satisfy their needs for a house or invest in real estate.

However, the overnight price rate (OPR) in the monetary policy can have an impact on home loans. OPR is an interest rate that is applied when a depository institution loans or borrows cash in the overnight market from a different depository institution. It is commonly established by the central bank of a nation for the purpose of monetary policy. In Malaysia, the OPR is set by Bank Negara Malaysia (BNM) as the central bank (James, 2022). Since banks count on lending as an essential commercial activity, maintaining their accessible cash reserves is critical to satisfy BNM's liquidity criteria. Bank interest rates, as determined by OPR, provide the foundation for national monetary policy to ensure that banks have a steady supply of accessible cash.

Changes in the OPR set in motion a chain of events that affect the base lending rate (BLR), basis rate (BR), fixed deposit rates, short-term interest rates, long-term interest rates, foreign exchange rates, and ultimately, a variety of economic variables such as employment, goods and services prices (inflation), and economic growth. When the OPR rises, banks pass on the cost to consumers in the form of a higher base rate (BR). This means that it is now more expensive for buyers to take out a home loan because the loan tenure will increase regardless of whether the monthly home loan instalment is higher or remains similar.

## **RESEARCH BACKGROUND**

Overnight Policy Rate is the rate of interest that a depository institution (usually a bank) loans or borrows cash in the overnight market from another depository institution (James, 2022). Malaysia's borrowing costs rose again for the fourth time this year, with Bank Negara Malaysia raising the OPR by 25 basis points to 2.75% during the sixth and last Monetary Policy Meeting (MPC) for 2022 held on 3 November 2022 (Priyatharisiny, 2022).

### Central bank policy rate for selected countries (%)

COUNTRIES	MONTHS, 2022			
	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER
Malaysia	2.25	2.50	2.50	2.75
Indonesia	3.75	3.75	4.25	4.75
Philippines	3.75	4.25	4.25	4.25
Thailand	0.75	1.00	1.00	1.00
Vietnam	4.00	5.00	6.00	6.00
India	5.40	5.90	5.90	5.90
Japan	-0.10	-0.10	-0.10	-0.10
Euro area	0.50	1.25	1.25	2.00
UK	1.75	2.25	2.25	3.00
US	2.25-2.50	3.00-3.25	3.00-3.25	3.75-4.00

**Figure 1:** Overnight Policy Rate for selected countries including Malaysia.  
*Source: Priyatharisiny (2022)*

According to the Malaysian Industrial Development Finance Berhad (MIDF) Research, the new sales prognosis for property demand is sluggish due to negative consumer mood caused by rising OPR. Loan applications for property transactions declined by 7.3% month-on-month to RM43.95 billion in October (Azanis, 2022). The two consecutive reductions in loan applications might be attributed to Bank Negara Malaysia's September OPR boost, which reduced buyers' interest and affordability. Loan applications dropped by 10% year-on-year in October after three months of strong growth, indicating that demand for real estate is moderating. Nonetheless, MIDF Research stated that the reduction in property overhang was modestly beneficial for the sector, since additional reductions in property overhang in the future may alleviate worries about the oversupply in the housing industry (Azanis, 2022).

The decline in applications for loans and approvals began in August 2022, owing to banks tightening lending rules, monetary policy normalisation, and growing living expenditures (Sharen, 2023). Other factors impacting loan growth in the real estate business include the OPR, trust among consumers, and inflation forecasts. Higher OPR will inflict more cost on loan money, which can have a major impact on the housing industry. BNM has kept the OPR rate at 2.75% as of the beginning of 2023, which is a 0.25% increase from the prior rate of 2.50% in September 2022 (Kathy, 2023).

OPR Decision and Statement			
Date	Change in OPR (%)	New OPR Level (%)	Monetary Policy Statement
09 Mar 2023	0	2.75	<a href="#">View Statement</a>
19 Jan 2023	0	2.75	<a href="#">View Statement</a>
03 Nov 2022	+0.25	2.75	<a href="#">View Statement</a>
08 Sep 2022	+0.25	2.50	<a href="#">View Statement</a>

**Figure 2:** The current OPR decisions set by Bank Negara Malaysia.  
*Source: Bank Negara Malaysia (2023)*

Many people are worried about the health of their family finances because BNM is expected to raise the OPR again at the end of the month. Maybank Investment Bank (Maybank IB) expects another 25-basis point (BPS) rise to return OPR to the pre-COVID-19 level of 3.00%, with its eyes placed upon the next three Monetary Policy Committee (MPC) discussions this year, which are scheduled for 2 to 3 May, 5 to 6 July, and 6 to 7 September (Kathy, 2023). Economists anticipate that BNM will continue to raise the OPR to at least 3.00% this year in accordance with the improving economic performance. Following the beginning of COVID-19 in Malaysia in early 2020, the OPR was reduced to a record of 1.75%. It was hiked four times last year by a total of 100 basis points to 2.75%, which is still lower than the pre-COVID-19 rate of 3.25% observed in March 2019.

## LITERATURE REVIEW

### Overnight Policy Rate (OPR)

OPR is a gauge of the BNM's monetary policy stance and acts as a target rate for BNM on a daily liquidity operation. Any shift in the MPC's monetary policy stance would be signalled by a shift in the OPR. Additionally, OPR stands as the principal reference rate used to calculate other market rates (Noor, Tzeng, & McGowan, 2014). According to Dieter and Jan (2011), OPR can be defined as signalling the desired rate of interest level and monetary policy perspective. Central banks have adjusted their monetary policy tools in recent years to

guarantee that the overnight rate closely matches their primary policy rate and that volatility is kept to a minimum. The mean and variance of policy spreads, such as the divergence of the overnight rate in relation to the policy-intended level, are sometimes seen as indications of monetary policy's efficacy.

If the policy spread persists for a prolonged period, the long-term impact of shocks would limit the overnight rate's signalling role and the central bank's control over interest rates. Jasmin, Eduard, and Veronica (2012) stated that over the last 30 years, most central banks have turned to use overnight policy interest rates as the main monetary policy weapon due to their clarity in signalling monetary policy stance. Its usage as the primary policy tool coincides with central banks' transition towards monetary aggregate targeting and other monetary policy frameworks incorporating control over short-term rates of interest. In conclusion, OPR describes the main monetary policy that signals the desired rate of interest level. Central banks' use of policy rates demonstrates their reliance on indirect monetary management, which is consistent with rising financial growth.

## **Factors Affecting Overnight Policy Rate**

### **1. Inflation**

Inflation refers to the rate at which prices rise over a specific time period (Oner, 2017). The term is often defined as a broad metric, such as the whole rise in prices or the rising cost of living in a country. However, it may also be computed more precisely—for instance, specific items such as food or services like haircuts. In any context, inflation reflects how much costlier a specific set of products and/or services has gotten over a specific time period, most typically a year (Oner, 2017). The cost of living for consumers is determined by the costs of various products and services, as well as the proportion of every item in the spending plan for the family. Government agencies undertake home surveys to establish a basket of regularly purchased commodities and track the expenses of buying this basket over time to determine the typical consumer's cost of living. In Malaysia, housing expenditures, including rent and mortgages, form the biggest part of the consumer basket (Oner, 2017). Nonetheless, Bank Negara has concerns regarding the core inflation rate as data from the Department of Statistics Malaysia (DoSM) showed a rise to 4% year-over-year at the end of September compared to 1.6% in January (Lukman, 2022). The rise will serve to control demand pressures, allowing inflation expectations to be handled without increasing inflation.

However, since the interest rate is currently below the neutral rate, it is anticipated that the central bank will continue to normalise, considering that the interest rate fluctuated between 3.25% and 5% prior to the pandemic (Lukman, 2022). The central bank may continue to press for hiking interest rates to the neutral rate. Naturally, the magnitude and rate will be determined by current inflation and growth momentum. Bank Negara's decision to begin raising the

OPR benchmark can potentially reduce the substantial spike in inflation or prices for commodities, hence strengthening the Malaysian Ringgit (MYR) against the US Dollar (USD). As shown in January 2018, when the OPR raised the cost of services and goods, the index for consumer prices fell to 2.7% year-on-year, down from 3.6% prior (Mikail, 2022). Furthermore, after the country's bond market reported a net international inflow of RM4.5 billion and international local equities investors became net purchasers of RM3.4 billion in January 2018, the rise in OPR is projected to accelerate foreign capital inflows towards Malaysia (Mikail, 2022).

## **2. Sustainability of Economic Growth**

Economic growth can be defined as a rise in the production of economic products and services in one period of time over another. It can be identified in nominal or real (inflation-adjusted) terms (Potters, 2021). Aggregate economic growth is commonly measured through Gross Domestic Product (GDP) or Gross National Product (GNP) while other measures are occasionally employed. The pace at which the economy is able to grow is referred to as sustainable growth. For some, increasing economic growth today above the sustainable rate might appear to be an appropriate move (Bank Negara Malaysia, 2023).

Good economic growth can cause the OPR to rise, whereas slow growth in the economy can cause the OPR to fall. A robust economy often results in higher inflation and more credit demand, necessitating tighter monetary policy. The responsibility of creating and implementing monetary policy in Malaysia is vested on BNM as the country's central bank. According to the Central Bank of Malaysia Act 2009, one of the primary objectives of BNM is to foster monetary stability that is favourable to the Malaysian economy's long-term growth (Bank Negara Malaysia, 2023). In promoting monetary stability, BNM is mandated to pursue a monetary policy which serves the country's interests with the primary objective of maintaining price stability while giving due regard to developments in the economy. It is crucial to have sustainable economic growth that does not cause other issues. Past years have witnessed how excessive growth or growth fuelled by cheap credit harmed the economy as evidenced in nations with excessively high inflation. When this occurs, the people, particularly future generations, bear the consequences and are left impoverished. Sustaining growth helps to mitigate such a boom-bust cycle.

## **3. Monetary Policy Stance**

Comprehensive knowledge, sound analysis, and excellent judgment are required for effective judgements. The actions of central banks are often based on the evaluation of their monetary policy stance, which may be characterised as monetary policy's contribution to financial, economic, and monetary



developments (European Central Bank, 2010). Assessing such a stance entails determining whether the contribution is consistent with the central bank's aim. Monetary policy refers to the actions taken by BNM to regulate economic interest rates. As the central bank of Malaysia, the purpose of BNM is to encourage monetary and financial stability (Bank Negara Malaysia, 2023). This is intended to create the circumstances for Malaysia's economy to thrive sustainably. Furthermore, the MPC determines monetary policy to maintain inflation low and stable while promoting economic development for achieving monetary stability.

According to Bank Negara Malaysia (2023), the Monetary Policy Committee (MPC) is responsible for creating monetary policy and policies for the implementation of monetary policy operations under the Central Bank of Malaysia Act 2009. The MPC makes monetary policy decisions by assessing the balance of risk to the forecast for domestic inflation and GDP. They also monitor risks of destabilising financial imbalances given its implications for the prospects of the economy. The MPC meets at least six times each year to deliberate on the OPR and issues concerning the Monetary Policy Statement (MPS) to explain what has been decided (Bank Negara Malaysia, 2023).

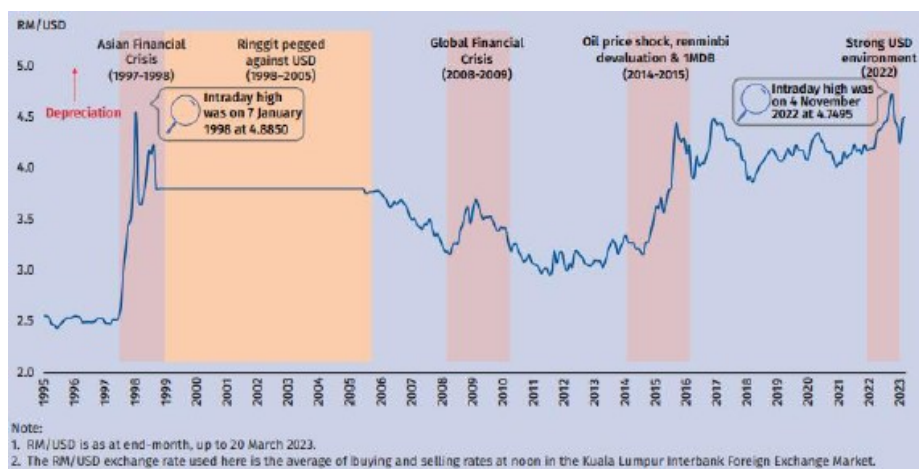
The MPC is formed by the Governor and Deputy Governors as well as three to seven additional members, including external members selected by the Minister of Finance following the proposal of the Bank's Board Governance Committee. The MPC membership aims to bring together a range of skills and experience that is essential for good monetary policy decision-making. BNM will provide optimal circumstances for the Malaysian economy through its role in supporting financial stability. As a result, if the inflation rate becomes excessively high, the OPR will be raised to calm the economy.

#### **4. Exchange Rate**

An exchange rate is the rate upon which one currency is exchanged for another which influences commerce and money flow between countries (James, 2022). Both the local and foreign currency values influence exchange rates. In June 2023, the exchange rate from MYR to USD was RM 4.67. The exchange rate between two currencies is generally decided by each country's market interest rates, unemployment rate, economic activity, and GDP. It is set in the global financial marketplace where banks and other financial organisations trade currencies around the clock depending on these criteria. This can be referred to as market exchange rates (James, 2022).

A rise in the OPR can swiftly result in a comparable appreciation of a currency's foreign exchange rate. This is because since everything else is comparable, investing in a nation with a greater rate of interest will increase demand for that currency, causing its exchange rate to rise (John, 2014). Changes in the rate of exchange can have an impact on the economy's inflation rate, thus

affecting the OPR. For instance, more inflation may emerge if the exchange rate falls, hence necessitating a rise in OPR by BNM. According to Bank Negara Malaysia (2022), the MYR rate suffered a persistent fall with USD in 2022. While slight changes in the ringgit currency exchange rate are typical, major moves can have long-term consequences for businesses, consumers, and the economy. MYR, in opposition to USD, was hovering at values last seen throughout the Asian Financial Crisis (AFC) in Figure 3, hence became an issue of concern.

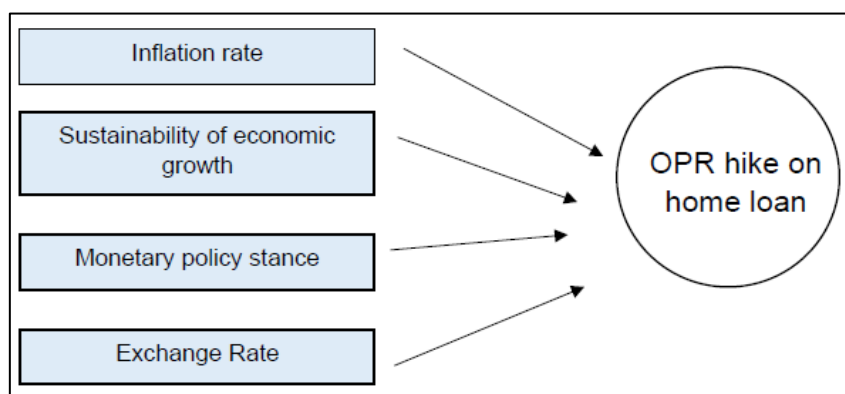


**Figure 3:** The performance of the Malaysian Ringgit against the US Dollar.  
 Source: Bank Negara Malaysia, 2022.

## RESEARCH METHODOLOGY

In this research, qualitative research design in the form of interviews was employed to attain a better comprehension and understanding about industry-specific references, such as economic theories or financial terms. Since Bank Negara Malaysia is the only entity eligible for OPR, the interview session was deemed the most accurate approach to obtain data regarding OPR. Additionally, findings from previous studies were also gathered for further support.

A review of past studies led to the proposal of a conceptual framework to achieve the aims of this investigation. As shown in Figure 4, the proposed conceptual framework comprises inflation, sustainability of economic growth, monetary policy stance, exchange rate, and global economic condition as the independent variables (IV) and OPR hike on home loans as the dependent variables (DV).



**Figure 4:** Conceptual Framework  
Source: Author's (2023)

## DATA ANALYSIS AND FINDINGS

The interview sessions involved several persons in charge from the central bank and commercial banks with work experience concerning financing and loans. The purpose of the interview was to explore the effect of OPR increase on commercial and Islamic bank home loans. All respondents were codenamed as R1, R2, and R3 while the banks were referred to based on their respective names.

**Table 1:** List of respondents from the central bank, commercial bank, and Islamic bank.

Respondents' Background		
Respondent	Bank	Location
R1	Bank Negara Malaysia (BNM)	Kuala Lumpur
R2	Malayan Banking Berhad (Maybank)	Johor Bahru
R3	Bank Islam Malaysia Berhad (Bank Islam)	Selangor

Source: Author's (2023)

The diverse responses obtained amidst the rise in OPR could inflict significant difficulty to obtain loans from banks. R1 said that the increase in the OPR rate will also increase the home loans. However, the data suggests that it is not difficult for people to apply for home loans because the OPR rate in Malaysia is still low. The data also showed that there is an increase in home loans and household loan applications, indicating that loan demand improved up to 4.1% during the third quarter of this year than 2.5% in the second quarter. BNM further reported that the rate of home loan borrowers rose at the end of 2023, indicating that it is not difficult for individuals to obtain home loans even if the OPR is raised to 3%.

**Table 2:** Loan application data for households in the second and third quarters.

Loan Indicator for households	2023			
	During Period (RM Billion)		Annual Change (%)	
	Q2	Q3	Q2	Q3
Loan application	RM 231.70	RM 231.70	2.5 %	4.2%

Source: Bank Negara Malaysia (2023)

Meanwhile, R2 said that higher OPR will result more expensive cost to borrow money, which can have a significant influence on the housing sector. The extent of such impact will depend on whether borrowing is tied more to short- or long-term rates.

This demonstrates the difficulty for people to obtain a loan depending on whether they want a short-term or long-term loan because the rates for both are different and rely on a person's financial status. According to R3, an increase in OPR could inflict significant difficulty for some Malaysians to obtain home loans from Islamic banks. This is because banks commonly price their home lending products using the base rate, which is related to the OPR. Subsequently, the rise in OPR will increase the base rate, resulting in larger monthly payments for borrowers. This demonstrates that an increase in OPR will affect home loan borrowers. Both respondents agreed that such an increase in borrowing rates can make it more difficult for certain people to finance a home loan, particularly those with lower salaries or high debt-to-income ratios since they may have to cut back on other spending or postpone their home purchase plans. Several commercial bankers highlight the effects faced by conventional and Islamic banks following the BNM's announcement of increasing the OPR rate. R2 said that such a condition will result in borrowers having to pay more for the loan to the lending bank. While there are cases of individuals pleading for lower rates, such a decision is not within the bankers' capability. R2 further stated that "no one had withdrawn from the loan", thus implying that borrowers are still opting to take out loans from this particular lending bank despite the increased interest rates. This might be attributed to various circumstances. For instance, borrowers may still regard this bank as a legitimate and dependable source of money lending. It is also probable that they could not find alternative entities offering better credit arrangements. Additionally, the borrowers may have pressing financial circumstances that necessitate fast access to cash and they are willing to pay a higher interest rate in exchange for the simplicity and rapidity of the loan procedure.

According to R3, banks earn profit by charging greater interest rates on loans than they do on deposits. Such a condition is referred to as the spread or the

net interest margin (NIM). When the OPR rises, the profit margins decrease because banks must offer lower interest rates for loans to remain competitive. The increased OPR also indicates that the central bank is tightening monetary policy to keep inflation under control. This will result in more alternatives for borrowers to choose and banks may cut their loan rates to remain competitive in the market. It also reduces the difference between loan and deposit rates, which could result in lesser bank profit margins. Therefore, banks will need to identify new sources of income or cost-cutting initiatives to compensate for decreased profit margins.

### **CONCLUSION**

In conclusion, our findings showed that the implementation of OPR in Malaysia is governed by BNM through the MPC, which is responsible for developing policies for monetary activities. Furthermore, BNM's decision to increase the OPR has inflicted an impact on existing home loans in Malaysia. However, statistics by BNM revealed a rise in home loans, thus implying that the OPR hike does not affect the demand for home loans. This is further supported by the significant increase in home loan applications in the third quarter of this year than the second quarter.

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**BRIDGING ISLAMIZATION OF HUMAN KNOWLEDGE (IoHK)  
THROUGH MAQASID AL-SHARI'AH'S COMPONENTS: A CASE  
STUDY OF COLLEGE OF BUILT ENVIRONMENT (CBE), UiTM**

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**Abstract**

The content of knowledge related to the built environment includes what is needed to plan, develop, build, and care for the earth as its occupants and guardians (Khalifah). However, the frequency of natural disasters has indicated that man has not been able to manage the Amanah. In pioneering research on Maqasid Al-Shari'ah, Ahmad Sarkawi and his group have raised question on whether man is aware of the correct ways to govern the Earth. As an early stage, the study aims to look at the implementation level of IoHK modes in incorporating Maqasid Al-Shari'ah components among lecturers in the College of Built Environment (CBE) at Universiti Teknologi MARA (UiTM). The institution serves as an ideal case study, parallel to the existence of the Shari'ah in Built Environment (SiBE) Research Group coupled with the huge numbers of graduates from CBE. Content analysis approach has been utilized, which analyzed academic programs and course outlines. This is followed by structured interviews among the Quantity Surveying (QS) lecturers to evaluate the implementation level of IoHK modes on the Maqasid Al-Shari'ah components. The results indicated that the implementation of the most permissible IoHK mode on all the components of Maqasid Al-Shari'ah is still low among QS lecturers in CBE. Through this scholarly research findings, the researchers aim to help in providing a meaningful recommendation to align the CBE's educational framework with the major components of Maqasid Al-Shari'ah, thereby advancing the harmonization of Islamic principles with the BE's body of knowledge.

**Keywords:** Islamization of Human Knowledge (IoHK); Maqasid Al-Shari'ah components; Built Environment, College of Built Environment (CBE)

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## **INTRODUCTION**

In Malaysia, the conceptualization of Islamization of Human Knowledge (IoHK) has been progressively studied and established by scholars at the International Islamic University Malaysia (IIUM) (Hashim (1999); Hashim & Ssekamanya (2013); Ssekamanya, Suhailah, & Nik (2011)). IoHK can be defined as a transformative intellectual movement that seeks to reframe contemporary knowledge within an Islamic worldview, ensuring that all forms of knowledge resonate with Islamic values and principles (Ahmad Sarkawi, Abdul Rashid, Aripin, Hassan and Othman(2015a); Hashim & Ssekamanya (2013); Ssekamanya, Hussien & Ismail (2011)). Meanwhile, Maqasid Al- Shari'ah represents the main goals of Islamic law, emphasizing its purposeful design to benefit individuals and society (Auda, 2008; Muhammad Al-Tahir Ibn Ashur (2006)). As developed and expanded by prominent early Islamic scholars, there are five (5) components of Maqasid Al- Shari'ah; preservation of i) faith or belief; ii) self or body, iii) intellect or reason; iv) lineage or posterity; v) property or wealth.

The initial revelation to Prophet Muhammad S.A.W. was the command 'Iqra', which translates to 'read' or 'recite'. This emphasizes the profound significance of the pursuit of knowledge in Islam. This directive not only highlights the importance of the learning process but also highlights the role of education in shaping societies and the global ummah. Being an educator, especially in this millennium, presents unique challenges. Educators are tasked not only with imparting concrete knowledge and skills to students for their future endeavours but also with nurturing individuals who will positively contribute to societies, nations, and the broader ummah. Consequently, educators must periodically pause and reflect: Does our existing educational system align with the needs of the Muslim ummah? Is our curriculum responsive to the evolving demands of global professionals? Do we prepare our graduates for the ever-changing landscape of technology, worldviews, and human ideologies and behaviours? As Muslim educators, we should draw inspiration from the path of our Prophet SAW, who emphasized seeking knowledge as a form of worship. His method emphasized both the acquisition of knowledge and the development of a moral and ethical character. Within the realm of literature, extensive research exists that separately delves into IoHK and Maqasid Al-Shari'ah. Therefore, this study seeks to implement the idea of bridging IoHK and the components of Maqasid Al-Shari'ah. The hypothesis of this research suggests that it is crucial to bridge the IoHK through the components of Maqasid Al-Shari'ah. This is necessary to align knowledge and education with the fundamental values and objectives of Islamic law. It ensures that the pursuit of knowledge is not only academically rigorous but also ethically grounded and relevant to the pressing issues of our time.

The following rationale for incorporating the concept of uniting IoHK with the components of Maqasid Al-Shari'ah in this study is rooted in concerns related to the de-secularization or de-westernization of the Muslim education system. The approach articulated by Al-Attas (Al-Attas, 1978 and 1980 and Wan Mohd Nor, 1997 and 1998) as described in the work by Hashim and Ssekamanya Siraje (2013) aims to replace the secular or Western perspective that prevails in contemporary education with an Islamic worldview. Al-Attas argues that the secularization of education has resulted in the loss of 'adab,' which encompasses discipline in mental, spiritual, and physical dimensions. This loss has resulted in a disoriented understanding of the value and hierarchy of knowledge among Muslims. To address this issue, Al-Attas (1978 & 1980) proposes the concept of Islamization of Knowledge (IoK), which is built upon the intellectual contributions of Islamic scholars such as al-Ghazali and various other philosophers, theologians, and jurists. This educational paradigm has played a central role in shaping the philosophy of the International Institute of Islamic Thought and Civilization (ISTAC) since its establishment in 1989 (Wan Mohd Nor, 1998). In essence, the importance of this bridge between IoHK and Maqasid Al-Shari'ah's components lies in the restoration of a holistic and Islamic-oriented approach to education, countering the challenges posed by secularization and westernization within the Muslim education system.

Within the academic literature, a prominent scholar who has dedicated significant attention to the examination of Maqasid Al-Shari'ah within the context of the school of the built environment is Ahmad Sarkawi (Ahmad Sarkawi et al., 2015a, 2015b, 2015c, 2017). Among the fields that comprise the body of knowledge related to the built and natural environment in the field of education are architecture, urban and regional planning, land and property management, engineering, quantity surveying, construction technology, and landscape architecture. This body of knowledge seems to be very similar to what is needed to plan, design, build, and take care of the Earth as its guardians (khalifah). Ahmad Sarkawi, Abdul Rashid, Hasan and Mohamad (2015c) mentioned that the frequency of floods, contamination, deforestation, droughts, and other natural disasters suggested that man has failed to bear the Amanah. As a result, questions about whether man has the necessary knowledge and awareness of how to govern the Earth, particularly in terms of achieving the Maqasid Al-Shari'ah, have been raised (Ahmad Sarkawi et al., 2015c).

Therefore, this study was conducted in an attempt to find answers to the issue. The study aims to look at the implementation level of IoHK modes in incorporating the components of Maqasid Al-Shari'ah among lecturers in the College of Built Environment (CBE) at Universiti Teknologi MARA (UiTM). The institution serves as an ideal case study, in line with the existence of the Shari'ah in Built Environment (SiBE) Research Group (September 2020) and the

huge numbers of CBE graduate students; 75,882 graduated since 1971. The research also aims in offering valuable insights into how knowledge related to the built environment (BE) can be aligned with the ethical and moral requirements set forth by Maqasid Al-Shari'ah components. To unravel implementation, the research methodology draws inspiration from prior work in the field (Ahmad Sarkawi et al., (2015a, 2015b, 2015c & 2017)). Specifically, it adopts a content analysis approach which analysed academic programs, followed by structured interview among lecturers to evaluate the implementation level of IoHK modes on the Maqasid Al-Shari'ah components.

In essence, the goal of this research is to contribute to deeper discussions about the Islamization of knowledge in the built environment by shedding light on how the principles of Maqasid Al-Shari'ah can guide and advise educational practices, curricular development, and knowledge pursuit in this critical realm. This scholarly research aims to provide meaningful recommendations for aligning the CBE's educational framework at UiTM with the major components of Maqasid Al-Shari'ah, thereby advancing the harmonization of Islamic principles with the BE's body of knowledge.

## **LITERATURE REVIEW**

### **Islamization of Human Knowledge (IoHK)**

The conceptualization of IoHK in Malaysia has been thoroughly studied and established by scholars at the International Islamic University Malaysia (IIUM). IIUM's vision and mission were to Islamize the faith and belief system so that modern societies, students, and educators could understand and practice it. Works done by Hashim (1999), Hashim and Ssekamanya (2013) and Ssekamanya, Suhailah, and Nik (2011) were the initial phases of IoHK in IIUM generated since 1983 under the supervision of its institutional rectors and fostered at the International Institute of Islamic Thought and Civilization (ISTAC). Meanwhile works done by Ahmad Sarkawi et al., (2015a & 2015b) focus on IoHK in the Built Environment department in IIUM.

As discussed by Ahmad Sarkawi et. al., (2015b), the main focus of the IoHK agenda at the IIUM is to trace the root of human secular knowledge back to the principal sources of knowledge in Islam, which are the Quran and the Sunnah. This process, known as the Islamization of Acquired Human Knowledge (IoAHK), aims to ensure that knowledge construction is in line with Islamic principles and values. By combining Hashim and Ssekamanya (2013), and Sayed Muhammad al-Naqib al-Attas knowledge framework (1989), the researchers proposed that Islamic education should aim for a well-rounded development of an individual in aspects like spirit, intellect, and body. The development of those components should be infused into his or her entire personality system which lead

to the production of good men, students, or alumni with a better expression of moral, ethical, expertise, and skilled knowledge.

IIUM aims to become a leading international center of educational excellence by revitalizing the intellectual dynamism of Islam and the Muslim ummah (Ahmad Sarkawi et al., (2015a), Ahmad Sarkawi, Abdul Rashid & Mohamad (2015b). The ultimate goal of Islamization is to help people become better servants and representatives (or 'Khalifah') of Allah on Earth. This role involves not just following Islamic laws and ethics, but also caring for humanity and the environment (Ssekamanya et. al., (2011). IIUM's Education has been designed to instill these principles in the students, shaping them into professionals who embrace Islamic values by incorporating Islamic teachings and values into its curriculum and promotes a holistic approach to education (CENTRIS, 2013). Through its Center for Islamization (CENTRIS), IIUM has developed policies and guidelines on Islamization, including various Islamization modes or academic efforts that can be applied in different disciplines of education (Sarkawi et al., 2015b). According to IIUM policies and guidelines on Islamization, there are twenty- two (22) modes of Islamization which can be divided into four (4) categories of IoHK efforts; a) Low necessity, b) Medium necessity, c) High necessity and d) Highest necessity (CENTRIS, 2013). These 22 Islamization strategies were examined by Ahmad Sarkawi et al. (2015b) to be applied to the built environment curriculum. The review deduced fourteen (14) modes of Islamization after a) summarization, b) division based on the group of knowledge related, c) refinement and rearrangement based on the degree of importance and complexity, and d) assignment of appropriate task words to the modes.

These fourteen modes were utilized in a survey by Ahmad Sarkawi et al., (2015b). In this present study, the most frequent mode of Islamization used by IIUM lecturers in teaching delivery will be utilised. The mode is promoting Islamic perspectives on aspects of human knowledge in various fields which are constructed or based upon the worldview of Islam. According to CENTRIS (2013) this mode falls under the low necessity mode, which is considered a permissible effort. This selected mode is then applied to cater for the early stages of the Shari'ah research group activities and considering the CBE, UiTM, this is an early step in embedding Islamic elements through creating an elective course for undergraduate program (BQS566; Shari'ah and Built Environment) which is offered to the 4th semester Quantity Surveying students. Promoting Islamic perspectives on aspects of human knowledge in various fields which are constructed or based upon the worldview of Islam can be referred to as an effort or approach that seeks to incorporate Islamic beliefs, principles, values, and worldviews into various areas of human knowledge and academic disciplines. This research aims to evaluate the implementation level of IoHK through lecturers' effort in incorporating the Maqasid Al-Shari'ah components;

preservation of i) faith or belief; ii) life or self or body, iii) intellect or reason; iv) lineage or posterity; v) property or wealth.

### **Maqasid al-Shari'ah**

Maqasid Al-Shari'ah refers to the "objectives" or "goals" of Islamic law, known as Shari'ah (Sarkawi, Abdullah, Dali and Mohd Khazmi, 2017). It is a value system established through the Qur'an and Sunnah, which embodied the elements deemed necessary for the establishment of a justly balanced community (ummatah wasatan) (Sarkawi et al., 2017). The Maqasid al-Shari'ah aims to protect and promote essential values such as justice, welfare, and equality, among others, to achieve the overall well-being of individuals and communities. It can be categorized into five essential objectives (Sarkawi et al., 2017), known as the "Five Necessities", which Islamic law seeks to preserve (Abdul Rashid et al., (2017); Ahmad Sarkawi et al., (2017); Ahmad Sarkawi et al., (2015c); Anas et al., (2016)) which are:

1. Faith or Believe: Encourage individuals to acknowledge and incorporate the existence of Allah SWT in every human undertaking, acts, or omissions.
2. Life or self or body (Nafs): Encourage an individual to appreciate the greatness of Allah SWT in the context of human creation thus directing him/ her to perform his/her role as a Khalifah toward his fellow men and the environment.
3. Intellect or reason ('Aql): Facilitates the development of intellectual abilities and knowledge, as well as the capacity to distinguish between right and wrong.
4. Lineage or posterity (Nasl): It relates to the institution of marriage, inheritance principles, and familial relationships. Develop an understanding among students of the common essence of humanity, thereby encouraging the adoption of Islamic values and manners in society and prohibiting immoral behaviour.
5. Property or wealth (Mal): Defines specific conduct and ethical principles that govern business dealings and economic transactions, ensuring the equitable distribution of wealth, avoidance of corruption, and prudent utilization of natural resources and the environment. Provide students with the knowledge and skills necessary to ensure that physical development is sustainable, cost-effective, and requires minimal maintenance.

The components of Maqasid al-Shari'ah are serving higher purposes that are intended to promote human well-being, justice, and morality. Islamic

scholars and jurists employ the Maqasid al-Shari'ah components to interpret and implement Islamic law in a manner that is consistent with its overarching purposes. By understanding these components, scholars can engage in "Ijtihad" (independent reasoning) to derive legal rulings that align with the ultimate goals of the Shari'ah (Auda 2008). It permits the interpretation of Fiqh to be flexible to meet modern problems and obstacles while adhering to the spirit and ideals of Islamic justice and ethics. This component plays a crucial role in maintaining the relevance and adaptability of Islamic law to the evolving societal requirements, while simultaneously upholding its fundamental principles; to promote human well-being, justice, and morality.

### **UiTM Academic Curriculum Scenario in Collage of Built Environment (CBE), UiTM**

Universiti Teknologi MARA, also known as UiTM, is a well-known public university in Malaysia that specializes in teaching and training in a range of subjects including business, science, engineering, and humanities. Numerous undergraduate and graduate programs are available at UiTM. College of Built Environment (CBE) formerly known as the Faculty of Architecture, Planning and Surveying (FSPU) was established in July 1967. As stated in the CBE website, 75,882 students have graduated from the faculty since 1971. CBE has five (5) campuses around Malaysia with Shah Alam Campus as its main. In 2022, students' enrolment for Shah Alam and Puncak Alam campuses is 5,892 and as of the same year, there are a total of 328 lecturers. CBE currently offers study programs both at undergraduate and postgraduate levels, in area of studies related to Architecture, Landscape Architecture, Quantity Surveying, Building Surveying, Town Planning, Real Estate Management, Geomatic, Park Management & Amenity, Construction Management and Interior Design. All programs are currently recognized and accredited by relevant bodies, as well as the respective professional boards and the Malaysian Qualifying Agency (MQA).

Table 1 shows UiTM CBE students' total credit hours by department. The Department of Construction Management has the fewest credit hours (122), while the Department of Architecture, Town Planning, and Interior Design has the most (140). UiTM CBE students must register an average of 47 subjects during their 3–4 years of undergraduate studies. The university courses made up 21-22 credit hours (11-12 subjects) from these subjects. The university's prerequisites include linguistic courses (12 credits), civilization courses (4 credits), national and patriotic courses (2 credits), and department-specific courses (2 credits). The remaining 111 to 112 credit hours (or 36 to 37 subjects) are set aside for each department's main course courses.

**Table 1:** Distribution of total credit hours according to department course in CBE, UiTM

	Department	Total Credit Hours	Dept. Courses Credit Hours	Uni. Courses Credit Hours	Numbers of courses
1	AP220 – Geomatic	136	115	21	52
2	AP221 – Town Planning	140	118	22	48
3	AP224 – Quantity Surveying	130	108	21	50
4	AP225 – Real Estate Management	130	109	21	47
5	AP229 – Building Surveying	124	102	22	47
6	AP230 – Park Management & Amenity	128	106	22	44
7	AP243 – Architecture	140	118	22	48
8	AP246 – Construction Management	122	109	23	44
9	AP247 – Interior Design	140	121	19	51
10	AP248 – Landscape Architecture	135	113	22	44
<b>Average accumulation to be completed</b>		<b>132.5</b>	<b>111.9</b>	<b>21.5</b>	<b>47.5</b>

*Source: CBE Course Coordination Unit*

Of all the subjects offered, only two subjects were created to shape students' development and comprehension of humanity, values, and philosophy. The CTU552 (Philosophy and Current Issues) and CTU554 (Values and Civilization) are the two subjects, each of which is worth two credit hours, for a total of four credit hours. This shows that CBE education at UiTM has placed great emphasis on imparting practical knowledge, which is also known as Fardhu Kifayah (acquired knowledge). Nevertheless, it can be deduced that the education designed under the CBE does not emphasize the understanding of Islam in the Fardhu Ain (knowledge derived from Islam). Here, too, the question can be raised whether the two 4-credit hour courses that touch on Islamic knowledge are sufficient to educate UiTM students about their responsibilities as Khalifah (vicegerents) on earth. Additionally, to bring extended tasks and responsibilities in creating peace between man to man, man to nature or environment, and finally to realize their roles as an 'abd (servant) to Allah. The matter of minimum courses with limited credit hours in the curriculum may need to be revised.

Further analysis of the curriculum is illustrated in Table 2. Eight (8) out of ten (10) departments required students to enrol in the main course of professional practice. Professional practice courses teach students about ethics, procedures, management, and real-world challenges. The subject is designed to equip and prepare the students for the upcoming working environment. Similarly, it could be questioned if these courses are sufficient to teach the UiTM CBE students about their responsibility as Khalifah on Earth.

**Table 2:** Related Courses to Ethical Practices in the CBE Programme of UiTM in 2023

No	Department	Course code and subject	Credit Hours
1	Geomatic	GLS 682 – Professional Practice	3
2	Town Regional Planning	TPR 582 – Professional Practice	2
3	Quantity Surveying	BQS 559 – Professional Practice 1	3
		BQS 609 – Professional Practice 2	3
		BQS 659 – Professional Practice 3	3
4	Real Estate	RES 614 – Professional Practice 1	3
		RES 654 – Professional Practice 2	3
5	Building Surveying	BSR 609 – Professional Practice 1	3
		BSR 659 – Professional Practice 2	3
6	Park & Amenities	No subject related to practice/ethics issues	-
7	Architecture	AAA 572 – Asian & Islamic Architecture	2
		AAA 686 – Architectural Practice	2
8	Construction Management	No subject related to practice/ethics issues	-
9	Interior Design	INA 527 – History & Islamic Arts & Architecture	2
			2
		INA 638 – Professional Practice	
10	Landscape Architecture	LAS 674 – Professional Practice	4

Source: CBE Course Coordination Unit

Therefore, this research intends to explore the implementation level of IoHK by looking at the most permissible lecturer efforts (IoHK mode as stated in CENTRIS, 2013) in incorporating Maqasid Al-Shari'ah (objective of Islamic law) components in their lectures. This study then seeks to provide actionable insights for the CBE's ongoing efforts to achieve a holistic and sustainable implementation of its Islamization mission.

## RESEARCH METHODOLOGY

To unravel implementation, this research draws inspiration from prior work in the field (Ahmad Sarkawi et al., (2015a, 2015b, 2015c & 2017). In fulfilling the early stages of exploration on the IoHK and Maqasid Al-Shari'ah implementation in CBE, UiTM, the scope of the case study is limited to the Bachelor of Quantity Surveying (Honours) (B. QS (Honours)) program only. A content analysis approach that analyzed the academic programs and course outlines has been adopted. As per program structure, there are 35 core courses, and 6 elective courses in the department courses. For the purpose of this research, practical training course and other elective courses were excluded, and the remaining courses were categorized into ten (10) major groups as shown in Table 3. Islamic content of each courses listed will be evaluated based on the percentage of time allocated for teaching said contents. For example, if there is one subtopic with Islamic contents in one main topic for week nine (9) of the semester (whole semester consist of 14 weeks), for a three (3) hours lecture, the approximate hour



of teaching that subtopic is about one and a half (1.5) hour. Therefore, the percentage of Islamic contents will be approximately 3-4% for that course. The percentage will then be reconfirmed with the resource person and the course master of the course. A resource person (RP) is a lecturer who is designated to ensure current and consistent content delivery of a course across the whole UiTM system. Meanwhile a course master refers to a lecturer responsible for overseeing a specific course or academic program at a university.

**Table 3:** Courses under Bachelor of Quantity Surveying (Honours)

Grouping	Course Code	No of Courses
1. Measurement	BQS401, BQS451, BQS501, BQS551, BQS601, BQS663	6
2. Construction Technology & Building Services	BQS402, BQS452, BQS 454, BQS502, BQS552, BQS554, BQS602, BQS652	8
3. Economics & Construction Economics	BQS406, BQS506, BQS556, BQS606, BQS656	5
4. Professional Practices	BQS559, BQS609, BQS659	3
5. Project management	BQS560, BQS610	2
6. Construction Law	BQS457, BQS507	2
7. Analysis of Prices	BQS408, BQS458	2
8. Applied Study	BQS612, BQS662	2
9. Computer Aided	BQS516, BQS562	2
10. Research	BQS514, BQS664	2
<b>Total Courses</b>		<b>34</b>

*Source: CBE Course Coordination Unit*

The second method adopted in this study is structured interviews among QS lecturers to evaluate the implementation level of IoHK mode on the Maqasid Al-Shari'ah components. Purposive sampling method was applied in the selection of interview participants among course masters and resource persons of the selected courses. The selection was made based on the participants' roles, expertise, and knowledge in each course. Twenty (20) QS lecturers were selected. The purpose of the interview was to ascertain, from the perspective of the lecturers, the level to which Islamic inputs and IoHK modes were implemented in the chosen courses. The interviews were conducted face to face or through phone calls. The criteria of the interviewees that contribute to the research findings in terms of reliability and validity are a) has more than five years of work experience as a lecturer; b) engage in the process of curriculum development and review; and c) was appointed as course master or resource person for the courses. The participants are required to indicate the level of IoHK modes of Maqasid Al-

Shari'ah. The question asked was to indicate the level of promoting Islamic perspectives of Maqasid Al- Shari'ah components (preservation of i) faith or belief; ii) self or body, iii) intellect or reason; iv) lineage or posterity; v) property or wealth) in conducting lectures for the courses. The implementation level was divided into three (3) categories; Low (0%-30%), Medium ( $\geq 30\%$  - 70%) and High ( $\geq 70\%$ -100%).

## ANALYSIS AND DISCUSSION

Through content analysis of the academic programs and course outlines, and supported by interview session with participants, Table 4 shows the percentage of Islamic content and IoHK mode implementation of Maqasid Al-Shari'ah components for each of the courses.

**Table 4:** Results analysis for Islamic content and IoHK mode implementation upon Maqasid Al- Shari'ah

Grouping	Course Code	% of Islamic content	IoHK mode implementation upon Maqasid Al- Shari'ah components
Measurement	BQS401- Measurement of Construction Works I	0%	Low
	BQS451- Measurement of Construction Works II	0%	Low
	BQS501- Measurement of Construction Works III	0%	Low
	BQS551- Measurement of Construction Works IV	0%	Low
	BQS601- Measurement of Construction Works V	0%	Low
	BQS663- Measurement of Civil Engineering Works	0%	Low
Const. Technology & Building Services	BQS402- Construction Technology I	0%	Low
	BQS452- Construction Technology II	0%	Low
	BQS 454- Building Services I	0%	Low
	BQS502- Construction Technology III	0%	Low
	BQS552- Construction Technology IV	0%	Low
	BQS554 - Building Services II	0%	Low
	BQS602- Construction Technology V	0%	Low
BQS652- Construction Technology VI	0%	Low	

Grouping	Course Code	% of Islamic content	IoHK mode implementation upon Maqasid Al- Shari'ah components
Economic & Construction	BQS406- Principles of Economic	0%	Low (with high %)
	BQS506- Construction Economic I	0%	Low (with high %)
	BQS556- Construction Economic II	0%	Low

	BQS606- Construction Economic III	15%	Medium
	BQS656- Construction Economic IV	4%	Low
Professional Practices	BQS559- Professional Practice I	4%	Low
	BQS609- Professional Practice II	15%	Medium
	BQS659- Professional Practice III	0%	Medium
Project Management	BQS560- Project Management I	0%	Low
	BQS610- Project Management II	4%	Low
Construction Law	BQS457 -Construction Law I	4%	Low
	BQS507- Construction Law II	0%	Low
Analysis of Prices	BQS408- Analysis of Prices I	0%	Low
	BQS458- Analysis of Prices I	0%	Low
Applied Study	BQS612- Applied Studies I	0%	Low
	BQS662- Applied Studies II	0%	Low
Computer Aided	BQS516- Computer Aided Design & Drawing	0%	Low
	BQS562- Computer Aided Measurement & Estimating	0%	Low
Research	BQS514- Research Methodology	0%	Low
	BQS664- Final Project / Dissertation	0%	Low

According to the data provided in Table 4, it is apparent that the courses offered by the B. QS (Honours) program consistently lack Islamic content (0% - 15% only). The Islamic content is not included (0%) in any of the course groups, which consist of Measurement of Construction Works, Construction Technology & Building Services, Economics & Construction Economics, Professional Practices, Project Management, Construction Law, Analysis of Prices, Applied Study, Computer Aided, Research, and Final Project/Dissertation. There are two reasons for the absence of Islamic contents as explained by the interview participants. Firstly, certain courses may be attached to their fundamental character which largely focuses on technical, computer/graphic application, and research-based knowledge due to the nature of the course. Therefore, these courses may have limited scope for integrating Islamic content due to their specialized and technical nature. Secondly, the absence of Islamic content in some courses is also caused by the structure of the curriculum. Often, the course has mostly focused on traditional methods, prioritizing technical elements rather than integrating Islamic viewpoints. This design decision has led to the limited inclusion of Islamic material in these courses.

In cases where there is a low level of IoHK implementation, with only 4% of Islamic contents, courses include BQS606- Construction Economic III, BQS656- Construction Economic IV, BQS610- Project Management II and BQS457 -Construction Law I. This may be due to an obstacle in lecturers' individual exposure to the Islamization agenda. The extent of integration seems to be determined by lecturers' understanding and commitment to incorporating

Islamic concepts into their teachings as disclose by Ssekamanya, Hussien and Ismail (2011). Greater emphasis on promoting the Islamization agenda among lecturers could potentially lead to more substantial integration of Islamic content.

As per Table 4, two courses (BQS406 - Principle of economic and BQS506 - Construction Economic I) indicated low level of IoHK implementation (with percentage of implementation of not more than 30%). As per the interview result, the lecturers claimed to have informally embedded the Islamic principles in those two courses due to the nature of the courses which could be related to the Maqasid Al-Shari'ah components (preservation of five (5) main necessity as a Muslim). Exposure to the Islamization agenda was also done by the lecturers individually.

In the context of the Construction Economics III course (BQS606), there is evidence of a medium level of IoHK mode implementation throughout lecturing by QS lecturers. This moderate effort can be attributed to the syllabus design, which thoughtfully incorporates a substantial portion of Islamic approach, accounting for 15% of the course's content. Additionally, the Professional Practice course, namely BQS609 (15% of Islamic contents), display a similar commitment to infusing Islamic values and principles into the curriculum. Meanwhile, BQS659 with zero percentage of Islamic contents but medium level of IoHK mode implementation, displays an extra commitment by the lecturers to infusing Islamic values and principles into the curriculum. These thoughtful inclusions signify an endeavour to merge Islamic perspectives with professional practices within construction education, providing students with a holistic understanding of ethics and Islamic values as they embark on their future careers.

The analysis of the data stresses the limited integration of Islamic content and the IoHK mode on Maqasid Al-Shari'ah components in construction-related courses. This represents a prospect for educators and institutions to further enrich their curriculum and ensure that graduates are equipped with a deeper understanding of the Islamic principles and values in the context of construction. Future research can delve into best practices and strategies for enhancing Islamic content integration in construction education.

## **CONCLUSION**

Bridging the IoHK between Islamic and Western perspectives into faculty and department programmes is expected to benefit UiTM students as well as our societies and ummah in the future. This effort should be highly suggested considering UiTM's strength of having the largest student population in the public university in Malaysia, with 172,000 students (Utusan.com, 2021). UiTM has many potentials and opportunities to help our students, especially the Muslim ones to learn more about Islam, develop moral values, and become better people. Unquestionably, UiTM's present program has produced professionals in

Malaysia's built environment market since 1970. But, with new ideologies, reform movements, evolving science and technology, and contemporary challenges, it is essential for educators at UiTM, as well as the institution itself, to explore, reflect, and revise the curriculum, institution mission, and vision, as well as to seek new formulations that will serve as the educational framework for UiTM students and the next generation of young people.

Previous studies have established a solid foundation that could aid UiTM and other institutions in reassessing their educational goals and objectives. Studies of literature have shown that IIUM's IoHK has made two important discoveries about their curriculum programme, educational approaches, and ways of teaching and learning in collaboration with UiTM. This study has shown that there are "missing" parts in both CBE and the institution's curriculum programmes right now. These parts dealt with (1) the IoHK in the curriculum programme and (2) the roles of human knowledge to be integrated with the Maqasid al-Shari'ah components in the professional practice of each course. UiTM also could adopt three (3) teaching methods on Islamization knowledge applied by IIUM's academic staff (Hashim and Ssekamanya, 2013); (1) Compare the main course to Western perspectives, (2) Integrate Islamic and Western perspectives in the classroom, and (3) Promote Islamic values and characters among students in technical and professional courses that are not ethical. The recommendations presented possess the capacity to transform UiTM's educational environment and provide a framework that can be adopted by other institutions aiming to enhance their curriculum with Islamic principles. It is crucial for educators and institutions, such as UiTM, to consistently analyse, adjust, and create new pedagogical approaches to address the demands of a swiftly evolving world, while remaining faithful to the fundamental principles of Islamic education.

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## **THE GENERATIONAL OF AGEING IN PLACE DECISION- MAKING PREFERENCES IN MALAYSIA**

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### **Abstract**

Housing fulfils a person's physical, psychological, social, and economic needs. Housing choices are made by maximizing satisfaction with the home by focusing on various factors, whether external or internal and this varies between generations (i.e. Baby Boomers, Generation X, Generation Y) or by age group. As age increases, an individual's needs and preferences also change due to the ageing factors. This study aims to identify the Malaysian generational Ageing in Place (AIP) housing decision. AIP refers to a person's preference to remain in the same place for as long as possible, which links to their sense of attachment towards a place. This study also aims to provide an overview of the AIP decision-making preferences of the generations in Malaysia. Thus, the objectives of this study are: (i) To identify the factors influencing AIP housing decisions and (ii) To determine the generational AIP decision-making by the generations in Malaysia with Johor Bahru, Johor as the case study. This study adopted a mixed methods of research strategies (qualitative and quantitative). The main findings revealed four (4) main ageing in place preferences such as (1) Economics, (2) Help and Support, (3) Dwelling characteristics, and (4) Neighbourhood. The findings are significant to the public and private sectors in understanding the housing consumers better. The in-depth information gained will help narrow the demand and supply gap between housing consumers and housing providers.

**Keywords:** Generation, Housing decisions, Ageing in place (AIP), Ageing-In Place Housing Decision, Place Attachment

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## **INTRODUCTION**

Each generation has unique characteristics that is linked with individually diverse needs and preferences (Ismail et al., 2020). Generations are distinct categories of population that differ based on their age cohorts or birth year. Lack of knowledge about what the science of generations tells us leads to misunderstandings of the evidence about generations, their existence, and their purported impact. In relevance, age and ageing research are neither remedy nor equivalent approaches to studying generations (Rudolph et. al., 2021).

Older adults are generally more active, healthier, wealthier, and highly educated than the previous generations. Older adults are also more often to be single and childless (having no child). Due to the changes of their life cycle stages including the retirement or the age-related losses incidents (e.g., death of partner or friend), along with the declining of health and the increasing of mobility limitations, more older adults experience feelings of loneliness and social isolation (Von Hippel et al., 2008). Therefore, interest in subjective aspects of the Quality of Life (QoL) in older adults, such as well-being, happiness, social satisfaction, and loneliness, is expanding.

Grimmer et al. (2015) stated that Ageing in Place is mainly about the opportunity for older people to remain in their homes for as long as possible without moving to a long-term care facility. Horner and Boldy (2008) defined Ageing in Place as a positive approach to meeting the older person's needs, supporting them to live independently, or with some assistance, for as long as possible. When people age in place, it somehow shows some bonding (attachment) to a place or location. However, the mechanisms of how people-place bonds play in the decision-making processes of taking pro-environmental behaviours still need to be explored (Wan et al., 2021).

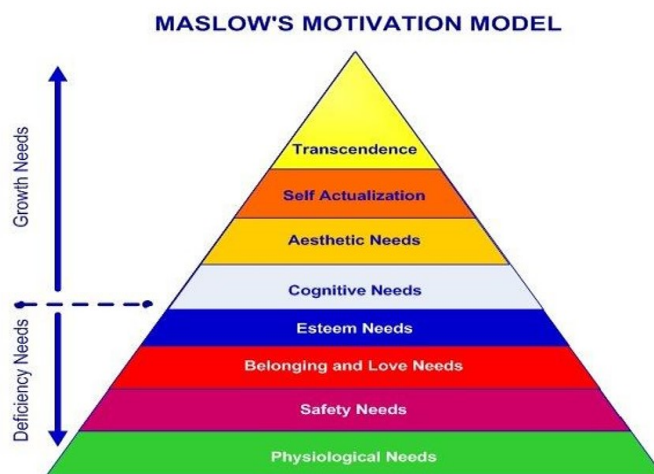
## **LITERATURE REVIEW**

### **The Generations**

Generation refers to the population categorized by age cohorts and their birth years. The name of each generation and their distinctive birth years are as follows: (i) Baby Boomers - born between 1946 and 1961; (ii) Generation X (Gen-X) - born between 1962 and 1976; Generation Y (Gen-Y) - born between 1977-1999; and Generation Z (Gen-Z) - born after 1992 (Ismail et al., 2019). The concept of generation is utilized both as an approach for grouping age cohorts (defined as groups of people born at a similar time), and for analysis of tracking people on a range of issues, behaviours and characteristics (Mahmoud, 2021). Significantly, generations are influenced by their generational characteristics, beliefs, experiences, lifestyles, ideals, and demographic backgrounds (Ismail et al., 2023).

### Consumer Decision Making

Every person plays the role of a consumer and makes many purchase decisions every day. Purchase decisions are made based on people's needs and preferences. A person's basic needs can be referred to the Maslow's motivation model (Figure 1). It is essential to understand the factors that influence personal buying decisions (Stankevich, 2017). In addition, the meaning of home for people is linked to their individual experiences of security, positive identity, and self-esteem, which are associated to the sense of ability to cope and ownership; identity comprises both self-identity and social identity (Chou & Kröger, 2022).



**Figure 1:** Maslow's Motivation Model (Kotler et al., 2007)

Problem recognition	Information search	Evaluation of alternatives	Purchase decision	Post-purchase evaluation
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**Figure 2:** Consumer Purchasing Decision Process

*Source: Adapted from Solan (2020)*

The study of consumer behaviour recommends that consumers experience or go through five steps of the decision-making process whenever they want to make a purchase (Solan, 2020). The model in Figure 2 indicates that consumers experience and pass through five steps in each purchase.

### Ageing in Place (AIP) and Place Attachment

Ageing in Place (AIP) is a term that covers many domains (Wong et al., 2023). A current review of the existing literature classified five AIP themes, covering

places, social networks, supports, technologies, and personal characteristics. According to Pani-Herreman et al. (2021), AIP can also be defined as independent living, healthy ageing, housing for elderly, and ageing at home. Despite the acceptance on the concept of Ageing in Place worldwide, it may also be argued that healthy ageing is an overriding concept put forward by the World Health Organization (WHO) and adopted by the United Nations, which is currently promoting the 2020–2030 as the UN Decade of Healthy Ageing. A prerequisite of Ageing in Place should enable healthy ageing to occur through the provision of a physical and social environment that able to maximise functional ability with ageing aspects (Wong et al., 2023). Moving into old age, relocation and housing transition have become significant issues in debates about Ageing in Place (Chou & Kröger, 2022).

Search Item	Synonyms	Linked Search Terms
Aging in place	<ul style="list-style-type: none"> <li>• Independent living</li> <li>• Healthy ageing</li> <li>• Housing for the elderly</li> <li>• Ageing at home</li> </ul>	<ul style="list-style-type: none"> <li>• Independent living</li> <li>• Healthy ageing</li> <li>• Housing for the elderly</li> <li>• Staying home</li> <li>• Ageing</li> <li>• Gerontology</li> <li>• Well-being</li> </ul>
Elderly people	Aged	<ul style="list-style-type: none"> <li>• Aged</li> <li>• Later life</li> <li>• Third age</li> <li>• Fourth age</li> </ul>

**Figure 3:** Definitions, Key Themes and Aspects of Ageing in Place  
*(Pani-Herreman et al., 2021)*

Place attachment is associated to bonds between people and places. Three levels of attachment to place are described as home, home environment and neighbourhood. As stated before, people usually wish to stay at home for as long as possible; they are quite attached to their home environment (Pani-Herreman et al., 2021). People will continue to stay in certain places or places attached if they are satisfied with the place and the environment, or move to other places if they are dissatisfied (Ismail et al., 2023). The concept of Ageing in Place involves many aspects of disciplines including architecture, building management, urban planning, neighbourhood facilities and social support. However, the most aspect is, these aspects involve the elder people themselves (Wong et al, 2023).

## **RESEARCH METHODOLOGY**

This exploratory study engaged a mixed-method research strategy with qualitative and quantitative data gathering. The expert interviewed surveys (industrial players – registered estate agents, local authorities, and housing developers) as part of the initial data collection to provide a comprehensive overview of the current Ageing in Place housing decision. The research stage was then followed by the final questionnaire surveys (housing consumers by generations) to acquire an insight into the future Ageing in Place housing decision preferences in the Malaysian context. The elderly Malaysian generation is anticipated to increase continuously, and by the year 2030, Malaysia will become an ageing nation. Thus, understanding the needs and the preferences of multi-generational place attachment decision-making is crucial in stipulating better, more focused housing provisions that can support the interdependency between generations. Johor Bahru was chosen as the case study due to its city status, which is equipped with a high population in Peninsular Malaysia. This paper will present and discuss only the main quantitative data findings.

## **MAIN FINDINGS, ANALYSIS AND DISCUSSIONS**

Table 1 presents the main demographic background of the respondents gained from the distributed survey questionnaires.

**Table 1: Demographic Background**

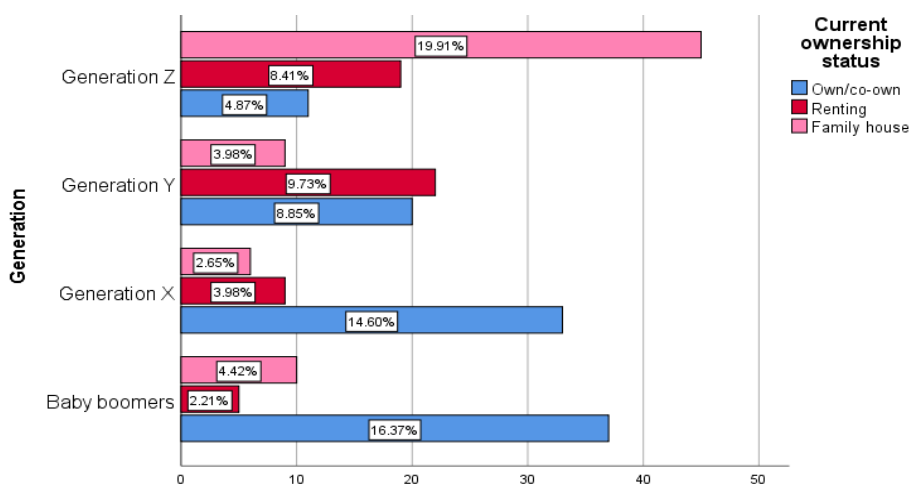
Characteristics	Frequency (N = 226)	Percentage of Respondents (%)
<b>Gender:</b>		
Male	107	47.3
Female	119	52.7
<b>Generation (Years of born):</b>		
Baby Boomers (1946 – 1964)	52	23.0
Generation X (1965 -1977)	48	21.2
Generation Y (1978 -1994)	51	22.6
Generation Z (1995 onward)	75	33.2
<b>Ethnicity:</b>		
Malay	189	83.6
Chinese	24	10.6
Indian	12	5.3
Bumiputera	1	0.4
Others		
<b>Marital Status:</b>		
Single/Never married	82	36.3
Married	116	51.3
Divorce	13	5.8
Widowed	15	6.6
Others		
<b>Education Level:</b>		
Primary School	21	9.3
Secondary School	53	23.5
Tertiary Level	112	49.6
Postgraduate Level	21	9.3
No proper education	19	8.4
Others		
<b>Occupation:</b>		
Employed in Public Sector	11	4.9
Employed in Private Sector	68	30.1
Self-employed	23	10.2
Retired	53	23.5
Unemployed/ Housewife	32	14.2
Student	39	17.3
<b>Group household Income (per month):</b>		
B40 (Less than RM4,850)	108	47.8
M40 (RM 4,850 – RM 10,959)	96	42.5
T20 (RM 10,600 onward)	22	9.7

Among 226 respondents surveyed, the female respondents (52.7%) slightly outnumbered the male respondents (47.3%). The responses came from the Baby Boomers generation (23%), Generation X (21.2%), Generation Y (22.6%), and Generation Z (33.2%). Most of the respondents were Malays (83.6%), followed by Chinese (10.6%), Indian (5.3%), and Bumiputera (0.4%).

Most respondents (51.3%) were married, whilst the remaining were single and never married (36.3%), followed by widowed (6.6%) and divorced (5.8%). Almost half of the respondents had tertiary level qualification (i.e. STPM/

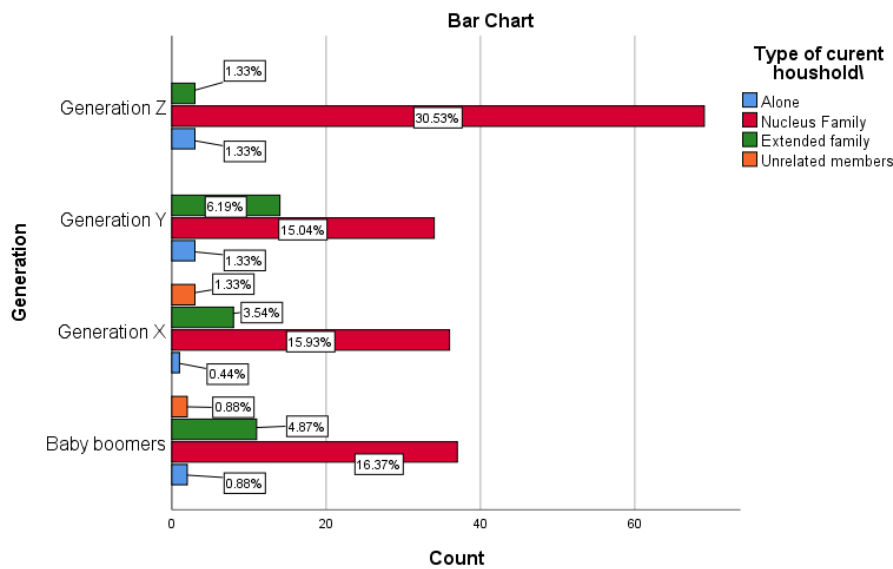
STAM/Matric/Diploma/bachelor’s degree) (49.6%), followed by secondary school qualification (23.3%), followed by primary school (9.3%), postgraduate level (9.3%) and had no proper education (8.4%). Many of the respondents were those working in the private sector (30.1%), followed by retirees (23.5%), students (17.3%), unemployed or housewives (14.2%), self-employed (10.2%), and the least were people working in the government sector (4.9%).

In terms of household income (per month), most of the respondents were in the category of B40 (less than RM4,850) (47.8%), followed by M40 (RM4,850-RM10,959) (2.5%), and the T20 group (RM10,600) (9.7%). Hence, the respondents of the survey questionnaires of this study were mainly Malays, married, with tertiary level qualifications, working in the private sector, and coming from the B40 group household income group (monthly household income of not more than RM4,850).



**Figure 4:** The Current Housing Ownership Status by Generation

Figure 4 shows the current housing ownership status by generations in Johor Bahru. For Baby Boomers, about 16.37% of them were owners or co-owners of the current house they live in. Most of the Baby Boomers (16.3%) were owner-occupied, followed by family houses (4.42%) and renting (2.21%). Likewise, many of Generation X also were owner-occupant, followed by renting (3.96%) and family houses (2.65%). Compared to younger generations, most of them still did not own a house: Generation Y (9.73%) and Generation Z (19.91%).

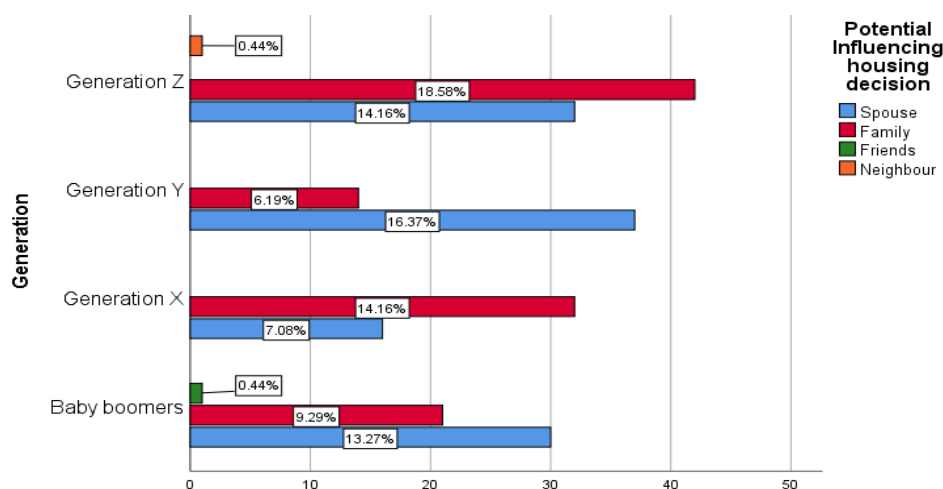


**Figure 5:** The Current Household Types by Generations

Figure 5 displays the type of current household by generation. There were four (4) types of households comprising person stay alone (consisted one person only), nucleus family household (consisted the head of household and members who were related by blood, marriage or adoption), extended family household (consisted a nuclear family like parents, or married children or other related members) and unrelated members household (consisted the head of household and members who were unrelated to household). The majority of the four generations were nucleus family households: Baby Boomers (16.37%), Generation X (15.93%), Generation Y (15.04%), and Generation Z (30.53%). The second highest type of household of the generations was extended family households: Baby Boomers (4.87%), Generation X (3.54%), Generation Y (6.19%) and Generation Z (1.33%). The high percentage of nucleus and extended family household compositions indicated that multi-generational households are a typical living arrangement in Malaysia. This household arrangement offers numerous advantages, especially in terms of financial expenses that family members can share and, most importantly, the shows of support between family members.

Figure 6 shows the person influencing the generations' housing decisions. The housing decisions of the Baby Boomers were highly influenced by their spouse (13.27%), followed by their family (9.29%). In contrast, most Generation X housing decisions were influenced by their family (14.6%) and their spouse (7.06%). As for Generation Y, many decisions were influenced by

their spouse (16.3%) and their family (6.19%). The housing decisions made by Generation Z were greatly influenced by their family (19.56%), followed by their spouse (14.16%). Most generations considered spouse (husband/wife/partner), and family as their main influential person to be considered in Ageing in Place (AIP) decision-making. This finding shows that each critical decision that the generations will make with the consideration of others, especially the family.



**Figure 6:** Person Influencing Housing Decisions by Generations

Figure 7 shows the future housing plans of the generations. All generations mostly preferred to age in place in their senior years: Baby Boomers (17.26%), Generation X (17.70%), Generation Y (13.72%), and Generation Z (19.47%). The generations also preferred to stay in their own house with children or move to their houses. The findings here suggested that the Malaysian generation prefers to age in place alone or with their immediate family members (children).



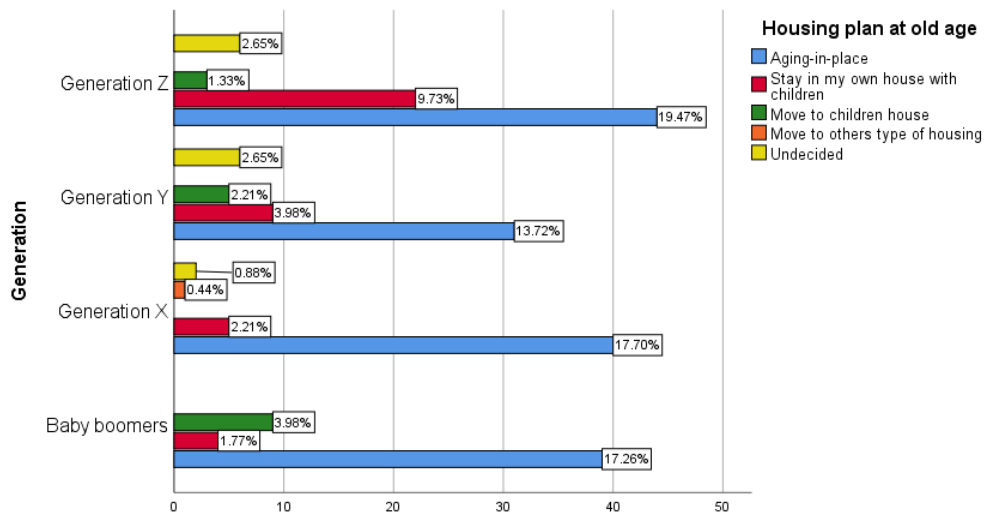


Figure 7: Future Housing Plan by Generations

Table 1 and Figure 8 present the Ageing in Place (AIP) preferences by generations. By ranking, the Baby Boomers generation preferred AIP decision-making factors and ranked as Rank 1 - dwelling characteristics, followed by Rank 2 – Economic, Rank 3 – Help and Support factors economic and Rank 4 – Neighbourhood Quality.

Table 1: Factors influencing Ageing in Place (AIP) housing decisions by generations

Generation	Baby Boomers			Generation X			Generation Y			Generation Z		
	Mean	Std Deviation	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	Rank
<b>Economic</b>												
Relocation costs to new house	4.25	0.763	1	4.17	0.781	2	4.25	0.757	2	3.76	0.942	2
House price	4.21	0.825	2	4.25	0.729	1	4.63	0.528	1	3.89	0.938	1
<b>Help and Support</b>												
Proximity to children	4.15	0.826	1	4.25	8.853	1	4.69	0.583	1	3.79	1.044	1
Proximity to friends	3.79	0.848	5	3.69	0.949	4	3.90	1.063	3	3.29	0.983	5
Proximity to siblings/families	4.00	0.929	3	3.75	1.120	5	3.45	1.254	5	3.47	1.057	2
Social activities	3.92	0.763	4	3.81	1.065	3	3.92	0.483	2	3.37	1.112	3
Relation neighbourhood	4.10	0.846	2	4.02	0.100	2	3.88	1.125	4	3.37	1.124	4
<b>Dwelling</b>												
Dwelling size	4.12	0.963	1	4.02	0.743	3	4.71	0.460	1	3.91	0.791	1
Condition/quality of the house	4.08	0.788	2	4.15	0.714	1	4.24	0.551	4	3.95	0.868	2
Garden/Yard	3.92	0.947	4	3.98	0.863	4	3.43	0.944	2	3.76	0.998	3
Number of storeys	4.00	1.029	3	4.06	1.119	2	4.25	0.659	3	3.60	1.197	4

Generation Factors	Baby Boomers			Generation X			Generation Y			Generation Z		
	Mean	Std Deviation	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	Rank	Mean	Std Deviation	Rank
<b>Neighbourhood</b>												
Proximity to services	4.37	0.817	1	4.27	0.869	1	4.69	0.469	1	4.13	0.759	1
Geographic conditions	4.04	0.862	4	3.79	1.010	4	3.84	0.731	4	3.48	1.167	4
General qualities of the neighbourhood	4.21	0.723	3	4.33	0.694	2	4.18	0.439	3	3.93	0.794	3
Public facilities	4.31	0.755	2	4.13	0.866	3	4.59	0.497	2	4.08	0.882	2

In terms of economic factors by generations, Baby Boomers considered relocation to a new house (Rank-1) as the prime factor of AIP decision-making, followed by house price (Rank-2). In contrast, the other three generations, namely Generation X, Generation Y and Generation Z, all regarded house price (Rank-1) as their prime factor compared to relocation to a new house (Rank-2). The finding of the AIP decision revealed that relocation costs and high housing prices are considered as the most financial considerations, while the elderly chose to age in place.

Regarding help and support factors, Baby Boomers perceived proximity to children (Rank-1) as the most critical factor in AIP decision-making, followed by proximity to friends (Rank-2), siblings/families (Rank-3), social activities (Rank-4), and relation neighbourhood (Rank-5). Interestingly, despite different age cohorts, all generations (Baby Boomers, Generation X, Generation Y and Generation Z) regarded proximity to children as the most important criterion to be considered for AIP decision-making. The findings here revealed that immediate family members (children) are the generations' prime factor for Ageing in Place. Living near their immediate family members is the prime reason they stay in the same location/house or age in place.

Baby Boomers shared same opinion with Generation Y and Generation Z, who regarded dwelling size (Rank-1) as the prime factor for AIP decision-making. In contrast, Generation X considered the condition/quality of the house (Rank-1) as their prime factor (Rank-1) for AIP decision-making, in terms of dwelling. This finding showed that for the older generation, the size of the house is the main factor of dwelling consideration for Ageing in Place, either with or without family members in the house.

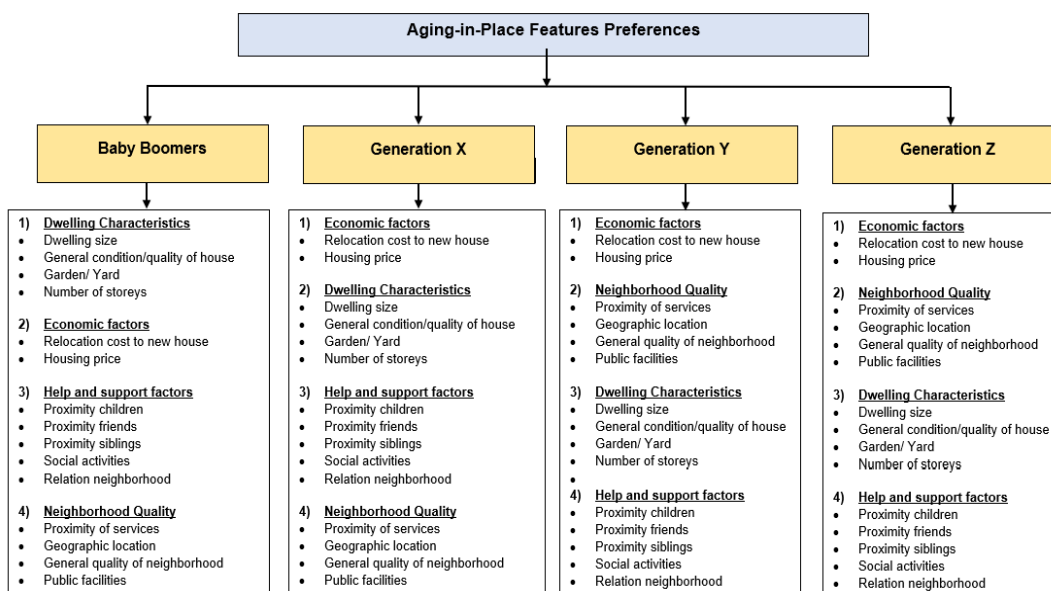


Figure 8: Ageing in Place Preferences by Generations

All generations considered service (Rank-1) as the most important neighbourhood factor. Public facilities were regarded as the second most important (Rank-2) factor by the three generations (Baby Boomers, Generation Y, and Generation Z) while Generation X considered it as less important (Rank-3). Meanwhile, general qualities of the neighbourhood were deemed to be the third (Rank-3) factor of by the three generations (Baby Boomers, Generation Y, Generation Z). Geographic conditions of the neighbourhood were perceived as the fourth important (Rank-4) by all generations. The findings revealed that neighbourhood considered service facilities (nearness to hospitals/clinics, banks, shops, or the town centre) as vital factor in deciding Ageing in Place. The elderly nowadays can mostly live independently in the senior life stage due to a good and healthy lifestyle (healthy and active ageing).

## CONCLUSION AND RECOMMENDATIONS

Consumer behaviour explores not only the behaviours of consumers but also reveals the reasons for those behaviours (Ismail & Shaari, 2020). In relevance, consumer decision-making is influenced by the needs and the preferences of individuals. Different generations (Baby Boomers, Generation X, Generation Y and Generation Z) are equipped with their needs and preferences, including their housing decision-making.

The findings of this study revealed four (4) main Ageing in Place (AIP) housing decision-making factors influencing the Malaysian generations consisting economic, help and support, dwelling, and neighbourhood.

The Malaysian generations (Baby Boomers, Generation X, Generation Y and Generation Z) are found to favour Ageing in Place and living independently on their own or with children during their elderly (senior) age. Due to a healthy lifestyle, most of the elderly generation, also known as Baby Boomers, remained healthy and active (active ageing) in the community. Therefore, public and private agencies should make more options for elderly-friendly or well-designed multi-generational housing provisions available to guarantee a good Quality of Life (QoL) for the Malaysian generation.

More elderly-friendly houses should be designed and made affordable to various generations (age-group/age cohorts) of housing consumers to support Ageing in Place in Malaysia. Housing neighbourhoods should be equipped with the housing design and the features that support active ageing. Furthermore, ageing is a dynamic process that requires home modification iterations when homes reach the threshold of unsuitability (Ma et al., 2022). Therefore, a comprehensive viewpoint is required to understand the opportunities and the challenges associated with implementing intelligent technologies in the home modification process and promoting Ageing in Place (Engineer et al., 2018). In addition, it supports the elderly in living independently by providing a regular, safe, and affordable transport system to be physically active and socially connected (Rashid et al., 2022).

Findings suggested that greater availability of age-friendly features influences older adults' perception towards their community, leading to a desire to age in place, supporting processes of belonging and agency. Housing, outdoor spaces and buildings, and transportation are essential in promoting the community's age-friendliness and the critical determinants of AIP (Choi, 2022). Thus, strategies from the recent research on Ageing in Place, place attachment, active ageing, and identifications of problems and countermeasures of independent living for the Malaysian generations, especially the elderly (seniors/Baby Boomers), should be taken into serious consideration and actions, by both the government and real estate players to guarantee the success of Ageing in Place in the Malaysian context.

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## **BEST PRACTICES IN ENSURING NATURAL JUSTICE IN ADJUDICATION PROCEEDINGS**

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### **Abstract**

This study explores the interplay between natural justice principles and adjudication within the Malaysian construction industry, focusing on challenges under the Construction Industry Payment and Adjudication Act (CIPAA). It assesses the impact of CIPAA on natural justice through a review of case law from 2014 to 2017, highlighting 11 key cases where adherence to natural justice was questioned. The study proposes best practices, including Obtaining agreement from the claimant for the request to extension time by the respondent to enhance fairness and reduce legal disputes in adjudication.

**Keywords:** Natural justice, CIPAA, payment, adjudication, bias, adjudicator's powers.

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## **INTRODUCTION**

The rapid expansion of Malaysia's construction industry, driven by the Economic Transformation Program (ETP), has propelled the nation into a phase of unprecedented growth accompanied by significant challenges. These challenges include speculative developments lacking sufficient financial backing, prolonged dispute resolution mechanisms, and imbalances in bargaining power among parties. Additionally, the industry's push for swift project approvals under the ETP has underscored the need for an efficient mechanism to resolve both payment disputes and broader issues like project delays.

The CIPAA came into force on 15 April 2014, since then it plays a pivotal role in reshaping dispute resolution within the construction sector. The CIPAA offers a streamlined process for submitting payment claims, but its significance extends beyond this. Under Section 25 the adjudicators have a range of powers to better control the overall adjudication proceedings including project delays. This provision is crucial for contractors facing unjust penalties due to delays beyond their control, which can cause severe cash flow issues. The CIPAA aiming for speedy resolution of payment related disputes, holding the relevant parties accountable and mitigating adverse financial impacts.

This paper explores the construction industry's evolution and the economic imperatives that have fuelled its growth. Against this backdrop, it examines Sections 15 and 25 of the CIPAA, highlighting their role in minimizing issues pertaining to natural justice in adjudication proceedings. Through analysis of decided case laws between 2014 and 2017, this study proposes potential best practices to strengthen natural justice within adjudication proceedings.

## **CONSTRUCTION INDUSTRY PAYMENT AND ADJUDICATION 2012 (CIPAA)**

The rapid expansion of Malaysia's construction industry, driven by the Economic Transformation Program (ETP), has led to remarkable growth alongside an increase in disputes (Prime Minister Office, 2023). In response, the CIPAA plays a crucial role in reshaping dispute resolution within the sector (Ratna, 2023).

### **Adjudication for Speedy Dispute Resolution**

In the construction industry, adjudication serves as a mechanism to obtain a speedy and impartial decision on disputes arising from a project<sup>1</sup>. The process ensures the resolution of payment disputes related to construction work in a timely and interim manner, facilitating cash flow (CIPAA, 2012). The judiciary recognizes the basic aim of the CIPAA, providing a statutory Adjudication mechanism to swiftly settle disputed interim certificates by CIPAA adjudicators (Section 12, CIPAA, 2012).

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<sup>1</sup> *Bina Puri Construction Sdn Bhd v Hing Nyit style Enterprise Sdn Bhd MLRHU 192, 2015*



### Legislative Framework and Enforceability

The CIPAA, enforced in 2014, introduces a legislative framework that appears clear and easily comprehensible to all stakeholders (Suriana , 2014). Adjudicators' decisions, though interim, are enforceable, as highlighted by Judge Mary Lim Thiam Suan J<sup>2</sup>. Even in cases where errors exist, the Court of Appeal emphasizes the enforcement of adjudicators' decisions<sup>3</sup>. Notably, Section 37 of the Act maintains parties' rights to concurrently arbitrate or litigate under CIPAA, reinforcing its enforceability upon application to the High Court<sup>4</sup>.

### Expedited Process and Timeframe

Part II of the CIPAA introduces a dispute resolution mechanism designed to last only 100 working days, emphasizing the expeditious nature of statutory adjudication. Section 12(2) imposes a 45 working days requirement for adjudicators to decide upon the completion of a reference, ensuring a swift resolution. However, the brief timeframe poses challenges for a detailed analysis, potentially impacting the reasoned fairness of decisions (McComb, 2014). This section establishes the legislative framework, emphasizing its significance in resolving disputes efficiently within the construction industry. The expedited nature of adjudication, coupled with enforceability mechanisms, underscores its role in ensuring timely and fair dispute resolution.

### ADJUDICATION PROCESS UNDER CIPAA

Adjudication, designed as a streamlined alternative to protracted legal proceedings, plays a pivotal role in resolving disputes in the Malaysian construction industry, as acknowledged by the Judiciary. Administered by the Asian International Arbitration Center (AIAC), a statutory body designated under Part V of the CIPAA, the Adjudication process unfolds in a structured manner, as illustrated in Figure 1.

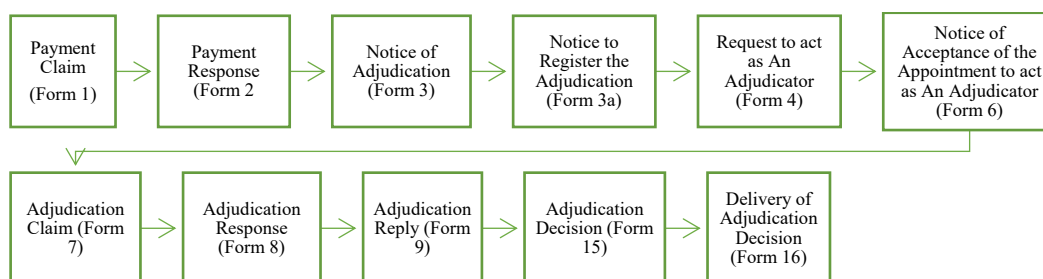


Figure 1: Adjudication process under CIPAA

<sup>2</sup> *View Esteem Sdn Bhd v Bina Puri Holdings Bhd [2015] MLRHU 850, 2015*

<sup>3</sup> *Bouygues (UK) Limited v. Dahl-Jensen [2000] BLR*

<sup>4</sup> *Carillion Construction v Devonport Royal Dockyard Ltd [2005] BLR 310*

### ***Initiation of Adjudication***

Commencing an adjudication proceeding is a structured process involving the submission of crucial documents. The Issuance of Payment Claim (Form 1) and subsequent Payment Response (Form 2) from the non-paying party sets the stage. Simultaneously, the issuance of a notice to appoint an adjudicator officially registers the dispute, marking the initiation of the two-tier process.

### ***Pre-Adjudication Decision***

This pre-adjudication phase, critical in establishing jurisdiction, spans from the initiation of a payment claim to the issuance of a notice registering the adjudication. Sections 5 and 6 of the CIPAA are determinative during this stage, as affirmed by the High Court.

### ***Post-Adjudication Process***

Upon issuing a notice to the AIAC, the post-adjudication process begins with the AIAC overseeing the procedure. This phase encompasses critical steps, including the appointment of the adjudicator and the subsequent delivery of the adjudicator's decision. Despite meticulous procedural adherence monitored by the AIAC, concerns persist regarding the potential for decisions to be set aside. Prior to the enforcement of CIPAA, concerns centred on the emergence of a claim culture, raising questions about the efficacy of the adjudication process in fostering project conclusion (Fong, 2012).

### ***Challenges and Set-Aside Grounds***

The ultimate deliverance of an adjudication decision faces challenges outlined in Section 15 of the CIPAA. Aggrieved parties may seek to set aside the decision on grounds such as improper procurement through fraud and bribery, denial of natural justice, lack of independence or impartiality by the adjudicator, or the adjudicator exceeding jurisdiction. Navigating the adjudication process requires proactive measures to address these challenges, ensuring a robust and equitable dispute resolution mechanism within the construction industry.

## **NATURAL JUSTICE IN ADJUDICATION DECISION**

Natural justice, constituting principles of procedural fairness, serves as a cornerstone to ensure fair and reasonable decision-making. Adjudication, often characterized as "*rough justice*," functions as a provisional alternative, swiftly resolving disputes to maintain cash flow<sup>5</sup> in ongoing projects. While adjudicators

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<sup>5</sup> Lord Denning in his now famous judgment in the Court of Appeal in *Dawnays Ltd v Minter Ltd (1971) 1 WLR 1205*, had proclaimed a profound understatement that *cashflow, albeit without a doubt crucial in any contract, is actually the "lifeblood" that keeps the construction industry running, often ensuring the success of a project due to the cooperation provided between contractors and sub-contractors especially when cash flow is ample.*

share the broad duty of acting impartially (Section 108(2)(e), Construction Act 1996) in the United Kingdom, distinct from arbitrators, they are not bound by statutory duty to ensure fairness or adopt fair procedures, operating within tight timeframes.

### **Principles of Natural Justice**

The principles of natural justice, encapsulated in two rules—the rule against bias and the rule of the right to a fair hearing<sup>6</sup>—are integral to maintaining public confidence in the legal system. Public trust is paramount, whether in courts or public decision-making bodies. Despite Section 25 of the CIPAA granting adjudicators extensive powers, their exercise must align with the CIPAA, ensuring impartiality, and adhering to the rules of natural justice. To further illustrate, consider our common complaint about fairness in daily conversation that:

- 1) Investigative and decision-making processes should be fair.
- 2) If a decision-making process is fair, similar consequences will result from similar actions by similar people.

### **Adjudicator's Powers and Natural Justice**

While Section 25 delineates adjudicator powers, it is not a *carte blanche* license to disregard fair play. Adjudicators must exercise their powers judiciously, ensuring justice and fair play prevail. Inquisitorial powers should not compromise fairness, and any misapplication may lead to the set-aside of the adjudication decision (Jocelyn, 2018).

### **Appointment of Adjudicator and Natural Justice Issues**

The appointment of an adjudicator, the inaugural step in adjudication, demands careful adherence to natural justice. Oversight here can lead to significant issues in enforcing adjudicators' decisions. Developments in 2021 highlighted the importance of natural justice in adjudication. For example, the court may refuse to enforce an adjudicator's decision due to a breach of natural justice, underscoring its relevance in adjudication proceedings. This is akin to laying a strong foundation for a building – foundational issues affect the entire structure.

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<sup>6</sup> Concerning to that, the Judge in *Rimbunan Raya Sdn Bhd v Wong Brothers Building Construction Sdn Bhd And Another Case [2016] MLJU 1189* reminded that the principles of Natural Justice are concerned with the provision of a fair hearing to contending parties. They do not mandate any particular result. *As long as the parties have been given a fair hearing, the decision cannot be set aside for failure to comply with Natural Justice.* A party who is dissatisfied with the decision on its merits cannot use the principles of Natural Justice to have the decision set aside.

### **Adjudicator's Immunity and Compliance with Natural Justice**

Section 34 of the CIPAA grants adjudicators immunity from legal action for acts done in good faith but mandates adherence to natural justice principles. This immunity ensures impartial decision-making free from legal repercussions. However, recent judgments affirm that breaches of natural justice can compromise this immunity. For example, in the 2022<sup>7</sup> the court emphasized that while adjudicators are protected from legal action, they must still comply with natural justice principles. This case highlights the balance between adjudicator immunity and the need for procedural fairness.

### **Natural Justice in Fast-Track Adjudication**

The fast-track nature of adjudication under the CIPAA, often dubbed "*rough justice*," prompts a critical question: Does this expedited process adequately enforce the rule of natural justice, a fundamental pillar of any civilized legal system? This question will be rigorously examined in subsequent sections, delving into the intricacies of balancing speed with the imperative of ensuring justice prevails. The Court of Appeal commented that there should be a limit to the requirements of natural justice in adjudication given that the procedure was designed to be speedy and that there is, therefore, an inbuilt unfairness in it<sup>8</sup>. The fact that it is open to an unsuccessful party to attempt to overturn an adjudicator's decision by litigation or arbitration also justified imposing such limits but only be in the case of serious breaches that the court would intervene and refuse to enforce the decision of an adjudicator (Boddy, 2024).

## **MATERIALS AND METHODS**

This study employs a three-phase methodology to investigate natural justice in Malaysian construction adjudication:

### Phase 1: Data Collection

- Sources: Malayan Law Journal, eLaw.my, CIDB Construction Law Report.
- Focus: Cases related to Section 15 of the CIPAA.

### Phase 2: Case Analysis

- Focus: In-depth analysis of 11 significant cases from 2014 to 2017 where adjudication decisions were set aside.
- Technique: Qualitative descriptive analysis to uncover patterns and challenges in adhering to natural justice principles.

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<sup>7</sup> *Meridian Contracts Sdn Bhd v Bauer (Malaysia) Sdn Bhd* [WA-24C-137-07/2022]

<sup>8</sup> *Construction v Devonport Royal Dockyard* [2005] EWCA Civ 1358 and *Amec v Whitefriars* [2004] EWCA Civ 1418

- Selection Criteria: From an initial 29 cases, narrowed down to 11 based on their significance in addressing natural justice issues under Section 15(b) of the CIPAA. This period captures a critical snapshot of the construction industry's landscape, foundational for understanding key dynamics prior to potential post-2017 changes.

### **Qualitative Descriptive Technique**

This phase employs a qualitative descriptive technique to examine court judgments, uncovering patterns, themes, and factors contributing to challenges and adherence to natural justice in adjudication decisions. The analysis focuses on the interplay between contractual interpretations, evidence considerations, and natural justice, providing a comprehensive understanding of the complexities involved. A meticulous analysis of cases set aside on adjudication decisions has been undertaken, utilizing the eLaw.my journal as a comprehensive repository of chronological court cases. The study's crux lies in Section 15 of the CIPAA, empowering aggrieved parties to seek the setting aside of adjudication decisions based on four specific grounds:

- a. *Fraud or bribery: Influencing the decision through fraudulent activities or bribery.*
- b. *Natural justice: Breach of natural justice principles during the adjudication process.*
- c. *Not acted impartially: Allegations of bias or lack of impartiality in the adjudicator's actions.*
- d. *Excess adjudicator's jurisdiction: Adjudicators overstepping their designated jurisdiction.*

The study thoroughly examines cases where adjudication decisions were set aside due to breach of natural justice. By scrutinizing judgments and outcomes, it sheds light on the nuances and challenges associated with each ground outlined in Section 15 of the CIPAA. Understanding the prevalence and implications of these set-aside cases is imperative for refining the adjudicatory process and upholding principles of fairness in construction disputes. Table 1 shows the total set aside cases from 2014 to 2017.

**Table 1:** Total set aside cases based on each CIPAA provisions.

	2014	2015	2016	2017	Total
Pecuniary Bias (Fraud or Bias) section 15 (a)	-	-	2	-	2
Natural Justice section 15 (b)	-	3	3	5	11
Not Acted Impartially	-	1	1	2	4
Excess Adjudicator's Jurisdiction	1	2	3	6	12
<b>Total Cases</b>	1	6	9	13	29

Source: AIAC 2019 Data and Author's Calculation

### Phase 3: Synthesis of Findings

- **Evaluation:** Assess the study process and conclusions from the analysis of the 11 cases.
- **Focus:** Grounds for setting aside adjudication decisions include fraud or bribery, breach of natural justice, lack of impartiality, and excess jurisdiction.
- **Objective:** Provide insights into natural justice issues in adjudication, refining the process to uphold fairness principles.

This methodology aims to elucidate natural justice in adjudication, ensuring a fair and effective dispute resolution process within the Malaysian construction industry.

**Table 2:** Set aside issues focusing on natural justice as per section 15 (b) of the CIPAA provisions.

Set Aside	Description	Findings/Lesson Learned	Best Practices
ACFM ENGINEERING & CONSTRUCTION SDN. BHD. v ESSTAR VISION SDN. BHD. [2016] MLRAU 499	<p><b>Issues/ Grounds of Challenge</b></p> <p>The Appellant raised concerns about the Adjudicator favoring the Respondent without sufficient proof, challenging the transparency of the decision-making process and seeking a set aside under Section 15 of the Act.</p> <p><b>Court Decision</b></p> <ol style="list-style-type: none"> <li>1. The High Court dismissed the application, noting no evidence that prevented the Appellant from presenting their case.</li> <li>2. The court found no indication of unfair treatment, as grievances were only raised after an unfavorable decision.</li> <li>3. For a set aside on Natural Justice grounds, a material breach by the Adjudicator must be proven.</li> <li>4. Despite the obligation to pay according to the Adjudication</li> </ol>	<ol style="list-style-type: none"> <li>1. The court emphasized that there must be triable issues and a material breach by the Adjudicator to set aside an Adjudication decision.</li> <li>2. Setting parameters for the scope of Adjudication helps mitigate Natural Justice issues, providing clarity on the Adjudicator's jurisdiction.</li> <li>3. The timeline for deciding disputes, when clearly outlined by the Adjudicator, contributes to a more transparent process.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjudicators should clearly define the parameters of the Adjudication, mitigating potential Natural Justice issues.</li> <li>2. Parties, despite adverse decisions, have alternative avenues such as settling by agreement or resorting to legal/arbitration proceedings for further clarity.</li> </ol>

Set Aside	Description	Findings/Lesson Learned	Best Practices
	decision, parties could settle the matter by written agreement or initiate legal/arbitration proceedings to clarify their claims.		
<i>VIEW ESTEEM SDN BHD v BINA PURI HOLDINGS BHD [2015] 2 MLJ 22</i>	<p><b>Issues/ Grounds of Challenge</b></p> <ol style="list-style-type: none"> <li>View Esteem (VE) sought to set aside the adjudication decision due to the exclusion of three additional matters raised in the adjudication response.</li> <li>Allegation of denial of natural justice based on unequal treatment by the adjudicator regarding the acceptance of hearsay evidence.</li> </ol> <p><b>Court Decision</b></p> <ol style="list-style-type: none"> <li>The Court disagreed, emphasizing that the three matters raised by VE in the adjudication response were not presented in the payment response.</li> <li>The Court found no fault with the adjudication decision and dismissed VE's application under Section 15.</li> </ol>	<ol style="list-style-type: none"> <li>The adjudicator, understanding the limitations of jurisdiction, appropriately dismissed the request to set aside as the additional matters were raised late in the proceeding.</li> <li>Despite the complexity and volume of documentation, the adjudicator methodically identified and evaluated issues, demonstrating a careful and measured approach to findings of fact.</li> </ol>	<ol style="list-style-type: none"> <li><b>Jurisdiction Awareness:</b> Adjudicators should focus on issues explicitly mentioned in the payment claim and response.</li> <li><b>Familiarity with the Act:</b> Adjudicators must thoroughly understand <a href="#">the</a> CIPAA provisions to handle disputes competently.</li> <li><b>Procedural Fairness in Hearings:</b> Ensure fairness in hearings and allow parties to address key conclusions drawn from the proceedings. If a substantial conclusion is drawn from matters discussed at a hearing, parties should be given an opportunity to address the basis of the adjudicator's conclusion, ensuring procedural fairness as held in <i>Ardmore Construction Ltd v Taylor Woodrow Ltd (2006) CILL 2309</i></li> </ol>
WRP ASIA PACIFIC SDN BHD V. NS BLUESCOPE LYSAGHT MALAYSIA SDN BHD [2015] MLRHU 1018 Item A – Natural Justice	<p><b>Issues/ Grounds of Challenge</b></p> <p>Alleged breach of Natural Justice as the plaintiff had no opportunity to respond to the defendant's adjudication reply, and unilateral communication between the Defendant and the adjudicator was asserted.</p> <p><b>Court Decision</b></p> <p>In this case, the adjudicator gravely misapprehended and wrongly applied his powers under the CIPAA, leading to the setting aside of the adjudication decision. The court emphasized that WRP did not file any payment response, and under subsection 6(4) of the CIPAA, WRP was deemed to have disputed the payment claim.</p>	<ol style="list-style-type: none"> <li>The adjudicator direct contact with the Defendant without informing the Plaintiff, and without offering the Plaintiff an opportunity to respond, constituted a breach of Natural Justice.</li> <li>The adjudicator failure to inform the Plaintiff about the purpose of the contact and his unilateral approach were key factors contributing to the breach.</li> </ol> <p>Natural Justice requires fairness, transparency, and the provision of equal opportunities for all parties to present their case.</p>	<ol style="list-style-type: none"> <li><b>Transparent Communication:</b> Adjudicators should clearly state the purpose of their communication with any party.</li> <li><b>Communication Protocols:</b> Establish clear protocols at the start, ensuring all communications are copied to all parties and the Adjudicator.</li> <li><b>Handling Direct Contacts:</b> If contacted directly, Adjudicators should respond in writing or take notes and inform the other party promptly.</li> </ol>
Item B: Inquisitorial Initiatives of the Adjudicator	<p><b>Issues/ Grounds of Challenge</b></p> <p>The adjudicator claimed to have taken inquisitorial initiatives to ascertain facts and law required for the decision,</p>	<ol style="list-style-type: none"> <li>While adjudicators have the power to take inquisitorial initiatives, there is a condition – when</li> </ol>	<ol style="list-style-type: none"> <li><b>Avoid One-on-One Calls:</b> Adjudicators should avoid private phone conversations</li> </ol>

Set Aside	Description	Findings/Lesson Learned	Best Practices
	<p>communicating with BlueScope for clarification regarding specific aspects of the Adjudication Reply.</p> <p><b>Court Decision</b>                      The Adjudicator gravely misapprehended and wrongly applied his powers under the CIPAA. The court set aside the adjudication decision with no order as to costs.</p>	<p>communicating with one party, the adjudicator must make known the communication to the other party.</p> <ol style="list-style-type: none"> <li>2. Failure to disclose such communications and offer the other party an opportunity to respond constitutes a breach of Natural Justice.</li> <li>3. Adjudicators must exercise caution when communicating with parties individually, ideally avoiding phone calls and insisting on written communication for transparency.</li> </ol>	<p>with parties to ensure fairness.</p> <ol style="list-style-type: none"> <li>2. Document and Disclose Calls: If unavoidable, adjudicators should document the call details and inform the other party promptly.</li> <li>3. Limit Discussions: Adjudicators should only discuss administrative issues over the phone, not case details.</li> <li>4. Duty of Care: Adjudicators must inform all parties of any communication and allow them to respond to maintain Natural Justice.</li> <li>5. Opportunity to Comment: Adjudicators should give parties a chance to comment on any material or evidence considered in the decision-making process.</li> </ol>
<p>INOVATIF ENGINEERING (M) SDN BHD v NOMAD ENGINEERING SDN BHD [2016] MLJU 1351</p> <p>Item A - Adjudicator's ruling on the late submission of the Adjudication Response.</p>	<p><b>Issues/ Grounds of Challenge</b>                      The challenge was based on the denial of Natural Justice as the Adjudicator ruled not to consider the Adjudication Response, citing lateness.</p> <p><b>Court Decision</b>                      The court rejected the argument of a denial of Natural Justice, asserting that the Adjudicator did not fail to exercise the discretion afforded by the CIPAA to extend the time limits for filing the Adjudication Response.</p>	<ol style="list-style-type: none"> <li>1. The aggrieved party must establish that the Adjudicator failed to apply the rules of Natural Justice, and such breaches must be more than peripheral but material.</li> <li>2. Breaches of Natural Justice are material when the adjudicator fails to bring crucial points to the parties' attention, decisive or of considerable importance to the dispute resolution outcome.</li> <li>3. The CIPAA emphasizes a fast and quick decision, and strict timelines are set for submissions.</li> <li>4. If the plaintiff needs more time, they must apply to the adjudicator for an extension under Section 25(p) with reasonable grounds.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjudicators should exercise discretion judiciously, particularly regarding extensions, to avoid bias.</li> <li>2. Seek an agreement from the claimant for the extension requested by the respondent to demonstrate impartiality.</li> <li>3. Offer the same extension to the claimant when replying to the Adjudication Reply to maintain fairness in the process.</li> </ol>



Set Aside	Description	Findings/Lesson Learned	Best Practices
Item B - Adjudicator advancing the decision date	<p><b>Issues/ Grounds of Challenge</b> The challenge was based on the adjudicator advancing the decision date by two days, which the Respondent and Plaintiff argued prevented the adjudicator from considering their submission.</p> <p><b>Court Decision</b> The court ruled that the advancement of the decision date by two days does not constitute a failure of Natural Justice. The adjudicator use of interrogatories to assist in understanding the case does not imply bias or a breach of Natural Justice.</p>	<ol style="list-style-type: none"> <li>1. The court found no merit in the argument that advancing the decision date by two days was a ground for alleging bias or Natural Justice failure.</li> <li>2. The adjudicator use of interrogatories is a legitimate means to assist in understanding the case, and failure to address them does not constitute a breach of Natural Justice.</li> <li>3. The strict timelines imposed by the CIPAA must be adhered to, and parties should be diligent in meeting the deadlines.</li> </ol>	<ol style="list-style-type: none"> <li>1. Parties should be aware of and adhere to the strict timelines imposed by the CIPAA.</li> <li>2. The adjudicator can use interrogatories to seek clarification, and parties should respond to them promptly to ensure a fair adjudication process.</li> <li>3. Adjudicators may consider including a simplified timeline chart in their decisions to enhance parties' understanding of the strict timelines imposed by the Act.</li> </ol>
RANCHAN HEAVY ENGINEERING SDN BHD v PELABUHAN TANJUNG PELEPAS SDN BHD [2016] MLJU 1182	<p><b>Issues/ Grounds of Challenge</b> The plaintiff alleged denial of Natural Justice as the adjudicator refused their right to be heard by not allowing them to comment on a material authority relied upon by the defendant.</p> <p><b>Court Decision</b> The Court held that rejecting the plaintiff's request did not constitute a breach of Natural Justice. The adjudicator, in an email dated November 12, 2015, had set deadlines for written submissions and informed that the decision would be delivered by January 14, 2016. The plaintiff's request to comment on the defendant's authority after the submission deadline was rejected.</p>	<ol style="list-style-type: none"> <li>1. The rejection was based on maintaining equality between the parties, as both were given ample time to submit and respond to written submissions. Adjudication under the CIPAA aims for speedy dispute resolution, necessitating strict adherence to timelines.</li> <li>2. Adjudicators must manage timelines effectively to deliver decisions within the stipulated time frames.</li> </ol>	<ol style="list-style-type: none"> <li>1. Parties should be aware of and comply with submission deadlines to facilitate efficient dispute resolution.</li> <li>2. Adjudicators should maintain a fair and equal process, avoiding extensions that may impact the timely delivery of decisions.</li> </ol>
Item A - Adjudicator's Rejection of Plaintiff's Request to Comment on Material Authority	<p><b>Issues/ Grounds of Challenge</b> The plaintiff claimed denial of Natural Justice, asserting that the Adjudicator required urgent submissions on costs at the eleventh hour.</p> <p><b>Court Decision</b> The Court found no merit in the plaintiff's allegation, emphasizing that the plaintiff had ample opportunity to address the quantum of costs. The adjudicator invited both parties to submit written submissions on costs by January 12, 2016, with the decision set for January 14, 2016. The plaintiff did not raise concerns about the</p>	<ol style="list-style-type: none"> <li>1. The plaintiff failed to utilize the opportunity provided and did not raise concerns about the timeline or cost submissions in a timely manner.</li> <li>2. The adjudicator had previously informed both parties about the possibility of requesting responses to specific questions arising from the consideration of cause papers.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjudicators may consider creating acknowledgment notices for new requests/submissions, including a comment/request provision for clarity.</li> <li>2. Awareness initiatives should be implemented regarding the procedural aspects of the CIPAA, especially emphasizing timelines at the beginning of adjudication proceedings.</li> </ol>

Set Aside	Description	Findings/Lesson Learned	Best Practices
	tight deadline or the cost issue during this period.		
RIMBUNAN RAYA SDN BHD v WONG BROTHERS BUILDING CONSTRUCTI ON SDN BHD AND ANOTHER CASE [2016] MLJU 1189  <i>Item A - Double Claim between Penultimate and Final Certificate</i>	<p><b>Issues/ Grounds of Challenge</b>                      The challenge revolves around the Adjudicator's finding that there was no double claim between the Penultimate Certificate and the Final Certificate.</p> <p><b>Court Decision</b>                      The court dismissed the claim of a breach of Natural Justice, emphasizing that dissatisfaction with the decision does not imply a lack of impartiality or independence on the adjudicator part. The court affirmed that both parties had equal opportunities to present their cases, and the adjudicator considered additional documents and witness statements.</p>	<ol style="list-style-type: none"> <li>1. Giving a fair hearing to both parties is essential.</li> <li>2. Proper documentation and evidence submission are crucial.</li> </ol>	<ol style="list-style-type: none"> <li>1. Giving a fair hearing to both parties upon request can assist the adjudicator in making a well-informed decision.</li> <li>2. Some claim submissions may not be sufficient for the adjudicator to process, and while the adjudicator has the power to call for new evidence, time limits are crucial to ensure the Adjudication decision is not void.</li> <li>3. Any grammatical, typographical, or arithmetic errors can be corrected later as per Section 26(2)(d).                      Courts recognize that Adjudication is a swift form of dispute resolution, which may provide a rough form of justice, especially in complex disputes.</li> </ol>
<i>Item B - Payments under Variation Orders Without Respondent's Representatives' Signature</i>	<p><b>Issues/ Grounds of Challenge</b>                      The challenge questions whether payments under Variation Orders are due without the signature of the respondent representatives.</p> <p><b>Court Decision</b>                      The court held that the Adjudicator considered the Respondent's defense, which mainly revolved around the lack of document substantiation. The Adjudicator had provided ample opportunity for the Respondent to present its case. The court found no breach of Natural Justice, and the Adjudicator had given sufficient reasons for his decision.</p>	<ol style="list-style-type: none"> <li>1. Adequate consideration of defenses and proper justification of findings is crucial.</li> <li>2. Parties should adhere to the timelines set during the adjudication process.</li> </ol>	<ol style="list-style-type: none"> <li>1. Giving a fair hearing to both parties upon request can assist the adjudicator in making a well-informed decision.</li> <li>2. Requests for additional submissions beyond the initial timetable should be considered on an individual basis, taking into account the issues raised and the time left in the adjudication timetable.</li> </ol>
<i>Item C - Maybank Base Lending Rate and Late Interest Payment</i>	<p><b>Issues/Grounds of Challenge:</b>                      The challenge questions whether the Maybank Base Lending Rate is 6.85%, and if the late interest payment of 1% above that may be imposed on late payment.</p> <p><b>Court Decision:</b>                      The court rejected the claim of a breach of Natural Justice, stating that the adjudicator decision on the Bank's Base Lending Rate falls within his jurisdiction. The court</p>	<ol style="list-style-type: none"> <li>1. Adjudicators should properly decide disputes, and the sufficiency of evidence lies within their purview.</li> <li>2. The court emphasized the objective test for assessing an adjudicator's independence and impartiality.</li> </ol>	<ol style="list-style-type: none"> <li>1. Shortly after receiving the Referral, the adjudicator should consider whether he can properly decide the dispute, reviewing its nature, size, and complexity.</li> <li>2. As an exception, some final account disputes may be so large and complex that they cannot be resolved properly</li> </ol>

Set Aside	Description	Findings/Lesson Learned	Best Practices
	emphasized that even if the adjudicator made an error, it doesn't imply a lack of impartiality. The court found no breach of Natural Justice.		by adjudication. However, there are no cases where an adjudicator decision has not been enforced based on this.
GUANGXI DEV & CAP SDN BHD V SYCAL BHD AND ANOTHER CASE [2017] MLJU 878  <i>Item A - Rejection of Expert Witnesses</i>	<p><b>Issues/ Grounds of Challenge</b> The Plaintiff contended that the Adjudicator breached the rules of Natural Justice by rejecting their application to call 3 expert witnesses to give evidence in the Adjudication proceedings.</p> <p><b>Court Decision</b> The court dismissed the Plaintiff's application to set aside the adjudication decision, stating that there was no denial of Natural Justice in the adjudicator not allowing a hearing.</p>	<ol style="list-style-type: none"> <li>The adjudicator considered the Plaintiff's application and provided cogent reasons for rejection.</li> <li>The adjudicator exercised powers under Section 25 of CIPAA to disallow and dismiss the request/application for expert witnesses.</li> <li>The adjudicator reserved the right to call for a meeting to clarify submissions or supporting documents if needed.</li> </ol>	<ol style="list-style-type: none"> <li>Decide the case based on party representations unless impossible, providing an opportunity for comments on alternative bases.</li> <li>Ensure all actions are viewed as impartial by a fair-minded observer.</li> </ol>
<i>Item B - Non-Consideration of Clause 8(d) of LA</i>	<p><b>Issues/ Grounds of Challenge</b> The Plaintiff contended a denial of Natural Justice, claiming that the adjudicator did not take into account clause 8(d) of the Letter of Award (LA).</p> <p><b>Court Decision</b> The court observed that the Adjudicator not considering clause 8(d) and not accepting a letter as a Payment Response did not constitute a denial of Natural Justice. The application to set aside the Adjudication decision was dismissed.</p>	<ol style="list-style-type: none"> <li>Although clause 8(d) of the Letter of Award granted the Respondent the right to correct errors in progress payments, it was not applicable in this case.</li> <li>Lack of evidence suggesting prior communication from the Respondent to the Claimant about errors in Payment Certificates.</li> </ol>	<ol style="list-style-type: none"> <li>Base the decision on party representations, allowing comments on alternative bases if necessary.</li> <li>Ensure actions are viewed as impartial by a fair-minded observer.</li> <li>Provide equal and effective opportunities for both parties to respond to pleadings.</li> <li>Encourage agreement on appropriate extensions for delivering the decision if needed.</li> </ol>
VIEW ESTEEM SDN BHD v BINA PURI HOLDINGS BHD [2017] 2 MLRA 460	<p><b>Issues/ Grounds of Challenge</b> The challenge was based on the claim that the adjudicator breached Natural Justice by excluding and refusing to consider certain defenses raised by the appellant.</p> <p><b>Court Decision</b> The Court disagreed with the claim, emphasizing that the matters or responses brought up by the appellant in the adjudication response were not raised in the payment response.</p>	<ol style="list-style-type: none"> <li>The adjudicator has an obligation to comply with the principles of Natural Justice, ensuring fairness and impartiality.</li> <li>Adjudicators should consider all defenses raised by the parties in the adjudication response for fairness.</li> </ol> <p>The notice of adjudication typically focuses on the claim, and the responding party is entitled to defend against the claim with legitimate available defenses.</p>	<ol style="list-style-type: none"> <li>Adjudicators should be diligent in considering all defenses raised by parties, as fairness and impartiality are crucial.</li> <li>Parties should be aware that the Notice of Adjudication may not explicitly cover all potential defenses, and adjudicators may need to address additional defenses raised in the Adjudication response.</li> </ol>

Set Aside	Description	Findings/Lesson Learned	Best Practices
MARTEGO SDN BHD v ARKITEK MEOR & CHEW SDN BHD AND ANOTHER APPEAL [2017] MLJU 1827	<p><b>Issues/ Grounds of Challenge</b>                      The challenge was based on the adjudicator's refusal of Martego's request to call for oral evidence to resolve a dispute.</p> <p><b>Court Decision</b>                      The learned judge rejected this contention, stating that Martego's complaint was substantially a finding of facts rather than a breach of Natural Justice.</p>	<ol style="list-style-type: none"> <li>1. The CIPAA does not prescribe a specific method for the adjudication process.</li> <li>2. The main requirement is to provide both parties with an opportunity to present their case, whether through written submissions or oral evidence.</li> </ol> <p>The choice rests with the adjudicator to decide the process, if the documentation is sufficient for them to work with.</p>	<ol style="list-style-type: none"> <li>1. An adjudicator should allow parties to comment on any material or evidence, including knowledge or experience from any source, when making a decision.</li> <li>2. Address the timetable for adjudication early in the process, considering the complexity of the issues and securing sufficient time if needed.</li> </ol>
MILSONLAND DEVELOPMENT SDN BHD v MACRO RESOURCES SDN BHD AND ANOTHER APPEAL [2017] MLJU 169	<p><b>Issues/ Grounds of Challenge</b>                      The challenge revolved around whether there was a breach of Natural Justice when the adjudicator disregarded the issue of delay and defects raised for the first time by the respondent in its adjudication response.</p> <p><b>Court Decision</b>                      The court ruled that there was no breach of Natural Justice as, constrained by the clear provision of Section 27(1) the CIPAA, the adjudicator did not consider the issues of delay and defective works raised for the first time in the respondent's adjudication response.</p>	<ol style="list-style-type: none"> <li>1. The failure to file a payment response allows the non-responding party some security against a default judgment, as Section 6(4) deems the payment claim to be disputed.</li> <li>2. In the absence of a payment response, the unpaid party (claimant in adjudication) is only required to prove the matters raised in the payment claim without meeting additional onus of proof.</li> </ol>	<ol style="list-style-type: none"> <li>1. Be familiar with the CIPAA to avoid disputes, especially if unfamiliar, contributing to Natural Justice.</li> <li>2. Follow the adjudication procedure agreed upon in the contract.</li> <li>3. Adopt procedures appropriate to the specific case.</li> <li>4. Ensure all actions are viewed as impartial by a fair-minded observer.</li> </ol>
ZANA BINA SDN BHD v COSMIC MASTER DEVELOPMENT SDN BHD AND ANOTHER CASE [2017] MLJU 146	<p><b>Issues/ Grounds of Challenge</b>                      The challenge centered around whether there was a valid payment claim in compliance with the CIPAA before the adjudicator.</p> <p><b>Court Decision</b>                      The Court found that the adjudicator did not exceed his jurisdiction, did not act impartially, or breach Natural Justice. The decision was reached based on the adjudicator's powers under Section 25(i) to inquisitorially ascertain facts and law and Section 25(n) to decide on matters even without a certificate issued.</p>	<ol style="list-style-type: none"> <li>1. The adjudicator has the power to inquisitorially inquire into the veracity of payment claims and objections.</li> <li>2. The adjudicator may exercise powers to decide matters even without certificates, ensuring flexibility in decision-making.</li> <li>3. The adjudicator may direct site inspections to gather information.</li> </ol>	<ol style="list-style-type: none"> <li>1. Ensure familiarity with the CIPAA to avoid disputes and contribute to Natural Justice.</li> <li>2. Follow the adjudication procedure agreed upon in the contract.</li> <li>3. Adopt procedures appropriate to the specific case.</li> <li>4. Recognize that a Section 15 the CIPAA setting aside application does not disturb the adjudicator's findings or interpretations; corrections can be made in arbitration or litigation.</li> <li>5. Consider the nature, size, and complexity of the dispute at the outset of the adjudication process.</li> </ol>

## FINDINGS

Upon scrutinizing various court judgments, it became evident that the setting aside of adjudicator decisions predominantly occurred under two primary circumstances:

- a) Questioning Adjudicator Power (Section 25 of the Act)
  - Parties often challenged adjudicator decisions by questioning the extent and exercise of powers under Section 25 of CIPAA.
  - Disputes arose concerning the adjudicator's discretionary authority, particularly where powers granted under Section 25 were perceived to be overused or misapplied.
- b) Non-Compliance with CIPAA Provisions
  - A recurring trend involved disputes where adjudicator decisions were set aside due to non-compliance with CIPAA provisions.
  - Concerns were frequently raised about the misinterpretation or misapplication of CIPAA provisions, leading to disagreements crucial to the adjudication process.

From these observations, a comprehensive Table 3 summarizing best practices in ensuring natural justice in adjudication proceedings has been formulated. Table 3 serves as a practical guide for stakeholders involved in adjudication processes.

**Table 3:** Best practices in ensuring natural justice in adjudication proceedings.

Item	Description	Cases	Proposed Best Practices
1	Setting Deadlines for Document Production (Section 25c):	<ol style="list-style-type: none"> <li>1. <i>Ranchan Heavy Engineering Sdn Bhd v Pelabuhan Tanjung Pelepas Sdn Bhd</i> [2016] MLJU 1182</li> <li>2. <i>ACFM Engineering &amp; Construction Sdn. Bhd. v Esstar Vision Sdn. Bhd.</i></li> </ol>	<ol style="list-style-type: none"> <li>1. The adjudicator should create an acknowledgment notice for new submissions, encouraging parties to comply promptly.</li> <li>2. Promote awareness of adjudication proceedings.</li> </ol>
2	Call for meetings with the parties (Section 25 f)	<ol style="list-style-type: none"> <li>1. <i>WRP Asia Pacific Sdn Bhd v. Ns BlueScope Lysaght Malaysia Sdn Bhd</i> [2015] MLRHU 1018</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjudicator's discretion on holding meetings, considering the case's nature.</li> <li>2. Deciding the formality of meetings based on party preferences.</li> </ol>
3	Conduct any hearing and limiting the hearing time (Section 25 g)	<ol style="list-style-type: none"> <li>1. <i>View Esteem Sdn Bhd v Bina Puri Holdings Bhd</i> [2015] 2 MLJ 22</li> <li>2. <i>Guangxi Dev &amp; Cap Sdn Bhd v Sycal Bhd And Another Case</i> [2017] MLJU 878</li> <li>3. <i>Martego Sdn Bhd v</i></li> <li>4. <i>Arkitek Meor &amp; Chew Sdn Bhd And Another Appeal</i> [2016] MLJU 1827</li> <li>5. <i>WRP Asia Pacific Sdn Bhd v. Ns BlueScope Lysaght Malaysia Sdn Bhd</i> [2015] MLRHU 1018</li> </ol>	<ol style="list-style-type: none"> <li>1. Oral hearings are not essential in every case; fairness does not always require one.</li> <li>2. Parties should be given an equal opportunity to address new findings.</li> <li>3. Adjudicators should set a timetable for submissions, ensuring fairness.</li> </ol>

4	Inquisitorially take the initiative to ascertain (Section 25 i)	1. <i>WRP Asia Pacific Sdn Bhd v. Ns BlueScope Lysaght Malaysia Sdn Bhd [2015] MLRHU 1018</i>	1. Adjudicators should avoid individual telephone conversations. 2. Encourage parties to copy all correspondence to ensure transparency. 3. Including correspondence created by him or his appointed advisors if he is attaching significance to it in reaching his decision.
5	Extend any time limit imposed on the parties (Section 25 p):	1. <i>Zana Bina Sdn Bhd v Cosmic Master Development Sdn Bhd and Another Case [2017] MLJU 146</i> 2. <i>Inovatif Engineering (M) Sdn Bhd v. Nomad Engineering Sdn Bhd [2016] MLJU 1351</i>	1. Adjudicator's discretion to seek agreement for time extension, ensuring fairness. 2. Agreements should be documented for proof of impartiality.
6	Adjudicator's Appreciation of Evidence (Section 15)	1. <i>ACFM Engineering &amp; Construction Sdn. Bhd. v Esstar Vision Sdn. Bhd.</i> 2. <i>Rimbunan Raya Sdn Bhd V Wong Brothers Building Construction Sdn Bhd and Another Case [2016] MLJU 1189</i> 3. <i>Zana Bina Sdn Bhd v Cosmic Master Development Sdn Bhd And Another Case [2017] MLJU 146</i>	1. Detailed reasons are not mandatory, but clarity is crucial. 2. Adjudicators should address each issue separately in the decision. 3. Adjudicators should avoid silly mistakes, ensuring accuracy.
7	Establishing Procedures and Limiting Document Submissions (Section 27(1))	1. <i>View Esteem Sdn Bhd v Bina Puri Holdings Bhd [2017] 2 MLRA 460</i> 2. <i>Milsonland Development Sdn Bhd v. Macro Resources Sdn Bhd And Another Appeal [2017] MLJU 169</i>	1. Adjudicators can consider all defenses, even if not included in the initial payment response. 2. Flexibility for additional submissions, evaluated based on issues raised and remaining time.

## SUMMARY OF FINDINGS AND CONCLUSION

The examination of challenges within CIPAA reveals a recurring theme centered on the pivotal role of Section 25 in shaping the powers of adjudicators. This section, while designed for procedural efficiency, must not compromise natural justice. Cases highlight that a narrow interpretation of jurisdiction can lead to fairness breaches<sup>9</sup>.

Setting aside adjudication decisions on natural justice grounds is challenging, as noted by (Rahmat, 2018). Success requires demonstrating the materiality of the breach, often due to an adjudicator's limited view of jurisdiction. Beyond these concerns, CIPAA, initially designed for expediency, faces complexities discouraging smaller industry players. The industry's perception of CIPAA is crucial. Unaddressed challenges might erode confidence in the adjudication process. Complexities and extended timelines may push stakeholders towards conventional court avenues, undermining the Act's original purpose.

<sup>9</sup> *Ranchan Heavy Engineering Sdn Bhd v Pelabuhan Tanjung Pelepas Sdn Bhd [2016] MLJU 1182* and *ACFM Engineering & Construction Sdn. Bhd. v Esstar Vision Sdn. Bhd. [2016] MLRAU 499*

Balancing efficiency and fairness remain critical with court underline the need to maintain this equilibrium<sup>10</sup>. Reflecting on whether CIPAA serves as a fast and cost-effective mechanism, especially for smaller players, is essential. Considering feedback from industry stakeholders, including contractors, adjudicators, and legal professionals, is crucial. Their insights on practical experiences and challenges can inform potential reforms.

In conclusion, CIPAA is vital for addressing payment disputes. Ongoing scrutiny and refinement are imperative. Balancing efficiency and fairness, coupled with procedural clarity, is essential to preserve the Act's effectiveness. Reforms should address observed challenges and reflect the collective experiences and needs of construction industry stakeholders.

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<sup>10</sup>*WRP Asia Pacific Sdn Bhd v. NS BlueScope Lysaght Malaysia Sdn Bhd [2015] MLRHU 1018*

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**DEVELOPING THE CITY AND SUSTAINABLE  
DEVELOPMENT: URBAN SUBURBAN AREA OF HERTASNING  
- TUN ABDUL RAZAK METROPOLITAN MAMMINASATA,  
INDONESIA**

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**Abstract**

The development of peripheral areas as centres of socio-economic activity has an impact on land use change and the complexity of the transport system. The ongoing spatial transformation contributes to anthropogenic enhancement towards urban macroclimate change. Increased anthropogenic activity is characterised by changes in typology, land use and traffic performance along the corridor. This study examines the relationship between traffic and land use performance variables and climatic conditions using a quantitative approach. The data that has been processed is then analysed using SEM PLS. The results of the analysis show that land use variables affect climate conditions with a T-Statistic value of  $2.752 > 1.96$  or a P value of  $0.040 < 0.05$ . These results suggest that land use in the Hertasning-Tun Abdul Razak road corridor is positively associated with increased urban temperatures. This study recommends the handling of urban fringe areas towards controlling spatial utilisation along major road corridors, in anticipation of increasing urban macroclimate change.

**Keywords:** Land Use, Traffic Performance, Climate Change

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## **INTRODUCTION**

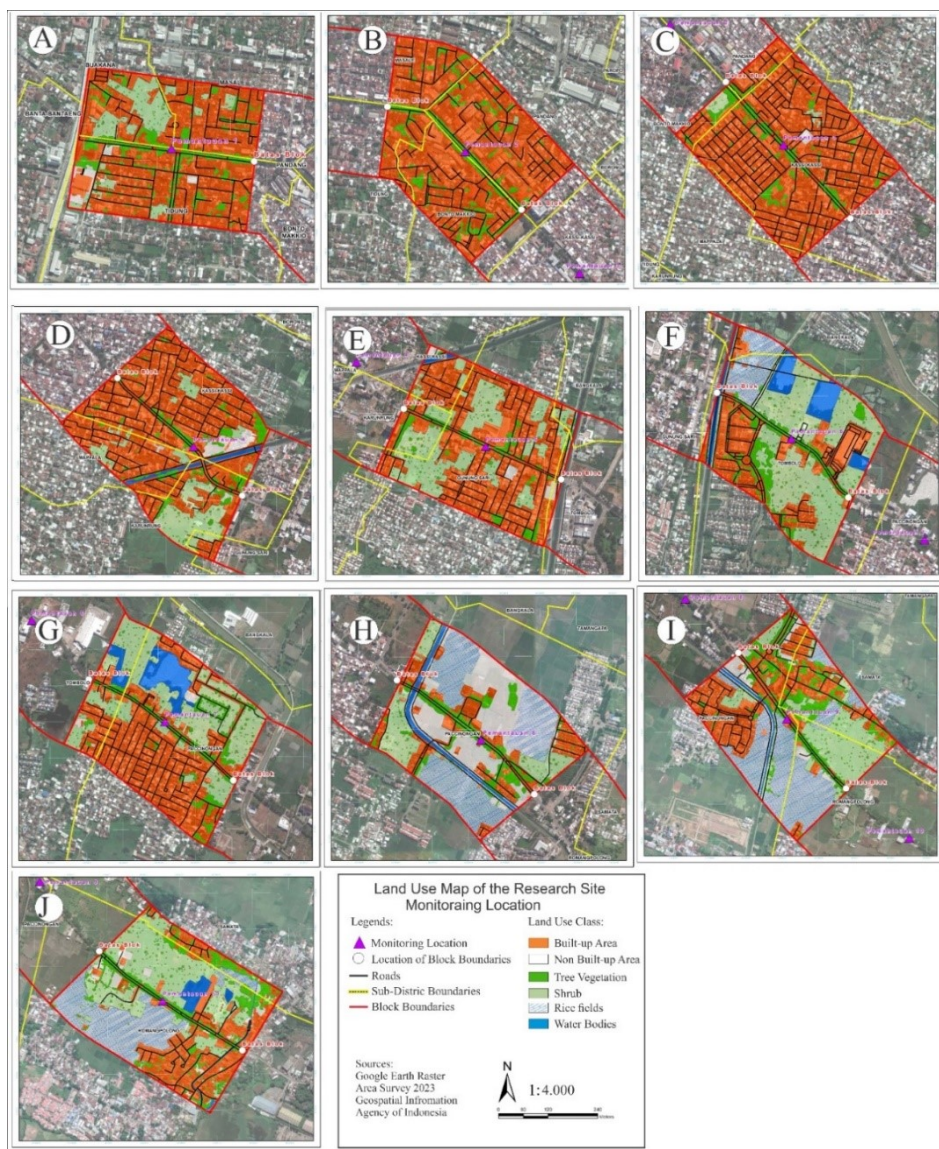
Excessive urbanisation in the dynamics of urban development has an impact on changes in the characteristics and typology of peripheral areas. This condition is characterised by changes in land use that develop as new settlement areas. Furthermore, the increase in development activities not only impacts the emergence of new activities but also contributes to the urban macroclimate (Liu, Z. et al., 2019; Aguilar et al., 2022; Sahana et al., 2023). Urbanisation is positively associated with the expansion of urban areas into peripheral areas and impacts land use change and transport system complexity towards environmental degradation (Dadashpoor et al., 2019; Othman & Ali, 2020; Surya et al., 2021). Furthermore, changes in the temperature profile of urban areas are characterised by increases in rainfall intensity, relative humidity, and solar radiation patterns (Morris et al., 2017; Pyrgou et al., 2019; Li et al., 2022). Thus, the effects of urbanisation not only contribute to urban sprawl but also to the complexity of transport systems, requiring comprehensive and integrated planning mechanisms towards sustainable development (Lara et al., 2021; Rasoolimanesh et al., 2022). The integration of urban systems will encourage the stability of spatial utilisation, ecosystem restoration, and the creation of community social cohesion. This means that the quality of planning and spatial utilisation of peripheral areas as a unified system will have an impact on social, economic, and environmental sustainability (Abid et al., 2019; Chatterjee et al., 2022). Furthermore, the development of urban areas will require consideration of land use effectiveness and efficiency, appropriate zoning practices, and transport systems that integrate towards sustainable development that requires collaborative support between the public sector, government, communities, and the private sector (Solly, 2021; Acierito et al., 2023; Alipour & Dia, 2023).

The Hertasning-Tun Abdul Razak suburb is an area that experiences intense development of socio-economic activities, resulting in changes in urban microclimate characteristics. These changes are more likely to result from increased population mobility based on the origin and destination of movement and its impact on the transport system and land use along the Hertasning-Tun Abdul Razak road corridor. The intensity of built-up areas that tends to increase over time contributes to the availability of land for green open areas, thus affecting the condition of natural vegetation and its effect on global warming. These conditions are characterised by climate change, weather anomalies, and their effects on urban flooding (Rushayati et al., 2016; Huang et al., 2020; Arshad et al., 2022).

The trend of spatial utilisation patterns in the Hertasning-Tun Abdul Razak periphery area is in line with the intensity of large-scale residential development and infrastructure development support has an impact on the connectivity of the Mamminasata Metropolitan urban transport system.

Furthermore, the development orientation of the Hertasing-Tun Abdul Razak periphery will require spatial utilisation control and land use regulation in areas that must be protected towards the management and arrangement of urban transport systems (Kii et al., 2019; Surya et al., 2021). Environmental degradation of peripheral areas is characterised by a decline in air quality and its effects on public health. Three factors have led to the decline in air quality, including: (1) conversion of productive agricultural land; (2) increased population mobility; and (3) increased urban activity or change in status of rural areas towards urban areas (Yunus, 2008; Xu et al., 2016; Piracha et al., 2022).

The Hertasing-Tun Abdul Razak area was originally productive agricultural land characterised by traditional settlement patterns (houses on stilts), later developments were characterised by the emergence of modern architectural types of residential buildings developed by housing developers. Furthermore, the spatial dynamics of the Hertasing - Tun Abdul Razak periphery were developed to fulfil the need for residential facilities integrated with infrastructure development (D'Acci, 2019; Ouedraogo et al., 2023). Agricultural land use change characterised by residential and commercial development is the driving force of land use change supported by high population density and its impact on the growth of the Hertasing-Tun Abdul Razak suburb. The land use of the peripheral area in 2023 occupies an area of 1,146.66 ha, consisting of: parking area zone of 0.54 ha, education facilities of 1.00 ha, worship facilities of 0.26, office and commercial facilities of 1.69 ha, residential area of 95.60 ha, road median of 0.03 ha, lake of 1.85 ha, road of 37.79 ha, road green belt of 1.71 ha, pond of 20.79 ha, field of 55.34 ha, mixed land of 93.51 ha, cemetery of 5.23 ha, grassland of 9.85 ha, yard of 208.34 ha, plantation of 36.84 ha, swamp of 7.40 ha, paddy field of 302.62 ha, shrub of 88.96 ha, river of 10.02 ha, and park of 10.62 ha. Thus, spatial utilisation in these peripheral areas is an urban area that requires management and control towards sustainability and the creation of a balance between space and carrying capacity and population capacity (Singh, 2020; Abera, et al., 2023). Furthermore, the Hertasing-Tun Abdul Razak periphery area requires treatment and strategies to support the integration of urban systems towards sustainable development (Barros, et al., 2018; Nickayin, et al., 2020). Thus, industrial activities and urban transport systems contribute to changes in the visibility and atmospheric absorption of solar radiation, which are determinant factors in the climate characteristics of urban areas (Barreto et al., 2017; Song et al., 2020; Perez & Pereira, 2023). The Hertasing-Tun Abdul Razak suburb is presented in Figure 1 below.



**Figure 1:** Hertasning-Tun Abdul Razak Road Corridor Area Based on Observation Segment  
 Source: Author Elaborator

The results of studies that support this research include: (1) Research conducted by Medeiros, et al. (2020) and the study by Chatterjee, et al. (2022) found that urban urbanisation and ineffective government institutional systems in metropolitan urban management have an impact on social, economic,

and environmental problems; (2) Research conducted by Lara, et al. (2021) found that planning mechanisms that lack integration of urban systems will cause new problems related to economic, social, and environmental aspects. The three studies confirm that ineffective planning systems and urban management institutions as well as weak community participation contribute to the dynamics of peripheral development and the sustainability of metropolitan urban settlement development. Furthermore, this study is more focused on examining and analysing the relationship of traffic performance and land use to climate conditions on the Hertasing-Tun Abdul Razak corridor. Thus, the difference between this study and previous research lies in the dimensions and aspects studied. This means that the study was conducted at the micro-scale of the urban environment, so the measured climate is a microclimate.

The long-term benefits that will be obtained are (i) the availability of air quality information needs as input in spatial planning in the Hertasing-Tun Abdul Razak corridor, (ii) the fulfilment of environmentally sound urban space, and (iii) the implementation of sustainable urban governance. These three things will help the government in formulating planning and spatial planning mechanisms to reduce the negative impacts, especially on-air quality degradation towards the creation of an efficient, quality and sustainable environment.

## **RESEARCH METHODOLOGY**

The quantitative approach in this study was used to test and analyse traffic performance and land use against climatic conditions on the Hertasing-Tun Abdul Razak Road corridor. Traffic performance was assessed based on average speed, side obstacles, vehicle volume, and average density. Land use was assessed based on built-up land, open land, road green space, natural vegetation, rice fields, and water body. Furthermore, climatic conditions were assessed based on temperature, air pressure, relative humidity, and wind speed. Determination of the sample in this study using purposive sampling technique which is determined by the researcher based on certain criteria. This research was conducted from April to August 2020. The data collection methods in this study were observation, survey, and documentation. The instruments used in data collection through observation are field notes and data checklists. Furthermore, the instruments used in data collection through surveys are open-ended questions and closed-ended questions based on the questionnaire set by the researcher. Documentation data in this study include: (1) Mamminasata Metropolitan Spatial Plan obtained through the Office of Spatial Planning, Human Settlements, and Water Resources; (2) Masterplan of large-scale settlement development obtained through housing developers; and (3) Development policies on the Hertasing - Tun Abdul Razak Road corridor obtained through the Regional Development Planning Agency of South Sulawesi Province.

The research variables defined in this study include traffic performance ( $X_1$ ), land use ( $X_2$ ), and climatic conditions ( $Y$ ). Furthermore, traffic performance data was observed based on the conditions and characteristics of resident trips based on origin and destination in relation to average speed, side obstacles, vehicle volume, and average density based on the conditions of the Hertasing - Tun Abdul Razak road corridor. This data was observed based on peak hour traffic volumes. Observations on land use were observed based on the condition of built-up land, open land, road green space, natural vegetation, paddy fields, and water bodies. This data is complemented by interpretation of natural colour composite pleiades satellite imagery with a spatial resolution of 50 cm. Observations of climatic conditions were observed based on temperature, air pressure, relative humidity, and wind speed. The data is complemented by climatic conditions obtained from relevant agencies. The variables of this study are described in Table 1 below.

**Table 1: Research Variables**

Type of Variable	Variable	Indicator
Independent Variable	Traffic Performance ( $X_1$ )	a. Average Speed ( $X_{1.1}$ ) b. Side Obstacles ( $X_{1.2}$ ) c. Vehicle Volume ( $X_{1.3}$ ) d. Average Density ( $X_{1.4}$ )
	Land Use ( $X_2$ )	a. Built-up Land ( $X_{2.1}$ ) b. Open Land ( $X_{2.2}$ ) c. Road Green Space ( $X_{2.3}$ ) d. Natural Vegetation ( $X_{2.4}$ ) e. Rice Fields ( $X_{2.5}$ ) f. Water Body ( $X_{2.6}$ )
Dependent Variable	Climate Conditions ( $Y$ )	a. Temperature ( $Y_1$ ) b. Air Pressure ( $Y_2$ ) c. Relative Humidity ( $Y_3$ ) d. Wind Speed ( $Y_4$ )

The data analysis method in this study uses descriptive statistics, chi-square analysis, and Partial Least Square (PLS) Structural Equation Modeling (SEM), which simultaneously tests the measurement model and structural model (Sarstedt et al., 2021). PLS SEM validates structural models that validate hypothesis testing through predictive models that do not assume specific data scale measurements, thus allowing for small sample sizes below 100 samples (Hair et al., 2017). Furthermore, factor analysis and regression in the PLS model test the relationship between variables through two main stages, namely the outer model and inner model. The analysis formulation used is as follows:

$$X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

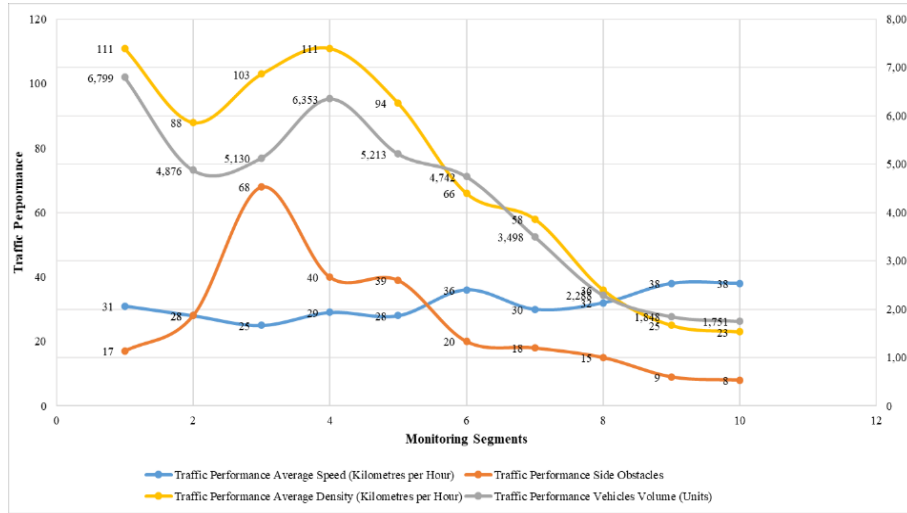
Where  $X^2$  is the value of the Chi-square statistic,  $O_i$  is the frequency of observations in the cells of the contingency table,  $E_i$  is the expected frequency in the cell of the contingency table based on the null hypothesis ( $H_0$ ).

## **RESULT AND DISCUSSION**

### **Traffic Performance of Hertasning-Tun Abdul Razak Road Corridor**

Traffic performance is closely related to the increase in commercial, service, and residential activities located around the Hertasning-Tun Abdul Razak road corridor. These conditions have an impact on increasing traffic volumes characterised by generation and attraction based on the pattern of origin and destination of trips. This means that population mobilisation is characterised by an increase in traffic volume that not only affects road conditions but also the difference in movement that occurs, so the level of service is categorised as category E. This fact illustrates that traffic volume is positively associated with road capacity. The Indonesian Road Capacity Manual (1997) confirms that the main function of roads in the city will result in the pull of population mobilisation towards transport system services. This means that the level of transport service is assessed based on road capacity, road user behaviour, and road traffic volume. Furthermore, traffic flow parameters are important factors to consider in relation to traffic planning. The indicators assessed are traffic volume, speed, and density. Thus, this study considers average speed, side obstacles, vehicle volume, and average density.

Traffic performance on the Hertasning-Tun Abdul Razak road corridor is assessed based on segmentation. The largest traffic volume on the Hertasning-Tun Abdul Razak road corridor is located on segment 1, followed by segment 4, segment 5, and segment 3. The overall traffic volume by segment varies greatly with an average value of 4,250 vehicles per hour. These results confirm that traffic volume is closely related to land use development along the Hertasning-Tun Abdul Razak road corridor. Furthermore, the average speed by segment shows an increasing trend in vehicle speed although not significant. Vehicle density and side obstacles show a decreasing trend based on each monitoring segment. This confirms that vehicle density and the number of side barriers are closely related to population mobility characterised by commercial, service, and residential activities. Traffic and Land Use Performance on Climate Conditions of the Hertasning-Tun Abdul Razak Corridor is presented in Figure 2 below.



**Figure 2:** Traffic Performance of Hertasing - Tun Abdul Razak Road Corridor  
 Source: Analysis Result

### Land Use of the Hertasing-Tun Abdul Razak Road Corridor

Urbanisation and urban expansion are closely related to land use change that occurs on the Hertasing-Tun Abdul Razak road corridor. These conditions result in increased socio-economic activities and changes in urban microclimate characteristics. These changes are more due to increased population mobility and the intensity of built-up areas that tend to increase over time and contribute to the availability of land for green open areas that affect the condition of natural vegetation and have an impact on global warming. The indicators assessed in this study are built-up land, open land, road green space, natural vegetation, paddy fields, and water bodies.

Land use on the Hertasing-Tun Abdul Razak road corridor varies greatly by segment. The largest built-up area in segment 4 is shown with socio-economic, office, service, and commercial activities. Furthermore, land uses such as open land, paddy fields, and water bodies tend to expand their areas from Segment 1 to Segment 10. This occurs because there is still some land in Segment 6 to segment 10 that has not been fully developed, with most of it still being used as paddy fields. Meanwhile, the use of road green space shows a relatively stable consistency from Segment 1 to Segment 10. Thus, land use confirms urban expansion in the Hertasing-Tun Abdul Razak road corridor area. McGee (1991) asserts that areas along corridors traversed by transport systems undergo spatial, economic, social, and cultural transformations, which ultimately lead to a significant shift from rural to urban characteristics. The land use of the Hertasing-Tun Abdul Razak road corridor is presented in Figure 3.



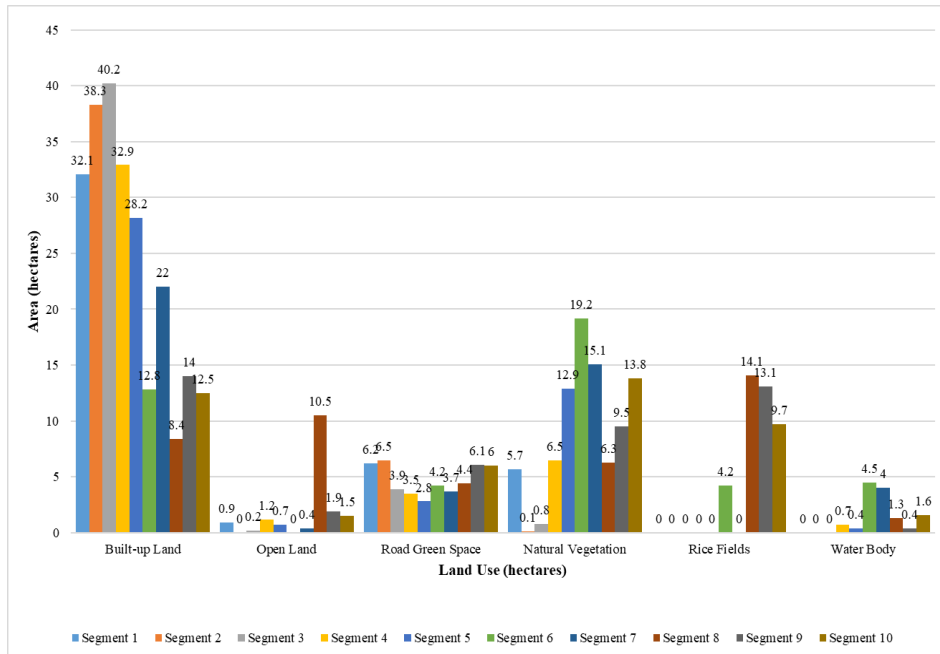
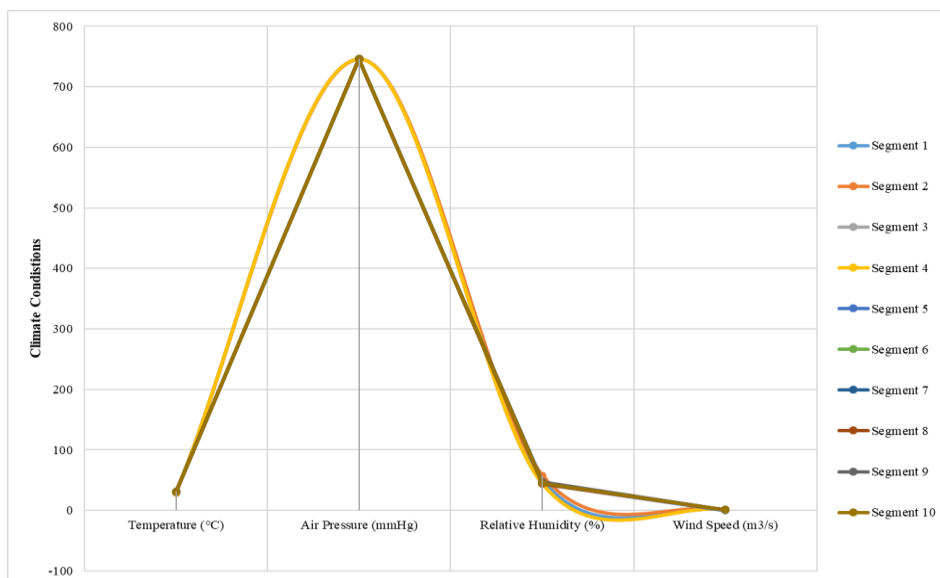


Figure 3: Land Use of the Hertasing-Tun Abdul Razak Corridor  
Source: Analysis Result

### Climate Condition of Hertasing-Tun Abdul Razak Road Corridor

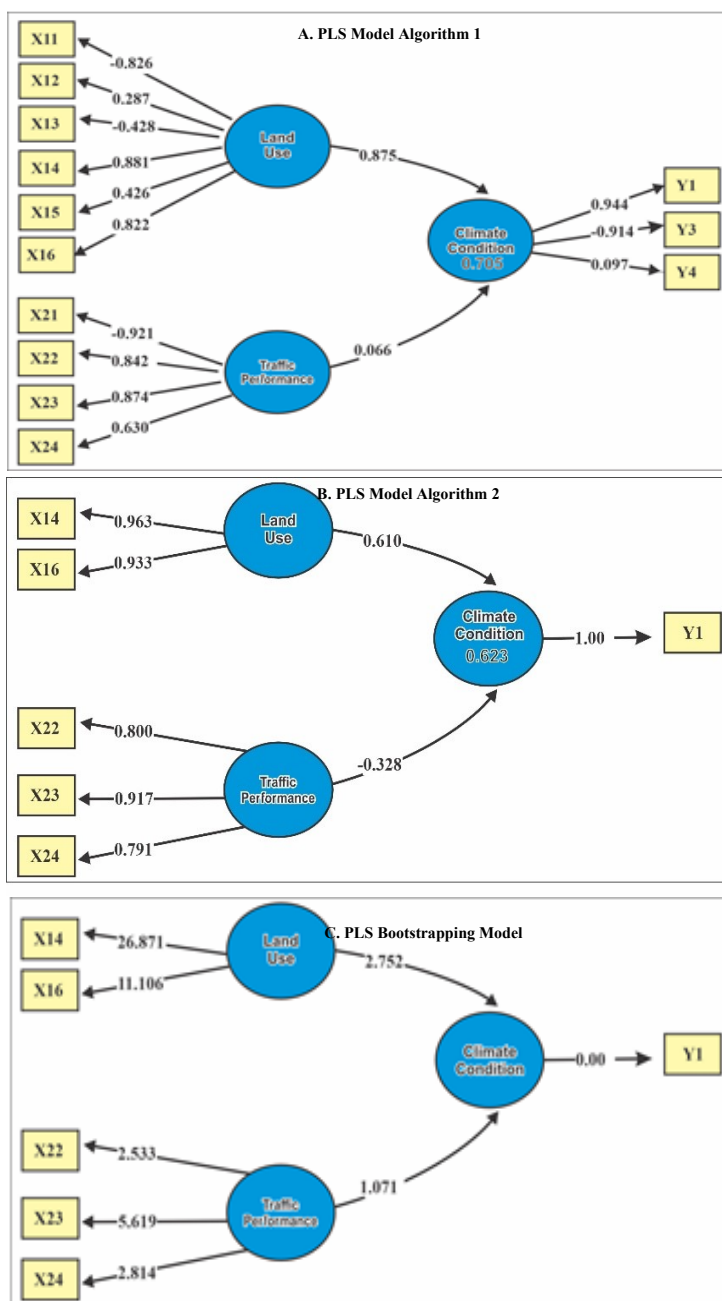
The measurement of urban microclimate conditions is strongly influenced by the physical conditions and socio-economic activities of the community. The study involved measuring climatic conditions with the parameters of temperature, air pressure, relative humidity, and wind speed. The measurement results show that the air temperature from segment 5 to segment 10 is about 2°C higher compared to segment 1 to segment 4. This contrasts with the relative humidity which tends to decrease from Segment 1-10. This decrease in humidity could be since segments 5-10 consist of open land, resulting in greater sunlight intensity. In addition, the amount of road green space in segment 5 to segment 10 is also less compared to segment 1 to segment 4, which also affects the relative humidity. Air pressure conditions were stable for all monitoring segments, at 746 mmHg. However, the wind speed varied in each segment. The lowest wind speed occurred in segments 1 and 2, at 0.7 m/s, as many buildings and trees blocked the wind. On the other hand, wind speeds are higher in segments 4, 9 and 10, which are more open, allowing the wind to move more freely. The climatic conditions of the Hertasing-Tun Abdul Razak road corridor are presented in Figure 4.



**Figure 4:** Climate condition of Hertasing-Tun Abdul Razak corridor  
 Source: Analysis Result

### Structural Equation Modelling

Traffic performance with a value on indicator  $X_{1.1}$  is -0.921,  $X_{1.2}$  is 0.842,  $X_{1.3}$  is 0.874, and  $X_{1.4}$  is 0.630. Land use variables, the loading value of the indicator  $X_{2.1}$  is -0.826;  $X_{2.2}$  is 0.287,  $X_{2.3}$  is -0.428,  $X_{2.4}$  is 0.881,  $X_{2.5}$  is 0.426, and  $X_{2.6}$  is 0.822. Furthermore, climate conditions, the loading value on the  $Y_1$  indicator is 0.944,  $Y_3$  is -0.914, and  $Y_4$  is 0.097. Furthermore, indicators with a loading factor value  $> 0.6$  are declared valid. Thus, the loading factor value is valid for each indicator, so test the second algorithm to see the validity of the indicator as a measure of its construct. The PLS Algorithm 2 model path diagram has no negative variance, so the existing indicators are declared valid. Furthermore, the loading factor value for each indicator shows that all indicators get a loading factor value above 0.6 where the loading value  $> 0.6$  is said to be valid, so that all indicators are declared valid as a measure of the construct. Thus, the indicators of land use are determined by indicators of natural vegetation and water bodies, traffic performance is determined by indicators side obstacles, vehicle volume, and average density, and climatic conditions are determined by air temperature. The calculation of the  $R^2$  value of climate conditions is 0.623 which can be interpreted that climate conditions are determined by land use and traffic performance by 62.3%. The Relationship Model of Traffic Performance and Land Use to Climate Conditions of the Hertasing-Tun Abdul Razak Corridor is presented in Figure 5.



**Figure 5:** (A-C) Relationship Model of Traffic Performance and Land Use to Climate Conditions of Hertasing-Tun Abdul Razak Corridor  
Source: Analysis Results

**Table 2:** The Relationship of Land Use and Traffic Performance to Climate Conditions in the Hertasning-Tun Abdul Razak Road Corridor

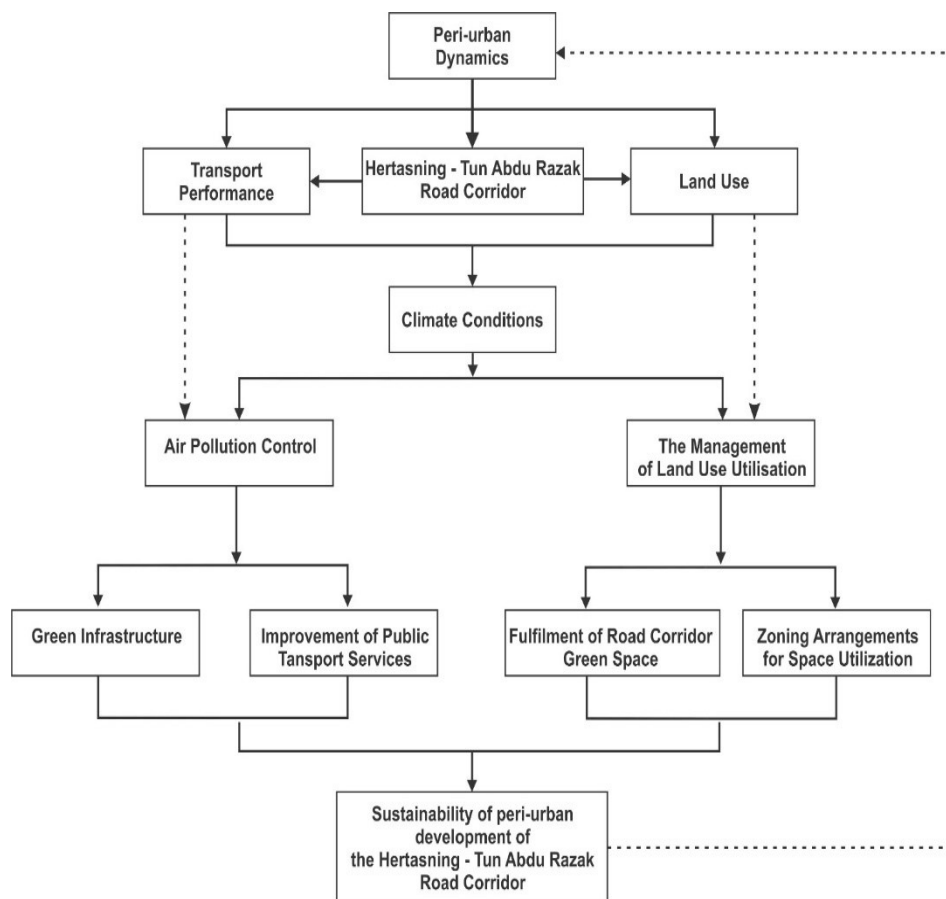
	Original Sample (O)	Standard Deviation (STDEV)	T Statistics ((O/STDEV))	P Values
Traffic Performance -> Climate Condition	-0.328	0.306	1.071	<b>0.285</b>
Land Use -> Climate Condition	0.610	0.222	2.752	<b>0.006</b>

Source: Analysis Results

Table 2 shows the testing of the relationship between land use and traffic performance on climatic conditions in the Hertasning-Tun Abdul Razak road corridor. The test results show the effect of land use on climatic conditions showing the results of the T-Statistic value of  $2.752 > 1.96$  or a P value of  $0.040 < 0.05$  then  $H_0$  is rejected. This means that land use influences climatic conditions. These findings confirm that land use on the Hertasning-Tun Abdul Razak road corridor causes an increase or decrease in climate conditions and air temperature. Furthermore, land use change is related to the socioeconomic activities of the community, including residential, urban, and agricultural areas (Camara et al., 2019; Ibrahim & Ash'aari, 2023). The rapid growth of the urban population and various development activities will increase land demand, leading to pressure to convert agricultural land to residential and commercial uses (Erasu Tufa & Lika Megento, 2022; Zaki et al., 2023). Furthermore, testing the effect of traffic performance on climate conditions shows the T-Statistic value of  $1.071 < 1.96$  or the P value of  $0.285 > 0.05$ , so  $H_0$  is accepted. This means that traffic performance does not significantly affect climate conditions. This suggests that an increase or decrease in traffic performance along the Hertasning-Tun Abdul Razak road corridor does not significantly alter climatic conditions, particularly air temperature. This finding contrasts with the literature that suggests that vehicle density, as part of traffic performance indicators, can affect climate with associations to air quality, human health, and climate change (Huang et al., 2020; Ogunkunle & Ahmed, 2021). This is closely related to the role of the transport system in increasing greenhouse gas emissions that can cause climate change on a macro scale (Kontovas & Psaraftis, 2016; Shahidan & Shafie, 2020). The difference in research findings with previous studies is due to the difference in measurement scale, where this study was conducted in a micro-scale urban environment, by measuring microclimate. At the micro scale, the transport sector does not directly contribute to microclimate improvement but affects the macroclimate through the greenhouse gas phenomenon.

The sustainability of peri-urban development along the Hertasning-Tun Abdul Razak road corridor is examined using a holistic approach. The dynamics of peri-urban areas are characterised by the interaction between urban sprawl and rural characteristics. Efficient and sustainable land use management, through

zoning arrangements, and distribution of space between residential, commercial, and green open space areas, directly contributes to the formation of a sustainable city (Surya et al., 2020; Daunt et al., 2021). Furthermore, the role of the transport system in reducing air pollution, encouraging public transport services, and developing green infrastructure that supports congestion reduction, air quality improvement, and provision of green open spaces. Thus, peri-urban development efforts include strategies for resilience to climate change and disaster risk management as well as the fulfilment of green open space towards environmental sustainability and improved quality of life. The sustainability of peri-urban areas is presented in Figure 6 below.



**Figure 6:** Sustainable Development Scheme in Peri-Urban Area of Hertasing-Tun Abdul Razak Road Corridor  
*Source: Author Elaborator*

## CONCLUSIONS

The dynamics of the development of peripheral areas have increased socio-economic activity, population mobility that has an impact on the transport system and land use on changes in urban microclimate characteristics on the Hertasning-Tun Abdul Razak road corridor. Climatic conditions are characterised by air quality and land use management and traffic performance. The statistical test results show that land use variables affect climate conditions. Thus, land use change on the Hertasning-Tun Abdul Razak road corridor is positively associated with an increase in urban temperature. Increases in urban temperatures are directly linked to increases in anthropogenic activities and their effects on land use change around the Hertasning-Tun Abdul Razak road corridor.

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## CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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## **AN ASSESSMENT ON THE IMPACT OF PHYSICAL DEVELOPMENT OF PERHENTIAN ISLAND, TERENGGANU, MALAYSIA TOWARD THE QUALITY OF LIFE OF ITS RESIDENTS**

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### **Abstract**

Development is important to increase residents' Quality of Life (QaL). The development of Perhentian island is far behind the development of other mainland towns and cities in Terengganu which has significantly affected the Quality of Life (QoL) of its residents. Therefore, a proper study on the benefits and strategies of developing an island has to be conducted to fulfil the needs of the island's residents. This research aims to investigate the development of Perhentian Island, Terengganu. The research used a quantitative methodology utilising an observation checklist as its instrument. The checklist comprises 23 elements which are housing area, education facilities, health facilities, entertainment facilities, safety facilities, office buildings, industrial sector, energy resources, water resources, restaurants, hotels, transportation, road, grocery store, scenery, conservation centre, jetty, waste management, drainage system, food resource, network and coverage, worship buildings, and buildings organization. The data collected from the observation were presented in Excel tabulated format with identification of strongly dissatisfied, satisfied, neutral, satisfied, and strongly satisfied. Overall, the findings of this study show that the development on Perhentian Island is at neutral level. It is hoped that the study outcome can provide guidelines for Perhentian Island's future development toward achieving a better Quality of Life for its residents.

**Keywords:** Island Development, Perhentian Island, Quality of Life

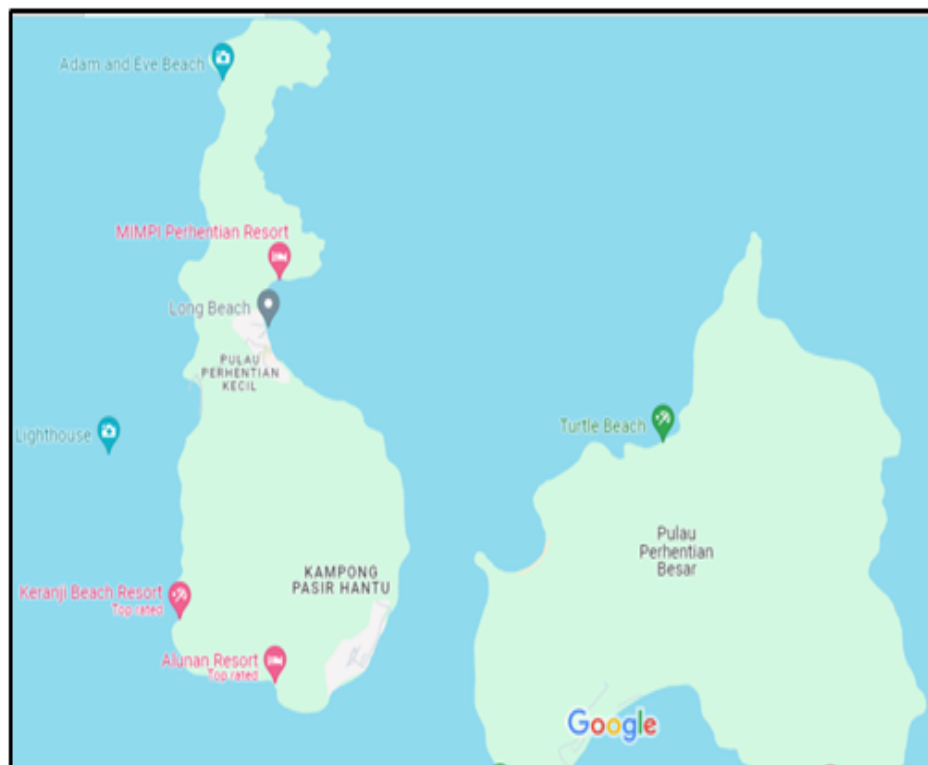
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## **INTRODUCTION**

Malaysia is known among tourists for its beautiful islands. For example, Pangkor Island which is situated in Perak, and Langkawi Island in Kedah, are well developed. Other than that, there is also Perhentian Island which is located in Terengganu, Malaysia, and is famous not only among Malaysians but also, among tourists from around the globe as a place to enjoy nature. However, although the island is famous, it is not as well developed as other famous islands such as Pangkor and Langkawi. As reported by Aizat Syarif in Astro Awani (2013), a resident of Perhentian Island insisted that "Perhentian Island needs to develop as it will ease the society." Ghani et al. (2011) stated that Perhentian Island residents have a low quality of life (QoL) due to the lack of development, which has contributed to the increase of the unemployment rate. By 2021, many accommodations like hotels and chalets have been developed due to demands from tourists, but the quality of life for the residents remains the same. An article from Wonderful Malaysia (2019) stated that Perhentian Island is located on the coast of Terengganu and is divided into Perhentian Kecil and Perhentian Besar. As the Monsoon season happens from October to March every year, all islands in Terengganu including Perhentian island, have been instructed not to accept any tourists during that period. Although Perhentian Island is full of modern accommodations such as hotels, homestays, and resorts for tourists, it is not the case for the locals' housing and public facilities. Since Perhentian Island is not as developed, the QoL of its residents is lower compared to the residents of other islands such as Pangkor and Langkawi. Hence, this research paper aims to identify the level of development in Perhentian Island, Terengganu through an observation checklist.

## **LITERATURE REVIEW**

Perhentian Island is famous among tourists and that has increased the number of facilities such as resorts and chalets along its beaches. However, Ghani et al., (2011) reported that the QoL among Perhentian Island's residents is low. This shows that the facilities that are built on the island are only focusing on the tourists while abandoning the comfort of the local residents. The majority of the residents from Kampung Pasir Hantu are part of the workforce in the tourism sector. Many of them have low self-dependence and competence. During the COVID-19 pandemic, many businesses failed to survive especially the tourism sector, the main industry which supports the residents economically. This has become a huge problem for the island residents to survive due to the pandemic circumstances.



**Figure 1:** Perhentian Islands Maps (Google Map, 2024)

In addition, another problem faced by Perhentian island is the lack of labour forces who are willing to work on the island. Not many skilled workers want to work on the island due to the high living cost and less favourable social environment. This has affected the construction sector since the number of skilled workers is limited (Ghani et al., 2011). Furthermore, Perhentian Island's residents mainly work in the tourism and fishing industries. The fishermen are the suppliers of marine products to the tourism sector and the residents. However, the fall of the tourism sector during the Covid-19 pandemic has affected the fishermen's livelihood. This paper will discuss the development in Perhentian Island, Terengganu. The development on the island is not as advanced as the mainland since many factors have become obstacles to the government's effort to develop the island. Therefore, this study was conducted to determine the level of development at Perhentian Island, Terengganu, and to measure the residents' QoL by using an observation checklist. Hence, this study focuses on 23 elements of QoL extracted from a previous study by several authors such as Moser et al. (2013), Harry (2022), Bukenya et al. (2003), Muhammad et al. (2008), Grant et al. (2007), Swaffield et al. (2019), Gibbs (2005), Okumus (2020), Dang et al.

(2020), Craglia et al. (2014), Haggblade et al. (2010), Ghani et al. (2011), Swanwick (2009), and Herzog (2011).


### RESEARCH METHODOLOGY

This study employed observational research methodology by using an observation checklist as its data collection instrument. An observation checklist was designed based on the objectives of this research. The checklist was filled out by the researcher during the site observation process. The observation checklist consists of one section. The researcher rated the statements on the checklist based on a 5-point Likert scale from 1 (Strongly Dissatisfied), 2 (Dissatisfied), 3 (Neutral), 4 (Satisfied), and 5 (Strongly Satisfied).







### ANALYSIS

According to Ramdas and Mohamed (2014), Perhentian Island is made up of two main islands which are Perhentian Besar (867 hectares) and Perhentian Kecil (524 hectares). Perhentian Besar and Kecil which are the main islands, are full of accommodations such as chalets and resorts along their beaches to fulfil the tourists' demand. In 2014, the number of accommodations accounted for 1000 rooms, from approximately 42 chalets and several resorts. The islands attract many local and international tourists, thus there has been an increase in the number of tourists' accommodations, infrastructures, and transportation systems being developed to cater to their needs as mentioned by Muhibudin and Mohamed (2014). Ibrahim (2007) states that boats are the most important means of transportation for the locals to get to the mainland and 47.4 percent of the population on Perhentian Island owns boats. Most of the people on the island use the boats themselves, while others use the boats to make a living by transporting passengers. In addition, Ghani et al. (2011) confirmed that 76.9% of Perhentian Island residents own low-cost and low-quality houses since most of them were uneducated and earning low wages. Table 1 indicates the observation analysis using the checklist of Pulau Perhentian Island Development in 2022.






**Table 1:** Observation Analysis of Pulau Perhentian Island Development

Criteria	Observation
Housing Area [2-Dissatisfied] 	The housing area can be categorized as a rural housing area which is located at the foothill of an island. The gap between each house is too close which resulted in hearing neighbors' voices when spoken. Other than that, the scenery of each house is messy because of the bushes that have not been cut. The road size is too small that it only can be accessed by riding a motorcycle or walking.
Education Facilities [3-	SK Pulau Perhentian is the only school in Perhentian

Criteria	Observation
Neutral] 	island which is located in Kampung Nelayan. The school provides many facilities to students such as a badminton court, football field, computer room, canteen, and others. The classes are fully equipped with chairs, tables, whiteboards, and fans. It also provides a guard house for the security guard to keep the school safe.
Health Facilities [3-Neutral] 	The only available health facility is Klinik Kesihatan Pulau Perhentian which is run by the government to treat and advise residents on health issues. The semi-concrete clinic employed 5 staff that consisting of doctors, medical assistants, and nurses. No guard secures the clinic. Other than that, the clinic equipment is fully equipped except for birthing. There are two options for birthing which are scheduling with the nearest hospital which is Hospital Besut that are located on the mainland or using a midwife service like in the old days.
Entertainment Facilities [3-Neutral]	Entertainment facilities such as karaoke, cinema, and shopping malls are surely not available on Perhentian Island. Despite this, they have water activities such as snorkeling, kayaking, swimming, banana boat, and others. All the equipment is placed under a tent or wooden store open.
Safety Facilities [2-Dissatisfied] 	Perhentian Island provides safety facilities such as a police station and firefighter station. Both safety facilities' structure is made from concrete. The size and the design are small to suit the number of staff. Unfortunately, during the observation process, the facilities could not be entered because no one was there. The firefighter station's interior design and equipment can be seen from outside of the building. However, the condition inside was seen as messy and the inner design was too simple. There are no firefighter trucks around the area.
Office Buildings [3-Neutral] 	Office buildings are owned by Perhentian Island residents. The office buildings are only a part of the building because the job opportunities are small on the island. However, the design for the office building is durable as it is made from concrete. The location is easy to access as is placed beside the restaurant and grocery stores.
Industrial Sector [3-Neutral] 	The industrial sector in Perhentian Island focuses on accommodation and business. There are so many hotels, chalets, and boats around the island. The fishing industry also become their main industry sector but the number of fishermen is not as much as expected and most of them are elderly.

Criteria	Observation
<p>Energy Resource [2-Dissatisfied]</p> 	<p>Perhentian Island energy resources use 2 methods. The first one is the supply from Tenaga Nasional Berhad uses a power generator. This method is usually used by Kampung Nelayan residents where the electricity supply is 24 hours per day. The second method is using a diesel generator which can supply for half or a full day depending on the management of each hotel and chalet. The TNB station is located on the hillside of Perhentian Island.</p>
<p>Water Resource [2-Dissatisfied]</p>	<p>The water resource in Perhentian Island is provided by Syarikat Air Terengganu (SATU). The office is located in the housing area and 3 water tanks supply water to Kampung Nelayan that are placed at the hillside around the Kampung Nelayan.</p>
<p>Restaurants [2-Neutral]</p> 	<p>Restaurants in Kampung Nelayan can be seen from the jetty. The restaurants are along the seaside and offer ocean views. Many restaurants offer a variety of food but the prices are a bit higher. The existence of restaurants is to fulfill the tourists' demand.</p>
<p>Hotels [3- Neutral]</p> 	<p>As Perhentian Island is famous among tourists, most of the structures of the hotels are made from concrete and the design can be rated starting from budget homestay to 5-star hotel.</p>
<p>Transportation [3-Nuetral]</p> 	<p>The only transportation on Perhentian Island is by boat. There is no road provided for motorcycles or cars. The boat has become the main transportation in Perhentian Island. Any trip to the mainland needs a boat as transportation. During rainy days, residents cannot go to the mainland because the ocean waves can make the trip dangerous.</p>
<p>Road [2-Dissatisfied]</p> 	<p>The road to the housing area, restaurant, and hotel can be accessed by walking from the jetty. Some areas are paved or concreted. There are no roads connecting Kampung Nelayan to Perhentian Kecil despite they are on the same island.</p>
<p>Grocery Stores [3- Neutral]</p>	<p>Grocery stores in Perhentian Island only have basic items such as food or housekeeping items. The structure is made from wooden and concrete beams.</p>
<p>Scenery [4-Satisfied]</p> 	<p>The scenery of Perhentian island is quite impressive. However, some places are not organized in terms of drainage systems and waste management, and that decreases the quality of scenery views.</p>



Criteria	Observation
Conservation Centre [3-Neutral]	Perhentian Island does not have a conservation center. Endangered animals such as turtles are being cared for by the "Pembangunan Pelancongan Maritim". 6 beaches are reserved for the turtles to lay eggs.
Jetty [3- Neutral] 	Jetty in Kampung Nelayan has a T design. There are no customer service or organized payment stalls for passengers to buy tickets. The function of the jetty is for the passengers to take off and depart and also for goods loading.
Waste Management [2-Dissatisfied] 	In Kampung Nelayan, there is no garbage truck. The residents and hostel facility will place the garbage on a spot beside the beach for garbage boats to pick up and transfer them to the garbage truck on the mainland for disposal.
Drainage System [1-Strongly Dissatisfied] 	Kampung Nelayan drainage system is not systematic due to the design of the drain being too open. Even the drains for housing areas and accommodation for tourists are not covered.
Food Resource [2-Dissatisfied]	Every day, there will be a boat that transports goods from the mainland. Orders from shop owners or residents will be taken every day and the cost will be higher than the mainland's cost.
Network And Coverage [2-Dissatisfied] 	Network and coverage in Perhentian Island can be rated as slow. The signal in certain areas is 4G, but most of the time, the internet cannot be connected. However, phone calls can still be made.
Worship Buildings [3 - Neutral] 	Masjid Terapung in Perhentian Island is the only worship building in Perhentian Island as the majority of the residents are Muslim. The design is very beautiful and modern and has all the accessories. It takes about a 10-minute walk from Jetty to this mosque.
Building Organization [3-Neutral]	Kampung Nelayan is not completely organized. This is because the housing area is in squatters while the accommodations for tourists, restaurants, and shop lots are well organized.

Source: Author's Galery (2023)



## **DISCUSSION**

The observation method was used in this research to determine the development level in Perhentian Island, Terengganu, and the observation checklist was filled up by the researcher during the observation. The development observed in this research was classified into twenty-three (23) elements, where each of the elements is discussed below:

**Criteria 1-Housing Area:** The housing area should be organized and complete with facilities such as a bank, access road, safety, health care, and others to ease the residents' daily lives. Squatters' housing areas need to be redeveloped into organizational housing areas that will increase the Quality of Life (QoL) of the island's residents. This will also increase tourists' perceptions towards island residents' housing area making them attracted to the surroundings of Perhentian Island and increasing the economy of Perhentian Island (Moser et al., 2018)

**Criteria 2-Education Facilities:** Education is the main thing that needs to be developed for residents to enhance their skills and knowledge for a better life. Perhentian Island only provides schools for primary students which makes it difficult for the local students to pursue their studies at the secondary level (Harry, 2022; Bukenya et al., 2003; Muhammad et al., 2008).

**Criteria 3 Health Facilities:** There are adequate health care and welfare facilities for the residents, but there is no delivery room for childbirth. The health facilities are rated neutral because the island's health clinic provides the same services as any other mainland clinic. However, because the distance from Perhentian Island to the closest hospital, Hospital Besut, is far, the government clinic should provide maternity services including a delivery room. The need to develop adequate health and welfare facilities is supported by Harry (2022), Grant et. al. (2007), and Bukenya et al. (2003).

### **Criteria 4: Entertainment Facilities**

Residents need entertainment to release their stress and to have a better QoL. On the mainland, there are many entertainment facilities such as karaoke, shopping malls, and others. While on the island, the entertainment facilities only focus on water sports where the focus is to entertain tourists (Harry, 2022; Moser et al., 2018).

**Criteria 5- Safety Facilities:** The police station and Fire Station are provided by the government in Perhentian Island to ensure residents' safety. The safety facilities should be well-kept to control and maintain the situation. Moser et al. (2018) support that the development of a safety facility will increase the residents'

safety while Harry (2022) agrees that developing a facility will ease the residents' affairs.

**Criteria 6- Office Buildings:** Office buildings that are located on Perhentian Island are owned by the government, and the buildings are rented by private companies for commercial use. The buildings are well-maintained and function well. The office buildings provide opportunities for residents to start businesses. Swaffied et al. (2019) stated that developing land and structures will open the chance for residents to start a new business.

**Criteria 7- Industrial Sector:** The industrial sector on the island is very limited compared to the mainland. The main business sectors that are operating on the Island include tourism and fishing. Many areas which may give opportunities to the residents to increase food resources or at least increase the economy of the island have not been explored. The development of structure will allow residents to start new sectors is supported by Harry (2022) and Gibbs (2005) who say that developing an area will provide opportunities for many sectors.

**Criteria 8- Energy Resources:** Energy resources at Perhentian Island are separated in two because of the limitation of supply by Tenaga Nasional Berhad. The energy resources supply fulfils the residents' demand but not the tourism sector. Any developer who wants to invest in the tourism sector on Perhentian Island needs to spend on electric generators to provide electricity to the client. Full electricity coverage needs to be developed for Perhentian Island to attract investors to invest in Perhentian Island which will give opportunity to the island residents on having jobs.

**Criteria 9-Water Resources:** Water resources provided by Syarikat Air Terengganu are sufficient to cover for both domestic and commercial use at Perhentian Island. However, the drainage and piping works are not as neat as the mainland's which affect the aesthetic appeal of the island. Proper organisation on piping works needs to be done to improve the landscape of Perhentian Island while increasing the water resources will also improve the development of agriculture sector or other sectors that will employ Perhentian Island's residents. This statement is accepted by Matos et al. (2013), who stated that the development of a public water supply system will improve the economy of places and needs to be considered before developing an area.

**Criteria 10-Restaurants:** The government provides food courts for residents to start businesses in the food and beverage sector which fulfils the demand of the tourism sector. Other than that, many residents operate food stalls along the walkways. The price of food in general is slightly higher than on the mainland.

However, Perhentian Island does not have any specialty food or beverages to attract tourists to the island. According to Okumus (2020) food and beverage can be one of the factors for tourist to choose their travel destinations.

**Criteria 11-Hotels:** The hotels and chalets provided in Perhentian Island are mostly owned by outsiders and they provide employment opportunities to the local residents. However, the residents have to compete with outsiders who come to the island seeking for employment as well. The lack of knowledge and skills among the local residents make the outsiders more eligible for the positions offered by the tourism sector. Harry (2022), Dang et al. (2020), Moser et al. (2018), and Craglia et al. (2014) agreed that development would improve the local residents' professionalism and enhance their skills.

**Criteria 12 -Transportation:** Boats are the only type of transportation that is provided on Perhentian Island. The size of the boats is relatively small to carry people and goods making the cost for each trip pricey. In contrast, in addition to boats other islands such as Pangkor and Langkawi provide ferries for tourists to travel to and from the mainland. The road and transportation issues are commented on by Othman and Ali (2020), Harry (2022), and Muhammad et al. (2008) that development will improve road and transportation to ease residents' daily life.

**Criteria 13 - Road:** There is no primary road provided on Perhentian Island. Only secondary or village roads are available throughout the island. Pangkor Island and Langkawi Island are well developed due to the availability of primary roads which provide access for the investors to construct new buildings and other infrastructure. This shows that the access road is very important in the development of the island which is supported by Harry (2022) and Muhammad et al. (2008).

**Criteria 14 - Grocery Store:** The number of grocery stores in Perhentian Island is limited compared to the mainland where they only supply basic household needs. The residents will have a hard time getting any goods that are only available on the mainland. Development in the business sector should be executed to ease residents' affairs and fulfil their demands. Swaffield et al. (2018) supported the statement by saying that development will open the chance for residents to start proper businesses that fulfil the demand of the community.

**Criteria 15 - Scenery:** The scenery of Perhentian Island is quite impressive and has attracted tourists to come for vacation. However, there are certain problems such as piping system, drainage system, and waste management that become barriers to a perfect scenery of the island. The surroundings and environment

should be well planned so that it will increase the residents' Quality of Life (QoL) and attract tourists to come to the island. This in turn will benefit the island's economy.

**Criteria 16 -Conservation Centre:** Besut district council declares that 6 beaches in Terengganu as the habitats of the turtles, and these beaches fall under the jurisdiction of Maritim Malaysia. However, there are no conservation centres for flora and fauna which will put the endangered species at risk. The conservation centre has the potential to improve scenery, employment, and economy for the island's residents. Thus, proper development on rehabilitation for flora and fauna could save endangered species while improving the environment

**Criteria 17 -Jetty:** The structure of the jetty at Perhentian Island is inferior compared to the jetties of other islands such as Pangkor and Langkawi. Pangkor and Langkawi Islands' jetties are complete with many facilities including grocery stores, toilets, and restaurants while Perhentian Island does not have all these facilities. A systematic ticket organization for boat transport will allow funds for upgrading the jetty. However, there is no proper planning to develop this structure for a better output. Haggblade et al. (2010) and Hettige (2006) agreed that the development of infrastructure will improve access and ease residents' affairs.

**Criteria 18- Waste Management:** Waste management in Perhentian Island is managed by the contractor hired by Besut District Council. There is no issue with the trips provided by the contractor, but strategic rubbish collection points have to be established to improve the landscape of the island. Ghani et al. (2011) supported that organized and proper waste management will improve the surrounding and consequently the residents' Quality of Life (QoL).

**Criteria 19 -Drainage System:** A proper drainage system will reduce water pollution. However, because of the location of Kampung Pasir Hantu is at the foothill, an open drainage concept is implemented to cater to the flowing water from the hills and mountains. Thus, safety measures must be introduced to ensure the safety of residents and tourists. Crossing an open monsoon drain without safety measures is dangerous. This statement is supported by Swanwick (2009) saying that the development will improve the safety of the surrounding environment.

**Criteria 20 -Food Resource:** The food resources in Perhentian Island are imported via boats from the mainland. Perhentian Island has no natural food resources, unlike other islands such as Pangkor Island and Langkawi Island. However, those two islands have ferry services to transport goods which makes the cost reasonable. Perhentian Island only uses boats to transport goods making

the resources limited and the cost high because the high number of trips from the mainland to Perhentian Island. Harry (2022) and Muhammad et al. (2018) commented that the development of transportation benefits the resident and will increase their Quality of Life (QoL).

**Criteria 21 -Network and Coverage:** Internet connection is provided in Perhentian Island. However, the speed and coverage are limited which is not suitable for tourist destinations. It also makes the island far behind in news and updates from the mainland. The government should upgrade the internet infrastructure of the island to improve network speed and coverage. Harry (2022) and Moser et al. (2018) agreed that facilities will ease residents' affairs and have a connection with Quality of Life (QoL).

**Criteria 22 -Worship Buildings:** Most of the Perhentian Island residents are Muslims. So, the government provides a mosque that fulfils the needs of the residents to perform religious activities. In contrast to the mainland mosques, the Perhentian Island mosque is powered by solar, using solar panels that are attached to the streetlights. It also brings happiness and calmness to the surrounding residents while balancing the economy through zakat and others (Herzog, 2011).

**Criteria 23 -Buildings Organisation:** Most of the buildings at Perhentian Island are well organized except for the presence of squatters which disrupts the residents' well-being and their Quality of Life (QoL). A new residential area to relocate the squatters can be proposed to improve their QoL while developing the island. Hence, the development will improve the landscape of the island, and Moser et al. (2018) and Hassan et al. (2013) agreed that the development will improve house quality for residents.

Overall, all of the elements observed in Perhentian Island are far inferior compared to the mainland and other islands which underscore that the Quality of Life at Perhentian Island is affected by the lack of development. The development on Perhentian Island only focuses on the infrastructures that are directly related to the tourism sector while sidelining the residents' needs and well-being. There are so many things that need to be reviewed and reorganized to increase the Quality of Life (QoL) for Perhentian Island's residents since the development of the island is not satisfactory and there is no immediate plan by the authority to improve the situation.

## **CONCLUSION**

The objective for this paper has been achieved by observing each of the elements in Perhentian Island as listed. It was noted earlier in this paper that there are 23 elements identified in this study and all the elements were observed which include housing area, education facilities, health facilities, entertainment facilities, safety

facilities, office buildings, industrial sector, energy resources, water resources, restaurants, hotels, transportation, road, grocery store, scenery, conservation center, jetty, waste management, drainage system, food resource, network and coverage, worship buildings and buildings organization. Thus, this can be concluded that the level of overall development on Perhentian Island is neutral. The importance of each element of development has been discussed based on several authors' writing including Moser et al. (2013), Harry (2022), Bukenya et al. (2003), Muhammad et al. (2008), Grant et al. (2007), Swaffield et al. (2019), Gibbs (2005), Okumus (2020), Dang et al. (2020), Craglia et al. (2014), Haggblade et al. (2010), Ghani et al. (2011), Swanwick (2009), and Herzog (2011) who agreed that each criterion is important towards QoL. Overall, the findings of this study to identify current developments on Perhentian Island indicated a neutral ranking. Nevertheless, Perhentian Island seems to be left behind in construction development compared to other famous islands such as Langkawi Island and Pangkor Island. Therefore, this study provides insight into how the development of the island will benefit citizens' daily lives and improve the image and surroundings of the island since Perhentian Island is among the top destinations for local and international tourists.

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**CLIMATE RESPONSIVE DESIGN IN HERITAGE STRUCTURE:  
AN ANALYSIS ON THE DECORATIVE ARCHITECTURAL  
COMPONENTS DESIGN OF RUMAH LIMAS BUMBUNG PERAK  
(RLBP)**

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**Abstract**

The absence of readily available energy in the past such as electricity has contributed to the indigenous formation of a climate-responsive dwelling structure that harnesses the provided energy from nature. The decorative architectural component is one of the heritage values in traditional Malay house that is not only functional but also symbolic and aesthetic towards the house's heritage architectural character. The aim of this research is to explore the climatic responsive function of the decorative architectural components of *Rumah Limas Bumbung Perak* (RLBP). Qualitative research was used as the research approach via case studies. This encompassed field works of site observation conducted on the decorative architectural components observed from the 9 samples of *Rumah Limas Bumbung Perak* (RLBP) chosen. The analysis was conducted by analysing the design attributes of the decorative architectural components that lead to the research findings. The findings of the research found that the design attributes of the decorative architectural components of RLBP correspond to multiple climatic functions – as a shading and filtering device, ventilation device, and climate protection device that contributes to the climate responsive design of the components. The output from this research not only strengthened the existing findings but also can contribute to the formation of the planning guideline for future housing planning in Malaysia, particularly on the spatial and sustainable quality of modern house design.

**Keywords:** Climatic Responsive, Decorative Architectural Components, Design Attributes, Heritage Structure, *Rumah Limas Bumbung Perak*

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## **INTRODUCTION**

More and more energy are used day by day. In recent years, the residential sector's energy requirements in Malaysia have surged significantly due to an increase in demand and enhancements in people's quality of life (Daud et al., 2023), causing the policymakers to express their concerns about this growing need for energy. It is projected that Malaysia's household electricity usage will rise due to an increase in possession of appliances, improved economic conditions, and shifts in lifestyle. The latest objective in household energy management is to enhance users' energy habits, lower electricity expenses, and encourage the optimal utilization of new energy devices. Prioritizing energy efficiency holds significant importance in curbing Malaysia's energy demand, attaining sustainability targets, and fostering environmental improvements (Daud et al., 2023). As stated by Ahmed et al. (2019) the use of sustainable building design practices is essential for cutting energy consumption. In achieving low energy consumption that includes energy and water consumption and the environmental impact, sustainable building design takes into account variables including culture, community, and particular site circumstances (Wu et al., 2018). Ideally, future designers or architects should come out with a residential design typology that is not only reasonable in term of its cost but also comprised of optimized design solutions that helps to reduce domestic energy consumption that is commonly due to thermal comfort. Optimum design solutions and strategies can be learned from the past precedent of vernacular structure design where in the Malaysian context, the traditional Malay house design. The ancestors from the past designed their dwellings thoughtfully by considering all aspects that affect their life. One of the very important aspects that affect their dwelling designs is the climatic aspect. The absence of readily available energy in the past such as electricity has contributed to the indigenous formation of a climate-responsive dwelling structure that harnesses the provided energy from nature.

Traditional Malay houses prioritize environmental and socio-cultural factors in their design, creating homes that are natural, flexible, and adaptable to various conditions and the lives of their occupants. Factors such as house design, size, space flexibility, arrangement, allocation, lighting, and ventilation are considered to enhance comfort and satisfaction for occupants (Ahmad et al., 2022). Its architecture has been known for its climate responsive and sustainable design. This has been proven in a lot of previous research conducted in studying the environmental influence and factors in the design and physical features of the traditional Malay house architecture. This includes the study on the architectural features of the house such as the elevated floor design, roof design, the usage of material, availability of opening, building orientation etc. Nasir (1986), Yuan (1987), Hanafi (2007), and Surat (2018) claimed that the carvings adorning the traditional Malay house that comprised of the decorative architectural

components of the house is one of the features that contribute to the sustainability of the house. The decorative carving components does not only function to contribute to the aesthetical appearance of the house, but also to function as a climatic device. The variety and exquisite design of the carvings functioned to encourage the air circulation inside the house, shade and filter the occupants from the heat and glare produced by the scorching sun as well as it also protects and shield the house from damage that can be caused by the humid, tropical weather (Hanafi, 2007). In the study of decorative architectural components as part of the features that contribute to the sustainability of the Malay house, previous research conducted by Denan et al. (2015); Othman and Abdul Majid (2017), and Mohd Nawayai et al. (2020) established the decorative architectural components as the shading, filtering, and ventilation devices in the traditional Malay house architecture. Extending from this research, therefore this research will be focusing on analysing the climatic role of decorative architectural components of *Rumah Limas Bumbung Perak* not only as the shading, filtering and ventilating purposes but also includes as a weather protection.

Perak is one of the Peninsula regions that has a unique traditional Malay house of its own. There are two types of traditional Malay house in Perak which is *Rumah Kutai* (RK) and *Rumah Limas Bumbung Perak* (RLBP) (Rashid et al., 2019; Rashid, 2017). RK is the oldest type, meanwhile RLBP is the later type of Perak traditional Malay house. RK architecture and characteristic is simpler than RLBP which is more decorative with exquisite decorative features. From the review of previous research conducted, it can be understood that there has been a lot of research conducted on RK architecture. However, there has been a gap of study conducted on studying RLBP, particularly on its architecture and decorative features. Based on these gaps of studies, therefore the aim of this research is to explore the design attributes of the decorative architectural components as a climatic responsive design in the architecture of RLBP. This study is hoped to strengthen and add up to the existing study in establishing the traditional Malay house architecture and its features as a sustainable and green design building.

## LITERATURE REVIEW

### Decorative Architectural Components of RLBP

Decorative architectural components commonly function as additional elements that enhance the architectural character of the house. In Malay traditional architecture, decorative architectural components are also known as carved components, aesthetic elements, ornaments, carving panels and *kerawang* several past research. The term decorative element represents the non-structural element that is used as decorative and adds aesthetic value in a particular traditional Malay house architecture, besides its basic house structure and component. It refers to a

non-structural feature utilised as a decorative element in a traditional Malay home to enhance the aesthetic value. The decorative architectural component is commonly composed of wood carving. According to Hanafi (2007) and Othman and Abdul Majid (2017), decorative architectural components function to add aesthetic value and it function as climatic devices to the traditional Malay house. In a *Rumah Limas Bumbung Perak*, there is an overall of 14 decorative architectural components in RLBP that is comprised of; *Tunjuk Langit, Kepala Cicak Type L, Kepala Cicak Type i, Papan Cantik, Lubang Angin Luar, Lubang Angin Dalam, Gerbang Luar, Gerbang Dalam, Papan Manis, Pagar Musang Serambi, Kepala Tingkap, Pagar Musang Tingkap, Kepala Pintu Luar and Kepala Pintu Dalam* (Rashid et al., 2018). As stated by Rashid et al. (2018), Denan et al. (2015), and Kamarudin and Said (2011), carved components in a traditional Malay house not only functions to add aesthetic value to the house, but also functional in term of its use. Besides functioning as a filtering device, the carved components also function as a ventilation panel that allow the air to pass through and ventilate the interior of the house. This natural ventilation system helps to maintain a comfortable indoor environment and reduces the reliance on mechanical cooling systems, thus reducing energy consumption of the house (Nik Hassin & Misni, 2019). In addition, Hanafi (2007) added that there are several decorative architectural components that commonly comprised of *kerawang*s (carving) functions to protect the structural members of the Malay house from weather – seepage of rain water that might damage and rot the timber members thus jeopardizing the structural integrity of the house. This can be seen through the function of the *Papan Manis* and *Papan Cantik* (that is also commonly known as *Papan Pator* or *Kening*) that functioned to protect the end of the timber rafters from rainwater seepage.

### **Design Attributes**

The carvings that adorned the traditional Malay house follow a specific order. The elemental characteristic of the traditional Malay woodcarving is very much influenced by the traditional Malay people's lifestyle, including the cultural and belief system, the climate, topography, and their surrounding natural environment. These carvings serve as a form of artistic expression and cultural representation, preserving and showcasing the rich cultural heritage of the Malay people (Choo, 2022; Hussain et al., 2020). The attributes of the Malay woodcarving in the traditional building throughout the Peninsula Malaysia based on the types of woodcarving element, carving category, carving element, pattern, motif, placement, carving technique and function (Hanafi, 2007). Choo (2022) stated that the motifs used in the carving of the decorative components of RLBP is commonly comprised of flora and geometrical motif where these motifs can be commonly found adorning the *Kepala Tingkap, Kepala Pintu* and *Lubang Angin*

panel. This panel is commonly placed at the top of the house components such as the wall, window, and door as a decorative panel as well as a ventilation panel that allow passage of air to pass through in and out of the house. The selections of the flora motif selected to adorn this carved panel have been selected from the type of floral species that commonly available from the surrounding area of the house that contains either medicinal benefits or fragrant properties.

### ***Rumah Limas Bumbung Perak (RLBP)***

Nasir and Teh (1996) in the book: *The Traditional Malay House*, discussed that the roof of *Bumbung Limas Perak* had emerged from an early and simplistic variant of the *limas* roof, known as the "*Perabung Lima*" roof shape. It consists of 1 primary ridge in the centre of the roof accompanied by a little crest falling to the roof eaves. This roof is distinctive for its 3-dimensional appearance. Colonization period played an important role in developing *limas* roof development (Nasir & Aziz, 1985; Rasdi et al., 2005). This had given birth to several other kinds of *bumbung limas* that are more interesting and luxurious in terms of their looks (Harun, 2005). From the view of the environmental aspect, according to Hanafi (1996), the evolution of *Bumbung Limas Perak* happened due to the improvement of the roof design by the carpenter where the roof design without the gable end traps the heat and the hot air in the internal spaces, making the internal air environment hot and uncomfortable, especially on hot days where this gives birth to the addition of gable end to the *limas* roof. *Rumah Limas Bumbung Perak* is commonly popular in the western regions where it has a distinctive feature of a smaller triangular shape space located at its gable end (Nasir & Teh, 1996). In term of the spatial characteristic, RLBP is comprises of several component of spaces such as *Rumah Ibu* (the main living room), *Serambi* (entrance porch), *Anjung* (guest area), *Selang* (intermediate space) and *Dapur* (kitchen) (Rashid et al., 2019).

## **METHODOLOGY**

The research is approached using the qualitative research approach by using case studies. There were nine case studies conducted in this research using the fieldwork approach of site observation. Photos, field notes and sketches were taken during the site observation process. Photos were taken both by using Canon DSLR Digital camera for the accessible area and mini-Mavic DGI Drone was used to take photos of the decorative architectural components that is located at the highly inaccessible area such as the roof. This was conducted on the decorative architectural components observed from the samples of houses chosen on RLBP.

### Sampling Selection

A total of nine RLBP samples have been chosen from the inventory list reported in Choo et al. (2020). The RLBP houses were selected from four main area of Perak – Northern, Central, Coastal and Southern area of Perak. The selection of the RLBP sample houses were subjected under a criteria which is; the architectural age of the house – aged more than 80 years old, the house is decorated with decorative architectural components, the roof of the house contains prominent RLBP architectural character – *Bumbung Limas Potong Perak* roof, the house is located within the studied area - Perak state, the physical condition of the house - the form and the structure of the house is still intact and fit for study and the accessibility of the house – ease of accessibility allows the researcher to conduct study. As suggested by Choo et al. (2020), central area of Perak comprised of the finest collection of RLBP. Therefore, six RLBP houses that meet the criteria outlined were chosen from the central area. Whilst, for the remaining three areas, the best one house of the area that full fill the criteria listed was chosen to represent the RLBP of the area. Therefore, for this research, there is an overall of nine samples of houses were identified and chosen to be used as case studies samples. Six houses are from the central area, while for the remaining three area, one house was chosen to represent each of the area.



Figure 1: Nine Sample Houses of Rumah Limas Bumbung Perak.

## **ANALYSIS AND FINDINGS**

As outlined earlier in the introduction of the research, the aim of this research is to explore the climatic function of the decorative architectural components of RLBP. This aim has been strategized to be achieved by analysing the design attributes of the decorative architectural components of RLBP that is relative to its function. The analysis was conducted on a total of 105 nos. of decorative architectural components gained from nine samples of RLBP house chosen. There are an overall of 14 nos. of decorative architectural components of RLBP analysed in this research, which is; *Tunjuk Langit (TL)*, *Kepala Cicak Type i (KCi)*, *Kepala Cicak Type L(KCi)*, *Papan Cantik (PC)*, *Lubang Angin Luar (LAe)*, *Lubang Angin Dalam (LAi)*, *Gerbang Luar (GBe)*, *Gerbang Dalam (GBi)*, *Pagar Musang Serambi (PGa)*, *Papan Manis (PM)*, *Kepala Tingkap (KT)*, *Pagar Musang Tingkap (PGb)*, *Kepala Pintu Luar (KPe)* and *Kepala Pintu Dalam (KPi)*. The analysis was conducted on the climatic function of each of the decorative architectural component that comprised of the function of the decorative architectural components as sun shading and filtering device, natural air ventilation device and weather protection device.

### **Air Ventilation Device**

From the analysis conducted on the climatic function of the decorative architectural components, it can be found that there is at least a total of 8 out of 14 decorative architectural components of RLBP functioned as the air ventilation device. This air ventilation device existed in the panel form. The panel is made up of the perforated panel where it is either comprised of the direct piercing carving panel or lattice panel or panel with louvers fin. The surface of these panel was found to be comprised of both solid and void surface quality. It can be observed that the void surface of the panel allows the passage of air passing into the houses. The location and placement of this air ventilation panel was found to be located at the wall - *Lubang Angin Luar*, *Lubang Angin Dalam*, *Gerbang Luar*, *Pagar Musang Serambi*, window - *Kepala Tingkap*, *Pagar Musang Tingkap* and door - *Kepala Pintu Luar*, *Kepala Pintu Dalam*. It can be identifiable from the data that the placement of most of these decorative architectural components were found at the spaces that mostly occupied by the occupants such as the *Anjung*, *Rumah Ibu* and *Selang* of the RLBP house sample studied. The placement of the panel can be relatable to the function of the decorative architectural components as air ventilation device that ventilate the spaces by allowing the exterior fresh air to the interior of the house.

**Table 1:** Climatic Function – Air Ventilation Device

RLBP House Sample	Decorative Architectural Components of RLBP													
	TL	KCL	KCi	PC	LAc	LAI	GBe	GBi	PGa	PM	KT	PGb	KPe	KPi
House 1					n/a	X	X		X		X	X	X	n/a
House 2					X	X	X		X		X	X	X	n/a
House 3					X	X	X		n/a		X	X	X	X
House 4					n/a	X	X		X		X	X	X	X
House 5					X	X	X		X		X	X	X	X
House 6					X	X	X		X		X	X	X	X
House 7					X	X	X		X		X	X	X	X
House 8					X	X	X		n/a		X	X	X	X
House 9					n/a	X	X		X		X	X	X	X

*Legends: TL- Tunjuk Langit, KCL- Kepala Cicak Type i, KCL- Kepala Cicak Type L, PC-Papan Cantik, LAc- Lubang Angin Luar, LAi- Lubang Angin Dalam, GBe-Gerbang Luar, GBi-Gerbang Dalam, PGA-Pagar Musang Serambi, PM-Papan Manis, KT-Kepala Tingkap, PGb-Pagar Musang Tingkap, KPe-Kepala Pintu Luar, KPi-Kepala Pintu Dalam, n/a - decorative architectural component not available.*

This finding supports the statement by Hanafi (2007), Kamarudin (2015) and Mohd Nawayai et al. (2020), the carving panel that located at the wall and window of the exterior wall of the traditional Malay house helps to cool down the house by allowing the air to pass through the perforated panel as well as minimizing the penetration of sun light and glare from directly enter the house.

**Sun Shading and Filtering Device**

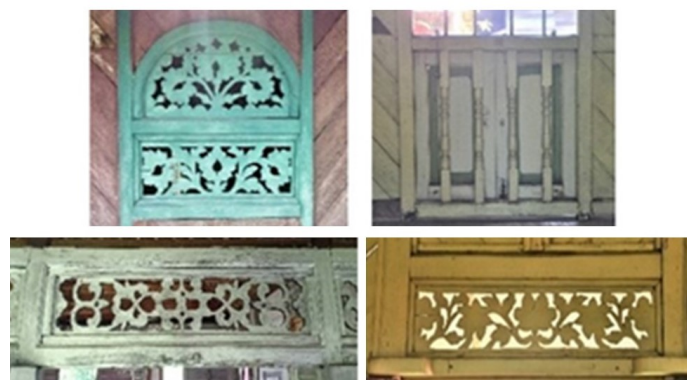
It appears from the analysis that there are at least four decorative architectural components of RLBP that function to shade and filter the heat and glare produced by the sun. This decorative architectural component is comprised of *Lubang Angin Luar*, *Gerbang Luar*, *Kepala Tingkap* and *Kepala Pintu Luar*. These components exist in the form of panel type where the panel is typically in the form of perforated panel. As suggested by Rashid et al. (2018), there are two types of perforation and incision in decorative elements of RLBP that comprised of carving type and lattice type of perforation. From the data collected, it can be confirmed that the perforation and incision type of the perforated panel of decorative architectural components of RLBP is comprised of either direct piercing carving panel or lattice panel. The characteristic of the perforation of the carving panel is comprised of both perforated (void) and solid, unperforated surface. The placement and location of these decorative architectural components can be found located at the exterior wall, window, and door. From the observation, it can be observed that the solid and void surface of the panel located at the exterior wall and window produced casted shadow during the day particularly when the sun light torch directly to the surface. As discussed by Denan et al. (2015), the function of the decorative architectural component is to shade and filter the heat and glare produced by the sun.

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**Table 2:** Climatic Function – Sun Shading & Filtering Device

RLBP House Sample	Decorative Architectural Components of RLBP													
	TL	KCL	KCi	PC	LAe	LAi	GBe	GBi	PGa	PM	KT	PGb	KPe	KPi
House 1					n/a		X				X		X	
House 2					X		X				X		X	
House 3					X		X				X		X	
House 4					n/a		X				X		X	
House 5					X		X				X		X	
House 6					X		X				X		X	
House 7					X		X				X		X	
House 8					X		X				X		X	
House 9					n/a		X				X		X	

*Legends: TL- Tunjuk Langit, KCL- Kepala Cicak Type i, KCL- Kepala Cicak Type L, PC-Papan Cantik, LAe- Lubang Angin Luar, LAi- Lubang Angin Dalam, GBe-Gerbang Luar, GBi-Gerbang Dalam, PGA-Pagar Musang Serambi, PM-Papan Manis, KT-Kepala Tingkap, PGb-Pagar Musang Tingkap, KPe-Kepala Pintu Luar, KPi-Kepala Pintu Dalam, n/a - decorative architectural component not available.*



**Figure 2:** Kepala Tingkap, Pagar Musang Tingkap, Kepala Pintu Luar and Kepala Pintu Dalam (from left)



**Figure 3:** Tunjuk Langit, Kepala Cicak i, Kepala Cicak L and Papan Manis (from left)





**Figure 4:** *Gerbang Luar, Gerbang Dalam, Pagar Musang Serambi, Papan Manis, Lubang Angin Luar, and Lubang Angin Dalam (clockwise)*

#### **Weather Protection Device**

The analysis of the research shows that there are three decorative architectural components that function as a weather protection device in RLBP house. These decorative architectural components are comprised of Kepala Cicak Type L (KCL), Kepala Cicak Type i (KCi), Papan Cantik (PC) and Papan Manis (PM). All of these decorative architectural components exist in the panel form where the form of the component is carved with simple direct piercing carving. From the placement of the decorative architectural components, it can be understood that KCL is located at the corner of the roof. This relates to the function of KCL – as a panel to cover the tip and corner of the roof rafter from water seepage produced by the rain. Meanwhile, KCi is located at the edge of the roof. It is placed at the centre of the roof apex where the panel functioned to cover the bare end of the roof ridge from direct exposure to the rain that might cause the edge of the ridge to get wet and rot over the time. PC and PM panel carry almost similar function to both KCL and KCi. PC panel function to cover the edge of the roof rafter ending at the roof eaves from water seepage caused by the rain. Whilst PM panel that is located at the bottom of the wall, at the edge of the floor rafter, function to cover the floor rafter from direct exposure to the rain and water seepage. Looking from the analysis, it can be understood that all of these decorative architectural components share almost the same function which to protect and shield the major structure of the house such as roof ridge, rafter and floor rafter from water seepage produced by the frequent tropical rain. These

decorative architectural components typically placed at the end of the structure that equal to the function of a cap. As explained by Hanafi (2007) and Yuan (1987), water seepage will encourage the exposed timber to rot, therefore panel such as *Papan Cantik*, *Papan Pator* or *Papan Manis* (PM) is commonly used as a weather board to shield the house structure from the rain.

**Table 3:** Climatic Function - Weather Protection Device

RLBP House Sample	Decorative Architectural Components of RLBP														
	TL	KCL	KCi	PC	LAe	LAi	GBe	GBi	PGa	PM	KT	PGb	KPe	KPi	
House 1		X	X	X							X				
House 2		X	X	X							X				
House 3		X	X	X							X				
House 4		X	X	X							X				
House 5		X	X	X							X				
House 6		X	X	X							X				
House 7		X	X	X							X				
House 8		X	X	X							X				
House 9		X	X	X							X				

Legends: TL- Tunjuk Langit, KCL- Kepala Cicak Type i, KCL- Kepala Cicak Type L, PC-Papan Cantik, LAe- Lubang Angin Luar, LAi- Lubang Angin Dalam, GBe-Gerbang Luar, GBi-Gerbang Dalam, PGA-Pagar Musang Serambi, PM-Papan Manis, KT-Kepala Tingkap, PGb-Pagar Musang Tingkap, KPe-Kepala Pintu Luar, KPi-Kepala Pintu Dalam, n/a - decorative architectural component not available.

## CONCLUSION

From the findings found in this research, it can be concluded that the decorative architectural components design of RLBP is comprised of a climate responsive design. The findings add up and strengthened the existing past research where the decorative architectural components, does not only add up to the aesthetic values of the house but also functioned as a climatic device that not only ventilate, and shade the house but also protect the structural members of the house from damage caused by the weather. This has been proven from the findings of the analysis on the design attributes of the decorative architectural components that have been analysed from its form type, form perforation and incision type and its placement that is relatable to the function of the decorative architectural components. Decorative architectural components of RLBP does not only function as air ventilation panel and sun shading and filtering panel, but also it functions as weather protection panel. This research finding is hoped not only to strengthen and add up to the existing literature in establishing the responsive design character of the traditional Malay house architecture, but the features can be adapted to the sustainable and green design building design features planning for a modern house. This will help the design of the modern house to become more sustainable and energy efficient so it can be part of the effort in helping to reduce

the energy consumption of the domestic residential sector for a better and greener future.

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## **DESIGNING A PUBLIC HOSPITAL IN MALAYSIA: A COMPREHENSIVE APPROACH IN ENHANCING HEALTHCARE FROM THE ARCHITECTURAL PERSPECTIVE**

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### **Abstract**

The public healthcare system in Malaysia was established in the 1850s, prior to the country's independence. Today, it encompasses 146 public hospitals to provide affordable and accessible healthcare services to all Malaysian citizens. However, the public healthcare sector faced various challenges, including ageing facilities and infrastructures, deferred maintenance, limited accessibility, and inefficient layouts. This paper presents a comprehensive approach in designing public hospitals in Malaysia, with a focus on addressing the healthcare needs of the population and improving healthcare infrastructures through architectural optics. This article explores key aspects of hospital designs, including architectural considerations, functional requirements, technological integration, and compliance with regulations and relevant acts. Eight expert samples were employed through semi-structured interviews to ensure credibility and validity. This methodology allowed flexibility in questioning and yet tailored exploration of relevant issues and expertise. Clear data sources and research objectives were established to minimize potential bias and limitations. By incorporating patient-centric design principles, enhancing accessibility, promoting sustainability, and considering future scalability, the proposed design aims to improve public hospitals that can effectively meet the healthcare demands of Malaysia. The recommendations outlined in this study can serve as a guideline for policymakers, healthcare authorities, and designers involved in the creation of efficient and effective healthcare facilities.

**Keywords:** Healthcare Facilities, Healthcare Services, Hospital Designs, Public Hospitals

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## **INTRODUCTION**

The public healthcare system in Malaysia commenced when Penang General Hospital and Taiping Hospital were established during the pre-independence era in 1850 and 1880. During the post-independence era in 1958, the Ministry of Health (MOH) was established to spearhead healthcare services in the country and objectively provide and develop a comprehensive public healthcare system in Malaysia. The healthcare system played a pivotal role in ensuring the well-being and prosperity of a nation (Ministry of Health, 2020). In Malaysia, the demand for high-quality healthcare services continues to rise, driven by population growth, increasing life expectancy, and evolving healthcare needs. Some of the challenges faced by public healthcare are overcrowding and long waiting-lists, financial and workforce sustainability, ageing facilities, accessibilities, spatial quality, technological integration, and others.

As a result, there is an urgent need to enhance healthcare infrastructures, particularly through the architecture's optics (Harrouk, 2020), that cater to the diverse healthcare requirements of the population. Due to constraints of financial management, the government and public healthcare authorities should find the perfect equilibrium of building new, extending, renovating, or retrofitting the existing facilities. The design of a public hospital goes beyond the physical structure; it encompasses a holistic approach that considers the needs of patients, healthcare professionals, and the community at large. Creating a healing environment that promotes patient well-being, accessibility, and operational efficiency requires careful planning, integration of advanced technologies, adherence to regulations, and consideration of financial sustainability. These comprehensive approaches aimed to address the evolving healthcare needs and challenges faced by Malaysia's public healthcare system, with a focus on maximizing user impact and improving patient outcomes.

## **LITERATURE REVIEW**

### **The Quality of Hospital Design Impact on User**

In the 21<sup>st</sup> century, new methodologies and increased efforts are being conducted to study various architectural qualities and their impacts on human perception. In keeping with the architect's belief that experiencing and controlling the physical healthcare environment as part of the supportive environment can significantly benefit their end-users, this situation directly boosts patients' physical and mental well-being, patients' reduction in stress, and avoids feelings of helplessness while being treated in the hospitals. Hospitals in today's world will always be associated with innovative healthcare practices that promote well-being (Sal Moslehian, 2023).

Advancements in healthcare, technology and research significantly influenced the design of therapeutic environments. Modern medical practices prioritised patient-centred care and integrate cutting-edge technologies, shaping the layouts and features of healthcare facilities. In the context of healthcare design, the notion of quality treatment originated from the "Plane Tree Theory" paradigm, which was pioneered as a new approach to architectural design as Patient-Centred Design (PCD). The PCD deals with the interaction between the physical environment and the patients' preferences thus improving their recovery and safety during their treatment. Several hospital design studies demonstrated that the quality of the physical environment and treatments offered in a healthcare setting played an important role in meeting the patient's preferences as well as the expectations of their family and friends (Jaafar & Othman, 2016). The impact of a positive physical environment in hospitals is illustrated in Table 1 below.

**Table 1: The Impacts of Positive Physical Environment in Hospital**

<b>Impact of Positive Experience</b>	
<ul style="list-style-type: none"> <li>● Reduced infections at hospitals.</li> <li>● Reduced medical mistakes.</li> <li>● The increased overall quality of healthcare.</li> <li>● Decreased patient and visitor burden.</li> <li>● Reduced depression.</li> <li>● Improved social functioning.</li> <li>● Health rehabilitation.</li> <li>● Strengthening patient safety and confidentiality.</li> <li>● Minimized patient downtime.</li> </ul>	<ul style="list-style-type: none"> <li>● Return to the hospital and a more substantial reputation for the organisation.</li> <li>● A shift in physical &amp; cognitive operation.</li> <li>● Strengthened social contact and social support.</li> <li>● Reduced use of pain medicines and negative emotions.</li> <li>● Reduced patient worries.</li> <li>● Health promotes behaviour &amp; therapeutic effects, such as relaxing surroundings.</li> </ul>

*Source: Jaafar & Othman (2016)*

This model enhances the current design requirements for healthcare facility projects in the United States, Canada, Australia, United Kingdom and Netherlands. Angelica Thieriot founded the PCD in 1978 due to her negative experiences with healthcare facilities and the environment (Sahamir et al., 2019). Table 2 below depicts several literature studies and discovered that the physical environment played an essential role in users' satisfaction variables. Some of the elements of the physical environment are indoor comfort, sustainability features, size and placement of openings, and universal design features. These elements may result in improvements in terms of psychological reactions such as mood, communication, interpersonal patterns, or work performances.

**Table 2:** The Physical Environment Affecting Users' Satisfaction

Subject	Physical Environment	Scholars
Indoor Comfort	Indoor comfort through architectural design and appropriate room temperature.	Abu Samah et al. (2012); Schreuder et al. (2016)
Sustainable	Physical well-being, healing environment, collection of material reservations and architectural design.	Gupta & Du, (2013); Rezazadeh & Sarbangholi, (2017).
Size and Scale Functionality	Sizing of the room, the placement of the windows, the amount, and the type of facilities.	Jaafar & Othman, (2016); Christiansen et al. (2016).
Universal Efficiency in Architecture	The criteria for ergonomics, accessibility standards, building codes and requirements for urban planning	Abdellah et al. (2018); Takashi et al. (2013)

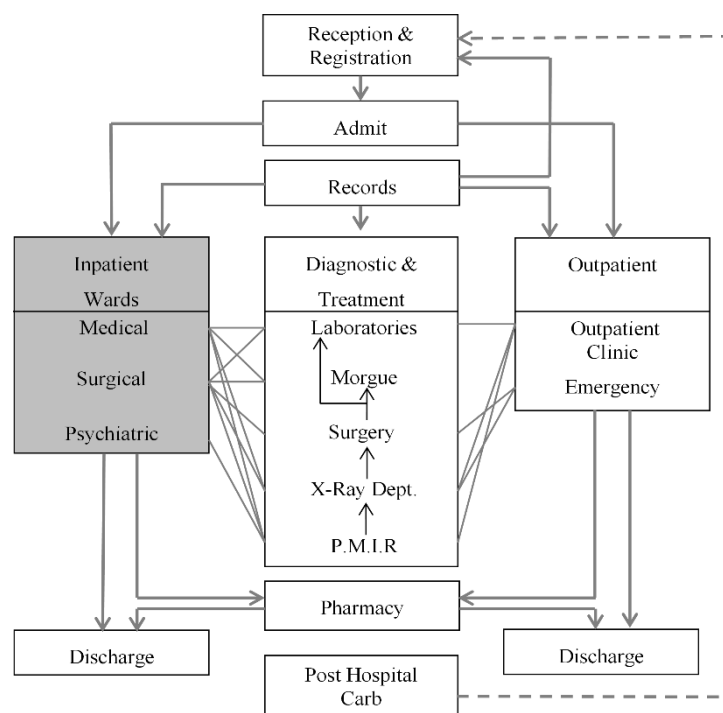
Source: authors

### Functional Requirement of Public Hospital and Relationship

The doctors' and patients' engagements in hospitals are influenced by a variety of spatial and configurational factors (Setola et al. 2013). The complexity of the hospital buildings in terms of spatial design requirements ranges from diagnostic and medical care to clinical laboratory, radiology, the emergency department, as well as surgery. Food service and housekeeping are offered as auxiliary services for patients in the ward. Integration with building services and building automation systems is crucial to ensure the efficiency of building operations. The physical relationship between clinical and non-clinical functions determined the configuration of hospital buildings. However, the physical layout and design of the hospital will be dependent on various determinants such as site restrictions, climatic factors, financial support, equipment, and existing technology (Alalouch, 2009).

A good hospital design should incorporate a system of public integration core, a system of staff integration core, public accessibility, vertical and horizontal linkages, and functional spaces (Setola et al. 2013). Integration of these will help to elevate the users' experience in the hospital. A team of consultants such as architects, engineers, planners, designers, and others will play essential roles in this process therefore a high-quality multidisciplinary effort and communication must be established (Mohd Fateh et al., 2023). The design and planning of healthcare buildings require holistic and meticulous processes such as considering the local identity, culture, and customs (Mozaffar et al. 2018). The intricate interrelationship between the clinical and non-clinical functions of a hospital is illustrated in Figure 1.





**Figure 1:** Major Clinical and Non-Clinical Space Relationship Diagram in Hospital  
*Source: Adapted from Alalouch (2009)*

## Element of the Physical Environment in Hospital Design

### *Windows and Openings*

There is a growing consensus acknowledging the pivotal role of windows and openings in creating optimal physiological, emotional, and psychological conditions for both patients and workers in energy-efficient settings. Windows contribute through three essential benefits: harnessing natural sunlight, facilitating natural ventilation, and offering a view. Numerous studies revealed that patients with access to well-designed windows were more likely to recall their admission and departure, maintain focus during their stay, and achieve improved health outcomes, including the prevention of sleep difficulties, hallucinations, and misconceptions. The significance of windows and openings extends beyond their functionality. It should be suitable for three distinct groups of people: patients' comfort, hospital staff's visual needs, and visitors' visual needs as indicated by Gatea et al. (2020). Windows served as vital connections to the outside world for patients, as it contributed to a sense of orientation and aid in maintaining normalcy. Consequently, well-planned windows are not an intuitive element but require meticulous consideration of design, context, and cultural

nuances. In addition to their impact on occupants, windows play a crucial role in enhancing thermal comfort within buildings and influencing green building standards. Rahman (2021) mentioned in a study that the green building rating system, while emphasizing energy efficiency, also considered factors like Indoor Environment Quality (IEQ) to ensure occupants' comfort. Research on improving thermal comfort in wards area through natural ventilation is limited, with conventional energy cogeneration methods proving ineffective in addressing tropical climate-controlled natural ventilation issues in government hospitals. Yau et al. (2011) suggests that while mechanical ventilation systems enhance the interior environment, their higher energy consumption and operational costs make them suboptimal for resolving the issue.

#### *Effective Accessibility and Efficient Furniture Placement in Hospital Design*

The implementation of modern open-plan ward designs brought significant advantages for medical personnel, notably in terms of facilitating easier patient monitoring and supervision as highlighted by Alkali et al. (2018). The open-plan layout was designed to streamline movement, establish a straightforward system of circulation, and enhance overall accessibility, functioning as both a friendly escape route and exit plan. This design not only fostered an improvement in family and social interactions but also contributed to encouraging better behaviour within the open-plan environment, as noted by Han (2014). However, despite these potential benefits of an open plan, there remains a challenge related to the audibility of patients' expressions of dealing with pain within the ward environment. This issue is compounded by space limitations and the bed layout specifications mandated by relevant parties, making it difficult to find a straightforward solution. Nevertheless, it is worth noting that the effective circulation and efficient placement of beds and medical equipment do help to facilitate treatment and streamline duties for both medical staffs' and patients' comfort. Interestingly, aligning the beds parallel to the windows offer additional benefits for patients. This positioning allows them to access outside scenery, providing direct ventilation and natural lighting. The intention behind this arrangement is to enhance the overall treatment experience and medical care for patients, aligning with both their well-being and the practical considerations of medical professionals. In the post-COVID-19 landscape, there is a noticeable increase in the demand for courtyard space (Rong & Bahauddin, 2023). This shift indicated a growing emphasis on outdoor environments within healthcare settings. The evolving priorities emphasised the demand for adaptable and patient-centric spaces in hospital design.

### **Challenges in Hospital Design**

There has been a surge in hospital design studies recently, emphasising the importance of prioritising the well-being of end users. This emphasis is especially critical given the inherent vulnerability and impairment often present in hospital populations (Ghani & Aripin, 2018). As hospital buildings evolve, there is an increasing awareness of the changing demands placed on both their internal and external environments. Recognizing and addressing these challenges throughout the development process is crucial, as emphasised in a study by Nirit and Yehuda (2017), Alkali et al. (2018), and Zainudin et al. (2023). By ensuring the safety of public facilities in hospitals, encompassing both clinical and non-clinical areas had remained paramount. The integration of advanced diagnostics and treatment technologies, along with compliance with the HIPAA Regulations (Health Insurance Accountability and Accountability Law), had addressed certain issues, but there is a growing concern about the potential increase in energy consumption resulting from the dependency on such equipment within hospital buildings.

Furthermore, the design of hospitals, especially regarding the fire safety requirements, differs from other building types. As mentioned by Ab Ghani (2018), natural ventilation through window design is a common form of ventilation control in hospital buildings. However, insufficient design considerations for natural ventilation may lead to inefficient airflow, contributing to the dispersion of undesirable hazardous gases during structural motions and healthcare policies. The Malaysian Standard, similar to the UBBL 1984 (Hanie Suraya, 2015), permits the use of windows as smoke ventilators in case of fire. While the UBBL 1984 focuses on window design criteria for daylighting and ventilation, it does not explicitly address window designs and specifications for smoke ventilation during a fire. Based on Section 39, sub-clause 2, specifically mandates window design criteria for natural lighting and ventilation in hospital wards, without accounting for smoke ventilation during a fire outbreak. A study done by Ashraf & Nambiar (2022) delineates the significance of hospital buildings in any community is undeniable, given their profound impact on human health and the environment. The increasing attention towards constructing health-centric, environmentally friendly, and sustainable hospital infrastructures is noteworthy. Sustainable hospital design signifies the interconnected dimensions of the environment, economy, and society. Sustainable hospital designs aim to reduce energy and resource consumption, mitigating their adverse environmental impact. Understanding the principles of sustainable design is crucial, especially in the context of hospitals, which are characterised by complex energy, air conditioning, and temperature management systems.

## **RESEARCH METHODOLOGY**

Hospital designs in architecture require a multitude of expertise and complexity. This study utilised a survey-based method. Semi-structured interviews were employed to develop questions based on clear definitions and linear frameworks from past studies. These questions were subsequently modified for data collection and generating themes (Miles & Huberman, 1994; Miller & Crabtree, 1999; DeWalt & DeWalt, 2002; Mason, 2002; Maynard & Schaeffer, 2006). Robson (2002) explained that the questions for semi-structured interviews were determined and can be modified, and these questions can be ignored or added during an interview session.

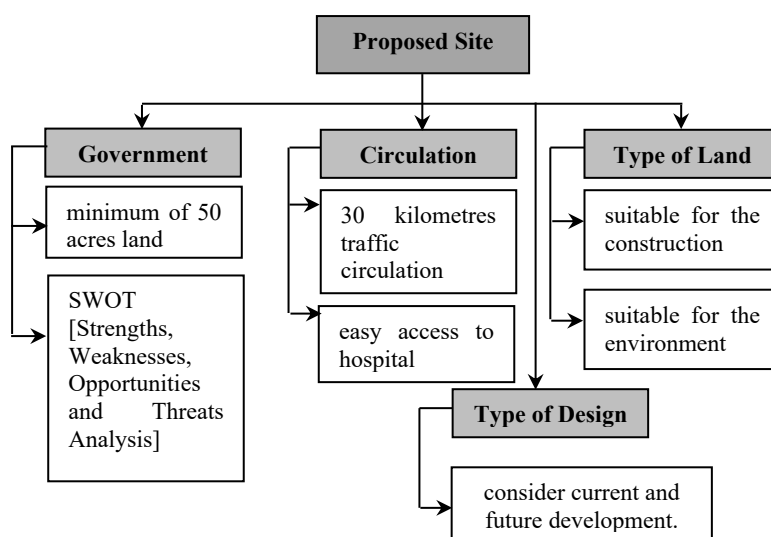
Semi-structured interviews of eight expert panels give a sense of balance between predetermined questions and flexibility in additional areas of interest. All participants have more than 10 years of experience in the built environment industry and healthcare design. Three of the participants are professional architects. Experts sampling allows for more in-depth responses from participants in healthcare design. The participants were selected based on multiple criteria such as working experience in industry and healthcare design, expertise, and academic qualification. Participants are from the health facility design unit, the architects branch of the Public Works Department, the medical planner (Architect), and the Consultants (Architects). The interviewer gathered insights from the project team before they initiated fieldwork and evaluated the project's compliance with environmentally friendly standards. The Ministry of Health (2020), Liyanatul et al. (2016), and Hyväri (2016) are in unison on the requirements for public hospital construction and passive design incorporation to ensure economical use of active energy.

This approach aligned with the government's goal of sustainable construction for public health facilities. The interview process for public hospital design criteria involves the participant's extensive knowledge, from receiving briefs to the building's operational phase. They played a critical role in integrating practical and user-centric considerations into the design of public hospitals. Key aspects encompassed the thoughtful selection of a proposed site and strategic ward design, emphasising user satisfaction and visual comfort. It highlighted the pivotal contribution of the participants in creating healthcare environments that prioritise functionality and the well-being of users. Data sources were cross-checked, and research objectives were clearly articulated to reduce potential bias and limitations.

## ANALYSIS AND DISCUSSION

### Criteria of Selection for the Proposed Site

The first component from this parameter would be the participants expressing a strong preference for a proposed site with a minimum of 50 acres of government-owned land that would be suitable for constructing a hospital. SWOT analysis is beneficial for architects in hospital design as it helps them identify project strengths, weaknesses, opportunities, and threats. It allows architects to leverage strengths, address weaknesses, explore opportunities for innovation, and mitigate potential risks. This tool guides architects in making informed decisions and creating effective hospital designs. Optimum land area will be beneficial especially during inception and planning stages such as ideal building orientation and effective placement of supporting facilities. The development of public hospitals or healthcare structures on such land is seen as advantageous for both macro and micro-scale benefits, particularly in residential areas. It is highlighted that careful planning of traffic circulation within a 30 km radius is essential to ensure convenient access to the facility and accommodate future developments. The establishment of a public hospital is viewed as a positive safety net, enhancing healthcare access, and creating opportunities for new development projects driven by increased demand. The criteria of selection for the proposed site of hospitals are shown in Figure 2 below.



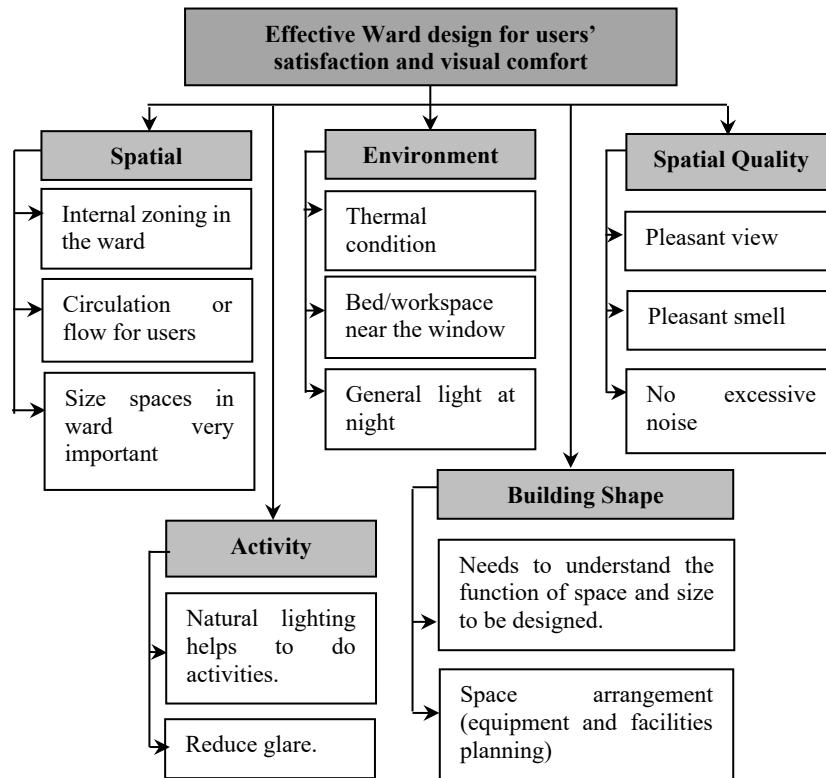
**Figure 2:** Criteria of Selection of the Proposed Site for Hospital Design

Source: authors

### **Effective Ward Design for Users' Satisfaction and Visual Comfort**

The second component of comprehensive hospital design involves spatial planning of effective ward design as it serves as the nucleus of accommodating care and treatment for patients. There are several classifications of wards such as medical wards, surgical wards, Intensive Care Units (ICUs), and other specialised wards. Effective ward design is scientifically proven to accelerate recovery and improve patients' well-being. There are several layers of ward design process. First, the designer will get an MBOR (Medical Brief of Requirement) from the Malaysian Ministry of Health (MOH). The MBOR includes a brief overview and requirements of ward design. Next, the medical planner specialist will create the TBOR (Technical Brief of Requirement) which is more detailed in terms of technical specifications and requirements to facilitate the ward designs and layouts. The design of this ward should be direct, practical, and functional for patients and staff to utilise. The participants signify the importance of effective spatial planning for the current and future development of the hospital. The setting up of a rectangle grid line with a length of 7.5 to 8.4 metres and a width of 24 metres will help to reduce negative space and maximise design efficiency. The 1100 square metres of functional floor space will accommodate a maximum capacity of 28 beds. The form of the building plan is essential since it influences the interior layout of the ward. These elements of effective ward design for users' satisfaction and visual comfort are illustrated in Figure 3.

Effective collaborations and communications between medical planners and medical officers will create a robust TBOR (Technical Brief of Requirement). Patient-Centred Design (PCD) will influence the equipment planning and requirements, power outlet, room dimensions and preferred layout, efficient flow and accessibility, infection and noise control measures and positioning of the bed for patients that will help to improve physical environments in public hospitals. Design coordination is paramount to guarantee that the layout organisation is properly executed. Façade design plays an essential role in natural lighting and ventilation. Common areas for discussion and communication for staff should be established, and auxiliary facilities for visiting family members. Most ward designs employ a central spine for effective ward circulation. In some cases, the wards are located in the centre of the block, necessitating the usage of mechanical systems such as lighting and ventilation, as well as an air conditioning system (HVAC) for user comfort. Relevant legislations and acts, such as the Uniform Building By-Law (UBBL) and the Malaysian Standard, help in standardising the minimum percentage of natural lighting and ventilation factors in hospital design. The related by-laws will regulate the buildings design to protect the life, health, and safety of the individuals.



**Figure 3:** Elements of Ward Design for Users' Satisfaction and Visual Comfort  
*Source: authors*

## CONCLUSION

As demonstrated in this study, strategic location in the inception stage is viewed as a positive measure, enhancing access to healthcare, and opportunities for new development projects. Design coordination in the planning stage will help optimise the ward area in various aspects such as equipment placements, layout preferences, and infection control measures. Incorporation of Patient-Centred Design (PCD) principles and adherence to relevant legislations, standards, and by-laws such as the Uniform Building By-Law (UBBL) and Malaysian Standard is essential. Moving forward, it is recommended to integrate evolving technologies for optimal energy consumption, and adaptive designs to address the changing needs of healthcare. Ongoing research and regular updates in design guidelines will ensure that public hospitals remain at the forefront of providing optimal patient care. This paper has highlighted three significant findings. First,

it emphasises the researcher's role in understanding success criteria through thorough analysis of primary and secondary data. Secondly, combining passive design strategies in hospital projects with effective collaboration among consultants has greatly improved performance criteria. Third, the study's framework has been validated through statistical guidelines and relevant scholarly research.

The unique contribution of this study emphasizes specific frameworks for different stages of hospital design. This approach not only addresses the current and future needs of healthcare facilities but also fosters an environmentally conducive design process. By aligning hospital functions with community and local environments, it stresses a commitment in serving the community. In the face of rapid technological advancements, which present challenges in balancing innovative design ideas with practical user requirements, this study provides valuable insights in enhancing public hospitals through thoughtful architectural considerations. Architects play a crucial role in designing modern, efficient, and patient-centred hospitals. To integrate technology effectively into hospital design, architects must stay proactive, continuously learn, and collaborate with others. The recommendations for future hospital design accentuate the importance of evidence-based spatial planning, the incorporation of technological advancements, and the flexibility to accommodate evolving healthcare needs. Partnership with healthcare professionals, research initiatives, and regular updates to design guidelines and relevant legislation are essential to ensure that hospital facilities continually evolve to provide optimal patient care and remain at the forefront of healthcare innovation. This comprehensive and adaptive approach will contribute to the creation of healthcare spaces that meet the dynamic challenges of the future while prioritising the well-being of patients and communities.

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## **INTER-REGIONAL POVERTY DISPARITIES IN JAVA, INDONESIA: AN ANALYSIS OF KEY INFLUENCING FACTORS (2010-2020)**

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### **Abstract**

This study seeks to investigate the evolution of poverty in Java from 2010 to 2020, as well as the regional factors that contributing to disparities in poverty between regions. The results of the analysis indicate a downward trend in the number and proportion of poor people on the island of Java but a rise during the COVID-19 pandemic. There are regional distribution groups with high and low poverty rates. The results of the ANOVA reveal significant differences in the occurrence of urban poverty on the island of Java based on province and regional status but not by zone. Positively and negatively, the majority of the predictors have a very significant relationship with poverty. Six regional variables (level of consumption (expenditure), level of health (life expectancy), income per capita, level of education (number of years of schooling), population density (people/km<sup>2</sup>), and economic potential (GRDP at current prices)) account for 68.10% of the variation in the number of poor people in Java, while the remaining 31.9% is determined by other variables. The model of variation in Java's poverty is determined by three variables: per capita income, GRDP, and public consumption level.

**Keywords:** Poverty, spatial variation, determining factor

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## INTRODUCTION

The problem of poverty is not new in development discussions (Goodwin et al., 2018). Like a labyrinth, poverty seems to be a timeless problem; from leadership to leadership, from program to program, it is constantly changing, including in Indonesia (Asrol and Ahmad, 2018). Theoretically, poverty has many definitions. The Indonesian Central Bureau of Statistics defines poverty as a condition in which a person's per capita expenditure is below the poverty line (BPS, 2021). Apart from referring to the definition of the central statistics agency, poverty in Indonesia can be approached through the Bappenas conceptual framework (Yusri, 2022). In addition to income, Bappenas mentions the importance of fulfilling ten basic human rights, namely the right to food, clothing, shelter, employment, education, health, clean water, a sense of security, political participation, and a sustainable environment (Nasution, 2023).

In line with poverty in Indonesia, the government's serious efforts to overcome poverty in Indonesia have been made since the new order era (Purwanto, 2007). Various implementations of anti-poverty policies have been carried out, both since the era of the first president and now. Not without results, the implementation of government policies and assistance has reduced Indonesia's poverty rate (Eko and Cahyani, 2022). However, poverty is still a problem that has not been resolved. This fact applies not only to Indonesia but to most countries in the world. Poverty then becomes a global issue that ranks first out of the 17 pillars of the SDGs. Eliminating poverty and hunger by 2030 is the "backbone" of the goals of the sustainable development agenda (Bappenas, 2020).

Based on historical time, for more than 20 years, the poverty rate in Indonesia has fluctuated. However, in the 2008-2019 range, the poverty percentage in Indonesia has consistently decreased. Poverty has been reduced by 6.01 percent in 11 years (BPS, 2020). This achievement is considered, politically, an extraordinary development achievement. The slowdown in the decline in the poverty rate shows that reducing poverty is getting more and more difficult, but the sustainable development strategy implemented by the government is considered successful (Tarigan, H., Sinaga, J.H., & Rika, 2020). Muta'ali (2014) explained that development goals cover four things, namely growth, equity, prosperity, and sustainability.

The consistency of reducing the poverty rate in Indonesia for 11 years finally stopped in 2020. The poverty rate increased again by 0.37 percent. In 2019, Indonesia's poverty percentage was 9.41 percent. Meanwhile, in 2020, the value will be 9.78 percent, and worse, it will increase again to 10.14 percent in March 2021 (BPS, 2021b). When accumulated in numbers, there were 27.54 million poor population in Indonesia in March 2021, an increase of 1.12 million people compared to March 2020 (BPS, 2021b). This increase in the poverty rate

is largely influenced by the outbreak of the Covid-19 pandemic that is currently spreading throughout the world.

According to Iswari and Muharir (2021) the Covid-19 epidemic significantly influenced the Indonesian economy's volatility. According to research by Widiastuti & Silfiana (2021) many sectors of society feel the pandemic's influence. The order of life altered dramatically in a short period of time, such as in economic activities and education, which were suddenly carried out from within the home. At a higher level, the pandemic has increased unemployment, decreased individual and corporate productivity, and resulted in the appearance of a new poor population, resulting in a rise in the total number of poor population (Powell (2009); Izzati, 2020; Suryahadi et al., 2020). In theory, Alkire et al., (2011); Alkire & Kanagaratnam (2018) refer to this situation as cyclic poverty. Periodic poverty is linked to global economic fluctuations, pandemics, and natural calamities (Schneiderbauer and Ehrlich 2004; Shah et al., 2023). A disease that rapidly affects a person and forces him into poverty beyond his control (Marten, 2010).

In terms of numbers, Indonesia's highest distribution of poor population is in Java. Data shows that out of a total of 27.54 million poor population in Indonesia, 14.8 million are on the island of Java, equivalent to 53.6 percent of the national total (Databoks, 2021). Giovanni (2018) explains that the high number of poor people in Java is motivated by the fact that more than 50 percent of the population is concentrated on this island, and the majority percentage of provincial poverty rates in Java Island is relatively high. Functionally, it is clear that Java holds the key to all aspects of development in Indonesia. Java is still the fulcrum of all centers of activity, economic, social, government, political, cultural, and so on. Java contributes more than 50 percent (59 percent, to be precise) of Indonesia's total GRDP (Bappenas, 2020a).

The phenomenon of poverty is a challenge for each region. This is because each region has different characteristics of poverty. In practice, efforts to reduce poverty in Indonesia are still global; they have not paid attention to regional aspects. Azzoni & Haddad, (2018) explained that inter-regional disparities play a major role in shaping poverty. According to Ryberg-Webster, (2022), one of the primary elements that impacts the emergence of poverty is related to geography. Zhou & Liu (2022); Robinson et al., (2019) through their research results, also explained that development programs, especially in poverty alleviation, must pay attention to spatial elements or locations to minimize program or policy failures. Industry also have their role in poverty alleviation due to acceptance of labor (Izzudin et al., 2022). Research by Shah et al. (2023) in Sabah, Malaysia also revealed that stakeholders involved in the poverty eradication is the key of successful programe. Poverty has a devastating impact on the subjective well-being of urban children in Kuala Lumpur, Malaysia (Sulaiman et al., 2023).

In this regard, the spatial element becomes important to study because the characteristics and factors that cause poverty in each region are different. Municipal regencies on the island of Java that have variations in regional characteristics (Handayani et al., 2020), both natural and human resources (Haryanto et al., 2019), as well as economic resources, will certainly provide varying outputs in population numbers and poverty percentages, making it interesting to serve as a spatial poverty determination model. The availability of poverty time series data from 2010–2020 can also be used as capital in developing poverty determinant models.

### RESEARCH METHODOLOGY

The scope of the research area is all regencies and cities on Java Island, totaling 119 regencies and cities, consisting of 85 regencies and 34 cities. These Regency-City areas have varied geographical conditions and physical environments, resulting in different socio-economic and environmental characteristics as well as regional development, which are believed to influence the phenomenon of poverty. In the study of developmental geography, this spatial difference or variation (area differentiation) is interesting and serves as a basis for regionalization.

The unit of analysis used in this study is the Regency-City with the observation period between 2010 and 2020, where the years 2019–2020 are specifically analyzed to see the development of poverty during the COVID-19 Pandemic. In general, this research is more descriptive-analytical with a quantitative approach Anderson et al. (2018) based on secondary data analysis, which includes details of poverty variables and regional variables. These variables are derived from regional and poverty data issued by the Central Bureau of Statistics. Several indicators, time frame variables, and research area differentiations are presented in the following table:

**Table 1:** Research Indicators and Variables

No	Indicators	Variables
<b>A Regional Poverty</b>		
1	Number of Poor Population (Y1)	1. Number of Poor Population
2	Percentage of Poor Population (Y2)	1. Number of Poor Population 2. Total Population 3. Percentage of Poor Population
3	Time Determination	2010-2019 (before COVID-19 Pandemic era) 2019-2020 (COVID-19 Pandemic era)
<b>B Region Data</b>		

No	Indicators	Variables
1	Influenced Variables (X)	<ol style="list-style-type: none"> <li>1. Regional economic capability (Gross Regional Domestic Product/GDP at current prices)</li> <li>2. Income Per Capita,</li> <li>3. Population Density,</li> <li>4. Health Level (Life Expectancy)</li> <li>5. Education Level (School Old Years)</li> <li>6. Level of Consumption (expenditure)</li> </ol>
2	Territory Determination	<ol style="list-style-type: none"> <li>1. Based on Province (Banten, DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java)</li> <li>2. According to Regional Status (Region and City)</li> <li>3. Based on geographical zones (north, central, south, and outside of the main island of Java).</li> </ol>

### **Data Analysis**

The data or variables obtained are analyzed through 3 (three) stages and analysis techniques as follows:

1. An analysis of changes in poverty, both the number of residents and the percentage of poor population. Changes are made either in the form of absolute or relative numbers and the trend of changes in poverty each year (%/year). Time series analysis of changes was carried out in two time periods, namely between 2010-2019 (before the COVID-19 Pandemic era) and 2019-2020 (Pandemic Covid19)
2. Analysis of regional cluster variations to strengthen the differential area analysis of the phenomenon of poverty in 3 types of regions, namely between provinces, between regencies and cities and between regional zones of Java Island. The One Way ANOVA technique is used to ensure that there are similarities or differences between types of regions
3. Correlation and Regression Analysis. This study uses Correlation and Multiple Linear Regression to analyze the relationship between variables and the poverty variation prediction model based on cross-sectional data from 119 districts/cities. This research developed a model of the relationship between poverty and regional characteristics. In this model, the poor population is placed as the affected variable (Y), and the influence variables originating from the regional characteristic variables (X) are six. Analysis was performed using correlation and regression techniques with the following formulation:



$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \dots + \beta_n X_n$$

Explanation:

- Y      Number of Poor Population (Person)
- $\alpha$     Intercept coefficient
- $\beta_1 \dots \beta_n$     Variable coefficients for  $X_1 \dots X_n$
- $X_1$     Regional economic capability (Gross Regional Domestic Product/GDP at current prices) (Rupiahs)
- $X_2$     Regional per capita income (Rupiahs)
- $X_3$     Population Density (Person/kilometer square)
- $X_4$     Health Level (Life Expectancy) (Index)
- $X_5$     Education Level (Old School Years) (Index)
- $X_6$     Level of Consumption (Expenditure) (Rupiahs)

## FINDINGS AND DISCUSSION

### Poverty Dynamics in Java Island

This study looks at poverty in two dimensions, namely the dynamics of the number of poor population and the proportion of poor population. In the 2010–2019 observation period, there was a decrease in the number of poor population by -4.47 million, where the composition of the largest decrease (> 32%) was in the Provinces of Central Java and East Java, followed by West Java. This reduction in the poor population accounted for 75.52% of the decrease in poor population in Indonesia. This shows that compared to regions outside Java, the decline in the poor population in Java is the highest.

**Table 2:** The dynamics of the decline in the number of poor population in Java for the 2010-2019

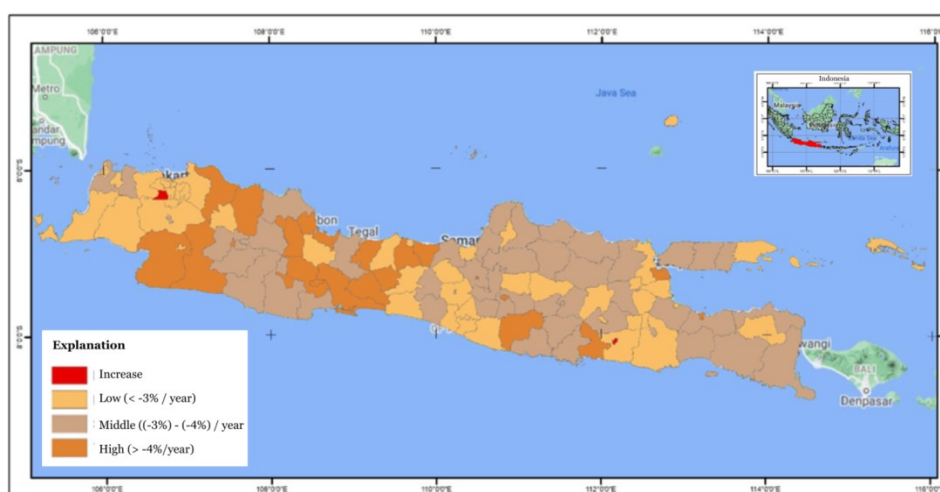
No	Province	Changes in the Poor Population (2010-2019)			JK	Classification Change of Poor Population (Decrease) (%)			
		Number in thousand	(%)	(%/year)		increase	Low (<-3)	Medium (3-4)	High (>-4)
1	Banten	-96,540	2.16	-1.61	8	12.5	75.0	0.0	12.5
2	Jakarta Special Region	-23,150	0.52	-0.74	6	16.7	83.3	0.0	0.0
3	West Java	-1,317,740	29.47	-3.49	27	0.0	34.6	26.9	38.5
4	Central Java	-1,475,470	32.99	-3.53	35	0.0	28.6	40.0	31.4
5	Yogyakarta Special Region	-92,030	2.06	-2.13	5	0.0	100.0	0.0	0.0

6	East Java	1,467,150	32.81	3.29	38	2.6	36.8	47.4	13.2
	Java Island	4,472,080	100.00	3.04	119	3	49	39	27
	(% Java Island)	75,52		100		2.5	41.5	33.1	22.9
	Indonesia	-5921370		2.38	514				

Note: JK = Number of Regencies/Cities

This is also supported by an analysis of the reduction in the annual poverty rate, where if Indonesia decreases by -2.38% per year, the decline in Java is higher at -3.04% per year. Among the four provinces, the highest reduction in the number of poor population was in Central Java (-3.35%/year), followed by West Java and East Java. Meanwhile, the lowest poverty reduction achievement was in DKI Jakarta Province (-0.74), which was made possible due to the high in-migration of people characterized by the lower middle class. Details can be seen in Table 2.

Table 2 above also shows the grouping or classification of changes in the poor population in 119 urban regencies on the island of Java, namely 41.5% low decline and 22.9% high decline. There are 4 City regions with anomalous occurrences where there is an increase in the poor population, which generally occurs in cities, including the City of Surabaya, the City of Mojokerto, the City of Tangerang, and Jakarta. This is because the rate of in-migration is quite high, exceeding the decline rate in the number of poor population. The complete spatial distribution of the Classification of Changes in the Poor Population 2010–2019 in Java Island is shown in the following map (Figure 1).



**Figure 1:** Map of the Rate of Decline in the Number of Poor Population in Java for the 2010-2019 Period (%/year)

Based on the map above (Figure 1), the decline in the number of poor population has occurred in areas that have so far been known as pockets of poverty, such as West Java, Central Java, and the southern part of East Java, as well as parts of the north. This phenomenon shows that the priorities for addressing poverty in these areas are relatively successful.

### Poverty during the COVID-19 pandemic

The COVID-19 pandemic has had an impact on many sectors, which has implications for poverty. The social restriction policy implemented to minimise the spread of the COVID-19 virus has an impact on people with lower middle incomes. In other cases, many people have lost their jobs, decreased wages, and decreased turnover. This has an impact on changes in the number of poor people, based on the results of an analysis of changes in the poor population in Java Island in 2019-2020 saw an increase of 1,329,680 or around 10.45% (higher than Indonesia (5.09%), where the highest percentage change in poor people occurred in DKI Jakarta Province with a percentage change of 31.54%, then followed by the Province of Banten (18.57%), West Java (15.33%), East Java (7.46), Central Java (6.35%) and the smallest percentage change, namely the Province of Yogyakarta (6, 08%). For more details, see Table 3.

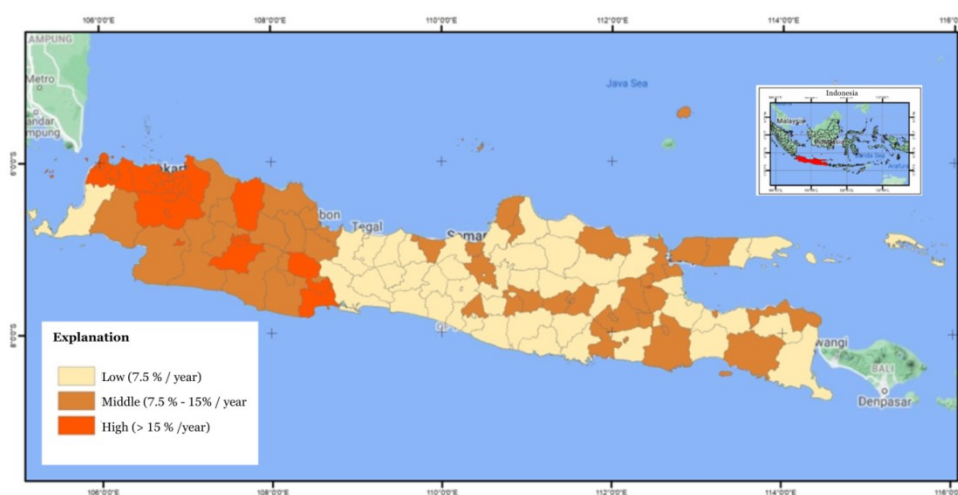
**Table 3:** Changes in the Number of Poor Population During the COVID-19 Pandemic (2019-2020) in Java Island

No	Province	Changes in Poor Population 2019-2020 (COVID 19 period)			JK	Classification of Changes in Poor Population 2019-2020 (COVID-19 Period) (Increase) (%)		
		Number	(%)	(%/year)		low (<7,5) middle (7,5—15) high (>15)		
1	Banten	121,530	9.14	18.57	8	12.5	12.5	75.0
2	Jakarta Special Region	115,310	8.67	31.54	6	0.0	0.0	100.0
3	West Java	521,070	39.19	15.33	27	0.0	55.6	44.4
4	Central Java	237,670	17.87	6.35	35	77.1	22.9	0.0
5	Yogyakarta Special Region	27,250	2.05	6.08	5	80.0	20.0	0.0
6	East Java	306,850	23.08	7.46	38	47.4	50.0	2.6
	Java Island	1,329,680	100.00	10.45	119	50	44	25
	(%Java Island)			100.0%		42.0	37.0	21.0
	Indonesia	1,279,410		5.09	514			

Note: JK = Number of Regencies/Cities

Table 3 above also shows the grouping or classification of Changes in the Poor Population during the COVID-19 pandemic period (2019-2020) in 119 Regencies and Cities on the Island of Java. IN. Yogyakarta (80%) was then followed by Central Java Province (77.1%), for the moderate category, most cases occurred in West Java Province (55.6%), followed by East Java Province

(55.6%), while for the highest category occurred in DKI Jakarta Province (100%), followed by Banten Province (75%). The complete spatial distribution of the Classification of Changes in the Poor Population during the COVID-19 pandemic on Java Island is shown in the following map.



**Figure 2:** Map of the Rate of Increase in the Number of Poor Population in Java Island in the COVID-19 period (2019-2020) (%/year)

Spatially, the increase in the number of poor people can be seen in locations close to DKI Jakarta Province, namely several regencies in Banten Province (Tangerang, Serang, Tangerang City, Cilegon City, Serang City, South Tangerang City, and Bogor Regency). Spatially, the distribution of the rate of increase in the number of poor people during the COVID-19 pandemic was mostly in the low category. In addition to the dimensions of population size, a more precise comparison of poverty between regions is to look at the proportion of poor people. Taking into account the number of poor people during the COVID-19 pandemic as in the previous table, during 2019–2010 there was a change in the percentage of poor people by 10.45% (higher than Indonesia (5.09%), if seen from changes in the proportion of poor people in 2019–2010, the average The highest absolute average occurred in DKI Jakarta (1.35), followed by other provinces in Java, namely West Java (1.02), Banten (.78), East Java (.72), Central Java (.58), and DI Yogyakarta (.56). The percentage change in the proportion of poor people during the COVID-19 pandemic in Java was 10.21%, or higher than Indonesia's 6.07%.

### Poverty Differences Between Regions

Based on the previous analysis, poverty in Java Island has a unique spatial pattern that differs between districts and cities. The determination of the area of Java

Island is expanded into three categories, namely between Provinces, between Regencies and Cities, and between zones. ANOVA analysis is used to test whether there are differences in poverty indicators between regions. The results of the ANOVA analysis show real (significant) differences in poverty indicators between Provinces and between Regencies and Cities (see table 4 below for details).

**Table 4: Results of One Way ANOVA Analysis of Poverty in Java Island**

No	Indicator	Differences Between Provinces		Differences Between Cities and Regencies		Differences Between Zones	
		F	Sig	F	Sig	F	Sig
<b>A Total And Proportions</b>							
1	Number of Poor Population	1.239	.296	53.012	.000	1.839	.144
2	Proportion of Poor Population	5.421	.000	70.147	.000	11.522	.000
<b>B Changes Every Year</b>							
1	Changes in the Number of Poor Population	5.573	.000	55.516	.000	2.774	.045
2	Changes in the Proportion of Poor Population	11.711	.000	5.747	.018	.711	.548
<b>C Changes During Covid 19</b>							
1	Changes in the Number of Poor Population	8.284	.000	4.076	.046	1.042	.377
2	Changes in the Proportion of Poor Population	55.027	.000	23.082	.000	2.475	.065

*Source: Results of ANOVA analysis*

Among the six aspects of poverty, there are five indicators that have significant differences, as indicated by sig values <0.05 between city and district area types and between provinces, namely the proportion of poor people, changes in the number and proportion of poor people, and changes in poverty during the COVID-19 pandemic. Only the number of poor people is spread evenly and there are no differences between regions. Among the three regional groups, the determination of Java Island into four zones, namely North, Central, South, and Outer Java Island, did not show a significant difference in the phenomenon of poverty; in other words, poverty is spread relatively evenly between zones. During the COVID-19 pandemic, between 2019 and 2020, there were differences in changes in the number of poor people and the proportion of poor people between Provinces and Cities, where there has been an increase in the number of poor people due to the COVID-19 Pandemic.

### **Relationships and Determinants of Poverty**

#### **Poverty Relationship Model and Regional Capability Variables**

The relationship between the variables determining the variation of poverty in Java was investigated by statistical correlation analysis, specifically looking for the strength of the relationship between the number of poor people and regional

economic capacity (GDP), per capita income, population density, education level, health level, and consumption level. The results of the Pearson correlation analysis are presented in Table 5.

The analysis results in the table above show a close relationship between the regional capacity variable and the population and percentage of poor people in regencies and cities on the island of Java. Among the six variables of regional capability, only economic capacity (GRDP) does not have a close relationship. Meanwhile, the other five variables have a very strong relationship ( $\text{sig} > 0.05$ ) and are negative, where poverty is higher if per capita income, population density, education level, health level, and consumption level are lower. Regional characteristics indicate that regions with a high level of regional development and characterized by developed regions tend to have a lower poverty rate.

The absence of a relationship between regional economic capacity (GRDP) and the amount of poverty indicates that the number of poor people is spread evenly and does not follow economic capacity. However, economic capacity has a close (negative) relationship with the percentage of poor people. Based on the analysis above, regional characteristics, both economic and social, are strongly related to the variable number and proportion of poor people in Java. This is shown by the strong relationship between variables (see Table 8). The complete relationship between poverty variables can be seen in the table 5 below.

**Table 5:** Relationship Patterns Between Poverty Research Variables in Java Island

	Y1	Y2	X1	X2	X3	X4	X5	X6
Y1	1	.419**	.064	-.254**	-.313**	-.221*	-.438**	-.381**
		.000	.491	.005	.001	.016	.000	.000
Y2		1	-.396**	-.297**	-.568**	-.190*	-.433**	-.593**
			.000	.001	.000	.040	.000	.000
X1			1	.712**	.608**	.117	.126	.636**
				.000	.000	.208	.172	.000
X2				1	.480**	.075	.199*	.497**
					.000	.418	.030	.000
X3					1	.251**	.424**	.785**
						.006	.000	.000
X4						1	.326**	.335**
							.000	.000
X5							1	.621**
								.000
X6								1

a. Predictors: (Constant), Consumption Level (Expenditure), Health Level (Life Expectancy), Per Capita Income, Education Level (School Years), Population Density (Person/Km2), Economic Potential (GDP Current Prices)

### Regression Models of Factors Influencing Poverty

Based on the theoretical basis, poverty is closely related to regional characteristics, which are translated into variables of economic potential and per capita income, human resources (education and health), urban level (population

density), and consumption level. A regression analysis was carried out using cross-sectional data on the distribution of poverty in 119 urban regencies in Java. The results of multiple regression analysis show that the six regional variables together contribute 68.10% (R Square value) to variations in the number of poor people on Java Island; the remaining 31.9% is determined by other variables (Table 6).

**Table 6:** Results of Multiple Linear Regression Analysis, Factors Affecting Variation of Poor Population in Java Island

Code	Variables	Unstandardized Coefficients	Standardized Coefficients	Sig
Model contribution				
	R square = .681			
Enter method				
	Constant	457399.874		.005
X1	Economic Potential (GDP at current prices)	.001	.830	.000
X2	Income per capita	-439.222	-.533	.000
X3	Population Density (Person/Km2)	-2.818	-.156	.159
X4	Health Level (Life Expectancy)	-1977.407	-.068	.363
X5	Education Level (Old School Rate)	-3490.818	-.047	.647
X6	Consumption Rate (Expenditure)	-12.899	-.462	.002
Stepwise Method				
	Constant	316660.893		.000
X2	Income per capita	-448.112	-.544	.000
X1	Economic Potential (GDP at current prices)	.001	.839	.000
X6	Consumption Rate (Expenditure)	-17.742	-.636	.000

The results of the t-significance test on the partial regression coefficients for poverty show that out of the six X variables, three show T counts with high confidence levels, namely X3, X4, and X5, which are greater than 0.01, while the other three variables have a t count with a high confidence level, namely X1, X2, and X6. On the basis of the results of this analysis, the factors that are considered to have a significant influence (with a degree of trust of more or equal to 95%) on poverty in Java (Y) in the order of the greatest influence include: economic potential (X1), income per capita (X2), and consumption level (X6). From these results, it is strongly proven that economic factors greatly influence poverty in urban districts on the island of Java. This fact also shows that the variables, which individually have a strong and influential correlation also collectively have a convincing and consistent influence. By removing the insignificant variables (X3, X4, and X5), further analysis with a stepwise model was conducted to obtain the following regression model of the determinants of poverty in Java Island:

$$Y = 0,839X1 - 0,544X2 - 0,636X6$$

In multiple linear regression line equation, it can be interpreted that each variable X has varying effect values. For example, the regional economic potential variable (GDP) (X1) has a Beta value of 0.839, meaning that if the values of other variables (X2 and X6) are constant, then for every 1 increase in the standardized GRDP index, it will result in an increase in poverty of 0.839. Likewise, with other variables. Thus, it can be concluded that the three X variables influence the occurrence of variations in poverty levels on the island of Java. However, each variable has a different magnitude of effect. Therefore, to determine the strength or weakness of this influence, a T-significance test was carried out for each coefficient.

## **CONCLUSION**

The number of poor people on Java Island is 53.18% of the total poor population in Indonesia, or as many as 14.05 million. Most are in three major provinces: East Java, Central Java, and West Java. During the 2010–2019 period, there was a decrease in the number of poor people by -4.47 million, at a rate of decline of -3.04% per year, faster than the decline in Indonesia's poor population. The rate of decline has stopped since the COVID-19 pandemic, which has increased the number and percentage of poor people at a rate of 10%, so it is as if the handling of poverty has been pushed back 5 years (2016). Considering the concentration of poverty in certain areas, it is clear that more focused measures to alleviate poverty are required.

Spatially, changes in the reduction of high poverty on the island of Java form a clustered pattern in the western part of the island and are also random in the central and eastern parts, especially in the south and north zones. There are significant differences in poverty between Provinces and between districts and cities. Spatially, the impact of the COVID Pandemic, which increased the number of poor people, is mostly clustered in the western part, especially around DKI Jakarta, Banten, and West Java, while urban districts in Central and East Java are relatively few and random in nature. The western region of Java Island displayed a clustered pattern as a result of the reduction in Java's high levels of poverty, as seen from a spatial perspective. On the other hand, the patterns in the central and eastern areas, particularly in the southern and northern zones, appeared to be more random. Concentrations of increasing poverty were identified around DKI Jakarta, Banten, and West Java as a result of the COVID-19 epidemic. On the other hand, Central and East Java had comparatively less afflicted metropolitan areas with more random patterns.

Moreover, the variation in poverty between regencies in Java Island is collectively 68.10% determined by six regional variables: level of consumption (expenditure), level of health (life expectancy), income per capita, level of education (years of schooling), population density (life expectancy/km<sup>2</sup>), economic potential (GRDP at current prices). Three variables have the highest



significant level and are used as determinants of the poverty variation model in Java, namely per capita income, GRDP, and the level of public consumption.

The study reveals that substantial gaps in the levels of poverty exist between Java's various provinces, districts, and cities. These geographical differences highlight the significance of customizing measures for poverty reduction to match different locations' distinct needs and constraints.

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## **THE EFFECT OF SECURITY IN THE GREEN BUILDING PRICE PREDICTION MODEL: A COMPARISON BETWEEN MULTIPLE LINEAR REGRESSION AND MACHINE LEARNING APPROACHES**

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### **Abstract**

Green building (GB) and building security are two pivotal factors that significantly influence the valuation of property prices. Nevertheless, the research on these determinants was very limited and no empirical study was done to prove the reliability of the factors as price determinants for green building. Hence, this study examines the factors by using two distinct approaches, namely the Multiple Regression Model (MRL) and Machine Learning (ML) to fill the existing empirical gap. With MRL as the conventional approach and ML as an advanced technique, the results were compared to provide maximum effectiveness in analysing the factors included. The data analysis was conducted based on a real GB dataset collected, which comprises 240 green building transactions in the city area of Kuala Lumpur, Malaysia. Prior to MLR modelling, an ANOVA test was conducted to test the statistical significance of all the independent variables (IVs) used in this study, while ML used the algorithm consisting of random forest, decision tree, linear regressor, ridge and lasso. The results indicate that building security has a strong and statistically significant impact on the price of green buildings in the MLR model. However, when it comes to enhancing prediction accuracy using the Random Forest and Decision Tree algorithms in ML models, building security has a relatively minimal influence. These results highlight a substantial difference between the outcomes of the two approaches. Specifically, the machine learning model did not demonstrate a significant relationship between green building attributes and price prediction, whereas the multiple regression model suggests otherwise.

**Keywords:** Green Building, Machine Learning Model, Multiple Linear Regression, Security of Building

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## **INTRODUCTION**

Sustainable Development Goal (SDG) is currently discussed worldwide as one of the important future roadmaps. Current research also includes this agenda as it is stipulated in the United Nations (UN) agenda, which has been put in place until 2030. Green building (GB) has been recently discussed as one of the initiatives to share the aspiration advocated by the UN. GB is expected to reduce the development of negative impact on human health and environment by enhancing building life cycle development (Bungau et al., 2022). GB provides a conducive living and working environment to allow people to benefit from healthier atmosphere and freedom from unnecessary waste and pollution (Bungau et al., 2022; Ismail et al., 2015). This initiative has also been considered by the Malaysian government, as it is in line with the green technologies in GB through the National Green Technology Policy.

Apart from GB, building security is considered important in housing, building and property industries (Olanrewaju et al., 2018). Free from threat and danger is the main concern behind a building's security, which involve many aspects such as the building structure, monitoring, and maintenances. In this research, building security is associated with social aspects such as the feeling of safety for life, natural surveillance, and social integration (Candas et al., 2015). Therefore, security and GB are closely inter-related for the development of sustainable building solutions. A number of factors have been identified to give some impacts on the building or property prices (Abdullah et al., 2018; Atilola et al., 2019; Portnov et al., 2018; Božić et al., 2013). However, until recently, much of the research from the literature provides less explanation on the contribution of building security to the GB transaction prices. A recent study by Azian (2020) highlighted that by emphasizing building safety, one is able to improve its security measures, such as access control systems, surveillance cameras, and security personnel as this helps provide a safe environment as well as act as one of the attractive elements to families and individuals which can drive up property demand and prices. The study, however, only discussed the theory in general, and no empirical evidence was provided. Hence, a more systematic approach is needed to identify the way building security influences the GB price through rigorous methods of predictor models. This paper presents the effect of security in the green building price prediction model by using two different approaches namely Multiple Linear Regression (MLR) and Machine Learning (ML). Comparing MLR and ML serves as a benchmarking exercise. It helps establish whether the added complexity and computational resources required by ML techniques result in significantly improved predictive accuracy compared to simpler model like MLR. Additionally, as this study uses real data cases, it is important to conduct an intensive data modelling with different approaches. This study empirically utilizes the MLR and ML techniques via multiple algorithms.

## LITERATURE REVIEW

### Green Building (GB)

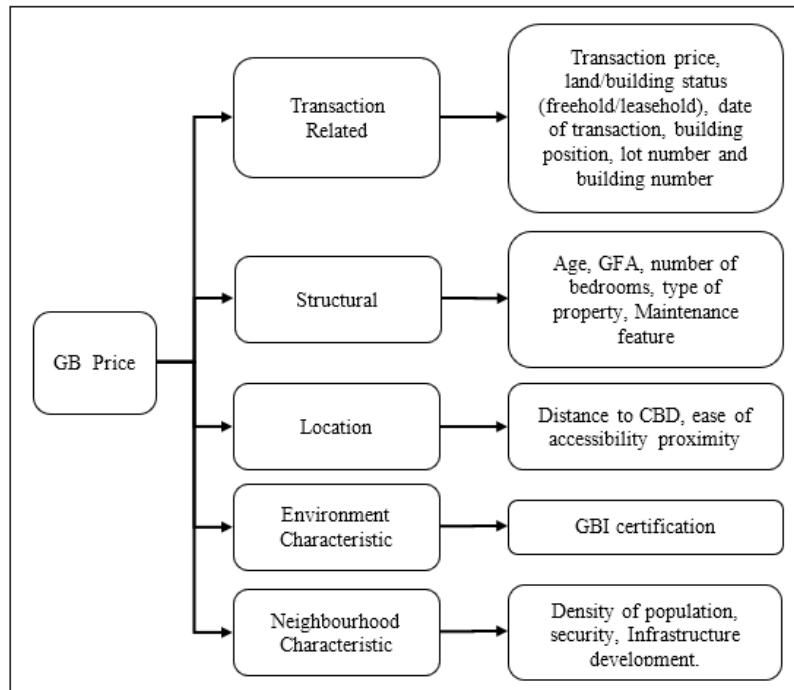
Green Real Estate (GreenRE), Green Performance Assessment System (Green PASS), Green Awarding Evaluation Scheme (*Skim Penilaian Penarafan Hijau* JKR (PH JKR)) and Green Building Index (GBI) are the available green rating tools in Malaysia (Shafiei et al., 2017; Ghaffarianhoseini et al., 2013; Zian et al., 2019; Shi & Liu, 2019; MGBC, 2019). Table 1 lists the summary of these rating tools.

**Table 1:** Characteristics of Malaysian Green Rating Tools

Name of rating tools	GBI	PH JKR	Green PASS	GreenRE
Years Introduced	2009	2012	2012	2013
Criteria	Energy efficiency Indoor Environmental Quality (IEQ) Sustainable site planning and management Material and resources Water efficiency Innovation	Sustainable site planning & management Energy efficiency Indoor environmental quality (IEQ) Material & resources management Water efficiency Innovation	<i>Building Construction:</i> Site Material Energy Water Waste <i>Building Operation:</i> Indoor environmental quality (prerequisite) 80% satisfaction of occupants Energy CIDB (Government-Driven)	<i>Energy Related Requirements:</i> Energy efficiency <i>Other Green Requirements:</i> Water efficiency Environmental protection Indoor environmental quality Other green features Carbon emission of development REHDA (Professional Associations)
Developers	PAM and ACEM (Professional Associations)	JKR (Government-Driven)	CIDB (Government-Driven)	REHDA (Professional Associations)

*Source: Shafiei et al. (2017)*

The criteria and developers for the four (4) rating tools, namely, 1) GBI, 2) PH JKR, 3) Green PASS and 4) GreenRE have been respectively introduced in 2009, 2012, 2012 and 2013 as indicated in the Table 1. These rating tools used the conventional similar criteria worldwide such as BREEM and LEED (Shafiei et al., 2017). Based on the rating tools and literature study, the conceptual framework of the GB price determinants can be presented in Figure 1. GBI Certification is categorized as an environmental characteristic, while security is a neighbourhood characteristic.



**Figure 1:** Conceptual Framework

The literature focuses on a multitude of factors contributing to the green building price. The rapidly progressing research discovers building security is one of the significant factors that contribute to green building prices (Jang et al., 2018). While green building practices focus on sustainability, energy efficiency, and eco-friendly materials, integrating robust security measures can add substantial costs (Hoon Lgeh et al., 2021). This includes expenses related to access control systems, surveillance technologies, and physical barriers (Azian et al., 2020). However, investment in security is essential as it not only protects the occupants, assets, and sensitive data but also enhances the overall value of the green building (Suriansyah et al., 2020). By providing a safe and secure environment, green buildings become more attractive to potential tenants, investors, and occupants, potentially commanding higher lease rates and resale values, thereby offsetting the initial security investment and contributing to the long-term sustainability of the building.

**MLR and ML for Property Valuation**

MLR has been recognized as an established approach in predicting the price of properties (Mao & Yao, 2020; Ping, 2020; Thuraiya et al., 2020; Wu et al., 2020;

Shahirah et al., 2021). The research conducted by Raja Zakariah and Md Termizi (2019), used MLR to analyze the determinants of house prices in Malaysia, while Abdul Rahman et al. (2021) argued that the MLR was used to analyze the housing prices specifically at the Kuala Lumpur in Malaysia. Compared to MLR, ML has been well known and widely used globally (Varma et al., 2018; Park & Kwon Bae, 2015; Chen et al., 2017; Āeh et al., 2018; Huang, 2019), but it is considered new in Malaysia (Daradi et al., 2018). The ML models which are commonly used in property valuation are Linear Regression (Borde et al., 2017; Dimopoulos et al., 2018; Wezel & Potharst, 2005), Decision Tree (Thuraiya et al., 2022; Huang, 2019), Random Forest (Huang, 2019; Wang & Wu, 2018), Ridge (Madhuri et al., 2019; Choi et al., 2019), and Lasso (Madhuri, Anuradha & Pujitha, 2019; Jin & Lee, 2020). According to Choi et al. (2019) and Jin and Lee (2020), the Ridge and Lasso models have been modified with more intelligent techniques such as fuzzy and autoregressive. The utilization of both MLR and ML in property valuation is not yet in existence in the current literature but can be found in other kinds of prediction problems, such as in Golbaz et al. (2019) and Niu et al. (2019). Furthermore, the use of ML for GB is also considered as a new area of research.

## **RESEARCH METHODOLOGY**

This study applied two different approaches in analysing the factors contributed to the green building prices namely the MRL and ML. These distinct types of approaches might come out with different results since MRL were considered as conventional approaches, while ML were more to computer generated with less biased. The variation of results was determined based on the prediction value discussed in the findings.

### **Multiple Linear Regression (MLR)**

Figure 2 presents the MLR implementation of this research. Initial data were collected from the Valuation and Property Service Department (JPPH). The data consist of the property valuation records for GB condominium located at the district of Kuala Lumpur in 2022. Based on Figure 1, 17 variables were used. The dataset consists of 240 records with GB as shown in Table 2.



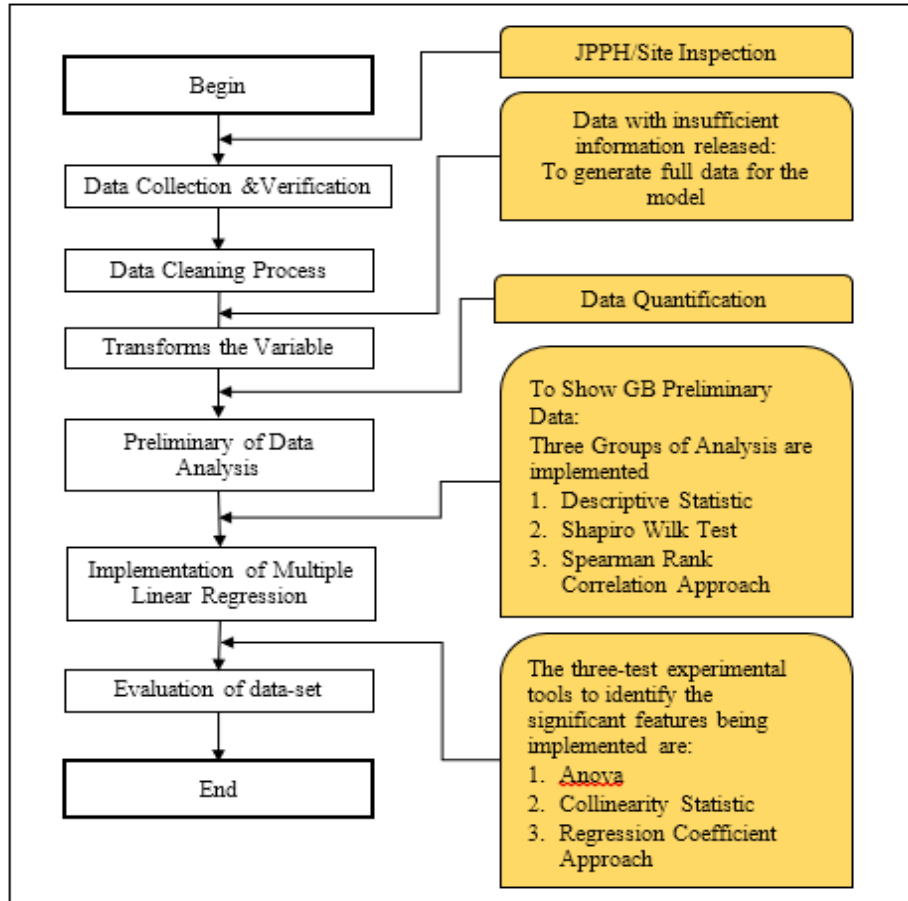


Figure 2: MLP Steps

Table 2: Data Collections and Cleaning

Data	Data Removed	Data left
Available data in 2018 from the JPPH		1858
Remove another residential category property	122	1736
Remove Transaction from Developer	70	1666
Remove Non-GB	1426	240
GB		240

Table 3 presents the descriptive statistics of the transaction price with an average price of RM1,589,152.87. The distribution was skewed to the right at value 4.03 which implied that most transaction prices were at the lower prices.

**Table 3:** Summary of Descriptive Statistic of Transaction Price

Measures	Values
Mean	1,589,152.87
Std. Deviation	1,661,053.37
Skewness	4.03
Minimum	2098.96
Maximum	11,280,000.00

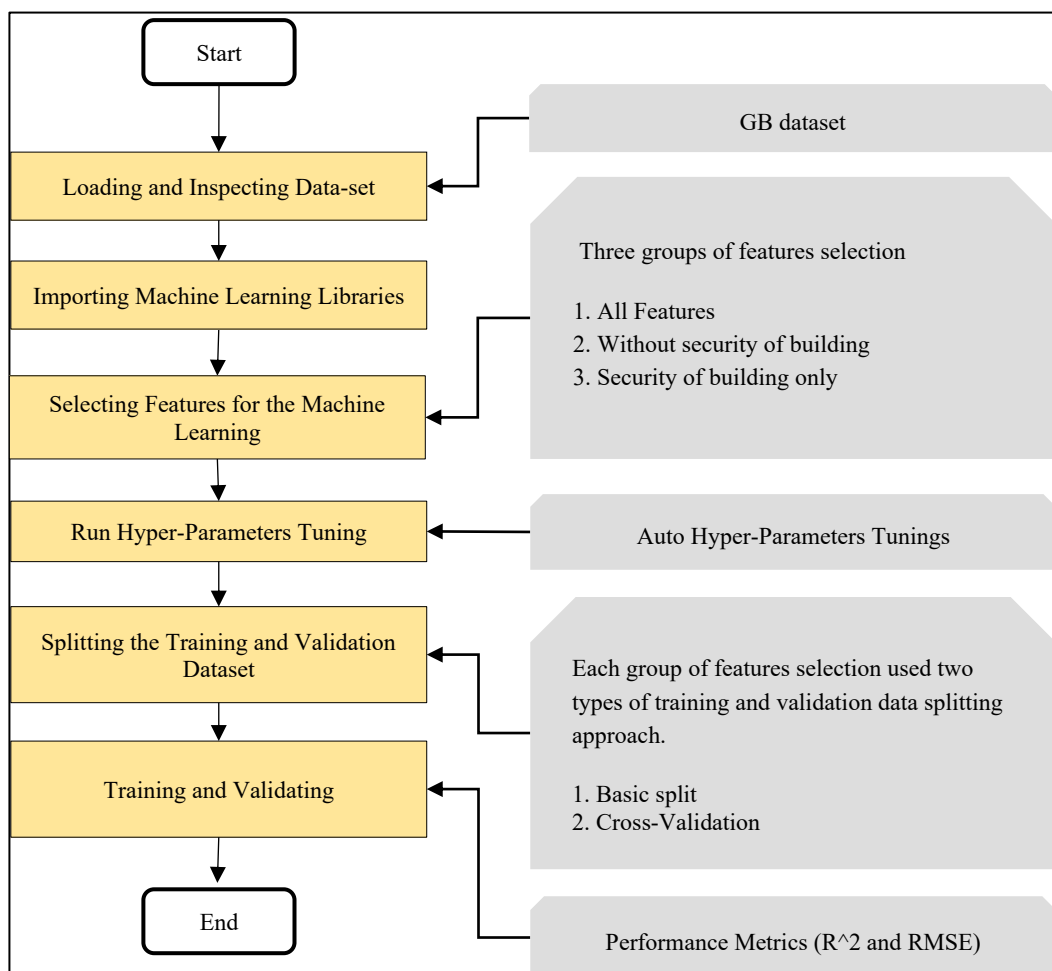
### *Machine Learning Models*

In this study, different ML models were tested on the GB dataset based on different feature selection groups. Five (5) ML algorithms were used namely Linear Regression, Decision Tree Regressor, Random Forest Regressor, Ridge and Lasso algorithms. In addition, each model in each feature selection group was also evaluated according to different training and validation splitting approaches namely basic split and cross-validation. Figure 3 presents the flowchart of the ML models evaluations.

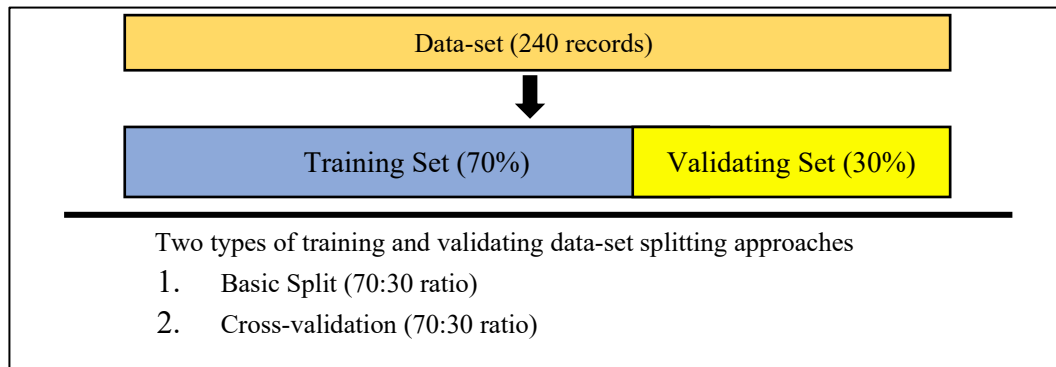
Python programming language was used to implement the models, run in the Anaconda Jupyter Notebook platform. The computer has Intel i7 7<sup>th</sup> Generation processor and 16GB RAM.

The Hyper-Parameters tuning is a technique to automate the parameters' configuraton of each ML model. This is an effective technique provided by Python to be used by inexpert data scientists (Masrom et al., 2019), Hyper-Parameters tuning optimized the best configurations of the machine learning. In this study, the researcher utilized the hyper-parameters tuning provided by Python.

Two types of training and validation splitting approaches have been used for the machine learning models. On the other hand, Figure 4 presents the distribution of dataset from the original numbers into the training and validating sets.



**Figure 3:** The Steps for Implementing Machine Learning Models

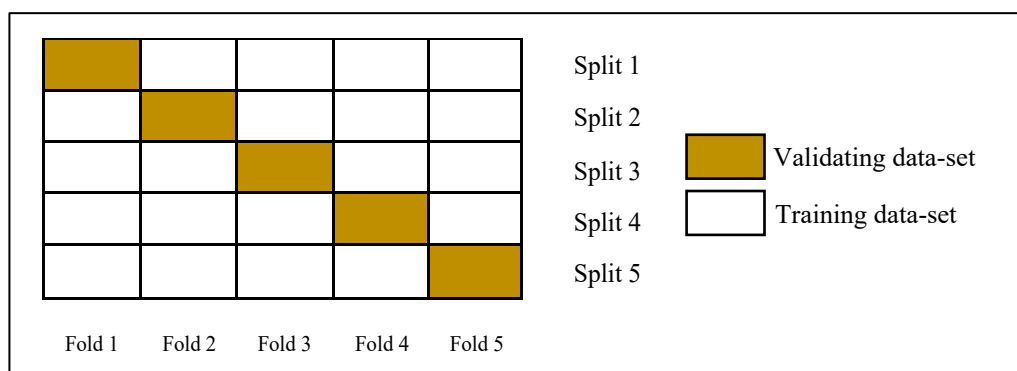


**Figure 4:** Splitting the Training and Validation Datasets

The Basic Split approach performs one time used on the dataset for training and validation while the Cross-Validation implements a comprehensive crossing from different training and validating folding. Below are some of the basic procedures of Cross-Validation training approach:

1. Split the dataset into 2 parts.
2. Set the 70% of the dataset as training dataset.
3. Set the balance 30% as validating dataset.
4. Train the model with the training dataset.
5. Evaluate the model with the validating set.
6. Repeat steps 1 to 5 for a different set of data folding.

The visualization process of data splitting in fivefold Cross-Validation is shown in Figure 5.



**Figure 5:** Data Splitting in Five-Fold Cross-Validation Approach

The Cross-Validation number of folding used in this research has been set to five. Hence, it involved five datasets crossing along five iterations of training and validating. The average accuracy scores from the five iterations were taken for the purpose of comparative studies with respect to other algorithms.

## RESULTS AND DISCUSSION

### Results of MLR

Prior to MLR modeling, an ANOVA test was conducted to test the statistical significance of all the independent variables (IVs) used in this study. Table 4 tabulates the variance ANOVA of the GB dataset. It shows that all the IVs that were selected for the model have contributed 83.40% of the total variation in the DV (transaction prices). This value is quite high and good enough for the Multiple Linear Regression Model (Shalizi, 2021). The model fitness value is 114.744 at a significant p-value of less than 0.05 (0.000). Table 5 lists the variables that have tolerance to the transaction price from the collinearity statistics.

**Table 4:** ANOVA Table

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	549715548267383.750	10	54971554826738.375	114.744	0.000
Residual	109708947536789.640	229	479078373523.099		
Total	659424495804173.400	239			

\*R<sup>2</sup> = 0.834

**Table 5:** Collinearity Statistics

Independent variables	Collinearity Statistics	
	Tolerance	VIF
Main Floor Area	0.461	2.171
Security of Building	0.129	7.755
Mukim – Kuala Lumpur	0.519	1.926
GBC - Gold	0.246	4.060
Tenure	0.443	2.257
Mukim - Petaling	0.436	2.296
Building Facade	0.466	2.146
Age of Building	0.353	2.831
Level Property Unit	0.779	1.284
GBC - Silver	0.531	1.884

Based on collinearity results, only 10 out of the 17 independent variables (IVs) present a significant relationship to the transaction price. The tolerance values were more than 0.10 to show that there was no multicollinearity problem in the dataset from the 10 listed variables in Table 5 and this was supported by VIF values less than 10. Therefore, these 10 variables were used in the MLR. The results are shown in Table 6.

**Table 6: MLR Regression Coefficient**

Model	Unstandardized Coefficients		Standardized Coefficients	t	p-value
	B	Std. Error	Beta		
(Constant)	-3223583.573	559809.921		-5.758	.000
Main Floor Area	5231.404	714.924	0.291	7.317	.000
Security of Building	-5138054.835	297945.798	-1.294	-17.245	.000
Mukim – Kuala Lumpur	1591963.798	219454.339	0.271	7.254	.000
GBC - Gold	-3898139.627	272201.193	-0.778	-14.321	.000
Tenure	5756105.972	429946.991	0.542	13.388	.000
Mukim - Petaling	-5806613.752	474014.069	-0.500	-12.250	.000
Building Facade	-4691198.063	419210.387	-0.442	-11.191	.000
Age of Building	475338.798	81308.937	0.265	5.846	.000
Level Property Unit	18023.874	4983.677	0.110	3.617	.000
GBC - Silver	1789518.271	270956.317	0.244	6.604	.000

The MLR results revealed that all the 10 variables contributed some degree of information in determining the DV (transaction price). Some variables with low standardized coefficients (less than 0.5) are *Main Floor Area*, *Mukim Kuala Lumpur*, *Age of Building* and *GBC-Silver*. Moderate contributions came from *GBC-Gold*, *Tenure*, *Mukim-Petaling* and *Building Façade*. The result shows that the *security of building* made the largest contribution to the MLR when compared to other features. The results of coefficients can be elucidated as follows: The "B value" of approximately -5,138,054.835 signifies that a one-unit increase in building security, measured in accordance with the specific criteria employed in the study, is associated with an anticipated decrease of approximately 5,138,054.835 units in the same currency or measurement scale used for building prices: this is assuming that all other factors remain constant. Meanwhile, the "beta value" of approximately -1.924, a standardized coefficient, conveys that a one-standard-deviation rise in building security corresponds to an expected reduction in building price by 1.924 standard deviations. This standardization facilitates the assessment of the relative significance of security compared to other factors within the model. In practical terms, these coefficients imply that augmenting security in a building tends to substantially diminish its price, and this relationship persists even after standardizing the variables for more meaningful comparison.

### Results of Machine Learning Models

The results of ML models are divided into three:

- i. Group 1: Used all factors from the Table 5
- ii. Group 2: Used all factors from the Table 5 exclude security of building
- iii. Group 3: Only used security of building

Table 7 presents the results of machine learning models with all the IVs in Group 1 features selection.

**Table 7:** Accuracy Results of The Five Machine Learning Algorithms with All Features (Group 1)

No	Algorithm	Split		Cross-Validation	
		R <sup>2</sup>	RMSE	R <sup>2</sup>	RMSE
1	Random Forest Regressor	0.962	393892.1	0.663	1010579.0
2	Decision Tree Regressor	0.894	664294.1	0.721	918429.4
3	Linear Regressor	0.885	504882.2	0.480	1254698.0
4	Ridge Regressor	0.796	921761.2	0.445	1296588.0
5	Lasso Regressor	0.781	954258.9	0.413	1332991.0

Table 7 depicts that all the five algorithms that used split training approach have produced better results than the cross-validation mainly from the Random Forest Regressor. The highest R<sup>2</sup> value was generated by the Random Forest Regressor (0.962) with the lowest error value. Meanwhile, Ridge and Lasso have lower R<sup>2</sup> value respectively compared to the other three algorithms as well as to the ANOVA result. These results, however, do not directly show the effectiveness of building security in the ML model. Furthermore, in Table 8, the results of each model with the feature selection without the security of the building are listed.

**Table 8:** Accuracy Result of the Five Machine Learning Algorithms with Features Selection exclude Security of Building (Group 2)

No	Algorithms	Split		Cross-Validation	
		R <sup>2</sup>	RMSE	R <sup>2</sup>	RMSE
1	Random Forest Regressor	0.963	389249.3	0.629	1059404.0
2	Decision Tree Regressor	0.905	627070.4	0.363	1389184.0
3	Linear Regressor	0.848	580528.2	0.317	1438139.0
4	Ridge	0.731	1058462.0	0.307	1448546.0
5	Lasso	0.715	1090277.0	0.255	1502699.0

Similar to the group features selection 1 (Table 7), Random Forest Regressor algorithm outperformed others in split approach. However, the exclusion of security of building did not extremely produce different accuracy result from the Random Forest. Meanwhile, the performance of Decision Tree

Regressor has increased without the security of building but not in the rest three algorithms. The security of building is identified as the most significant determinant from the MLR but it shows less impact in most of ML models in the group of features selection 2. However, to use the security of building alone in the ML models has drastically dropped the performances of each algorithm. This phenomenon can be observed in Table 9.

**Table 9:** Accuracy of Result from The Five Machine Learning Algorithms with security of building only( Group 3)

No	Algorithm	Split		Cross-Validation	
		R <sup>2</sup>	RMSE	R <sup>2</sup>	RMSE
1	Random Forest Regressor	0.215	1808990.0	0.084	1666258.0
2	Decision Tree Regressor	0.242	1777426.0	0.107	1644604.0
3	Linear Regressor	0.076	1434889.0	0.107	1644604.0
4	Ridge	0.237	1783934.0	0.108	1643834.0
5	Lasso	0.242	1777430.0	0.107	1644604.0

The results indicate that the security of the building itself does not exert a significant influence on the performance of the ML models. Across all algorithms, the accuracy results are notably of low accuracy, with values falling below 0.5, and the Linear Regressor demonstrating the lowest accuracy at 0.076.

### Results Comparison (MRL VS ML)

The unexpected negative relationship between building security and price in the MLR model prompts the need for a more in-depth analysis. While the conventional approach would suggest that enhanced security features should positively influence building prices, the researcher's initial findings suggest otherwise. This intriguing result underscores the complexity of factors influencing property valuation and highlights the importance of exploring this relationship from a different perspective. To gain deeper insights into these results, the variables were tested with ML and tested via multiple algorithms and still did not show any significance of the security of the buildings as a green building price determinant. In all, this study tends to highlight that via the MRL approach, the prices of green buildings correspond to the security of buildings but remain insignificant when tested via ML.

### CONCLUSION

In summary, this study aims to assess the impact of building security on green building price prediction using both ML and MLR models. The findings revealed a noteworthy disparity between the two approaches. While the ML model did not demonstrate a significant influence of green building attributes on price prediction, the MLR model indicated otherwise. These contrasting results



underscore the importance of selecting an appropriate modeling technique for a given research context, as different methods may yield diverse conclusions. Furthermore, the results emphasize the necessity for further investigation and validation to gain a comprehensive understanding of the complex relationship among green building features, security, and property prices. Such insights are invaluable for policymakers, investors, and stakeholders in the real estate sector for those seeking to make informed decisions about sustainable building practices and security investments.

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*The Effect of Security in the Green Building Price Prediction Model: A Comparison Between Multiple Linear Regression and Machine Learning Approaches*  
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## **EVALUATION OF THE READINESS OF THE KULON PROGO GEOHERITAGE IN SUPPORTING THE PROPOSAL OF YOGYAKARTA NATIONAL GEOPARK BASED ON SWOT ANALYSIS**

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### **Abstract**

Since the establishment of 20 geological sites as Geoheritage sites in the Yogyakarta region, this has encouraged the Provincial Government's desire to form a national-scale Yogya Geopark area. The plan to form the Yogya Geopark area certainly requires an in-depth study so that the plan can be achieved. Of the twenty sites, 5 of them are in the Kulon Progo area. This study aims to find out how the conditions of the five geoheritage locations in Kulon Progo are, with the final result evaluating the readiness of the five locations in supporting the proposed Yogyakarta National Geopark area. The research method is in the form of field observations at the five locations. The results of the field data collection were then carried out by a SWOT analysis referring to the criteria from the Government. Of the five geosites in Kulon Progo, only two locations met the requirements, namely Mangan Kliripan-Karangsari and Kiskenda Cave. Hard and planned efforts are needed for structuring the geoheritage area in Kulon Progo so that it can support the Yogya Geopark proposal.

**Keywords:** Geoheritage, Geopark, Kulon Progo, SWOT, Yogyakarta

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## INTRODUCTION

The Special Region of Yogyakarta is an area that has quite interesting geological phenomena to study and research. One of the proofs is the stipulation of 20 Geoheritage sites in the Yogyakarta Region (Penetapan Warisan Geologi (Geoheritage) Daerah Istimewa Yogyakarta, 2021). The 20 geosite locations are 5 in Kulon Progo Regency, 7 in Sleman Regency, 3 in Bantul Regency and 5 in Gunungkidul Regency (Figure 1). Of the twenty geosites, 5 in Gunungkidul Regency have been designated as part of the Gunungsewu Geopark area which has been recognized by UNESCO.

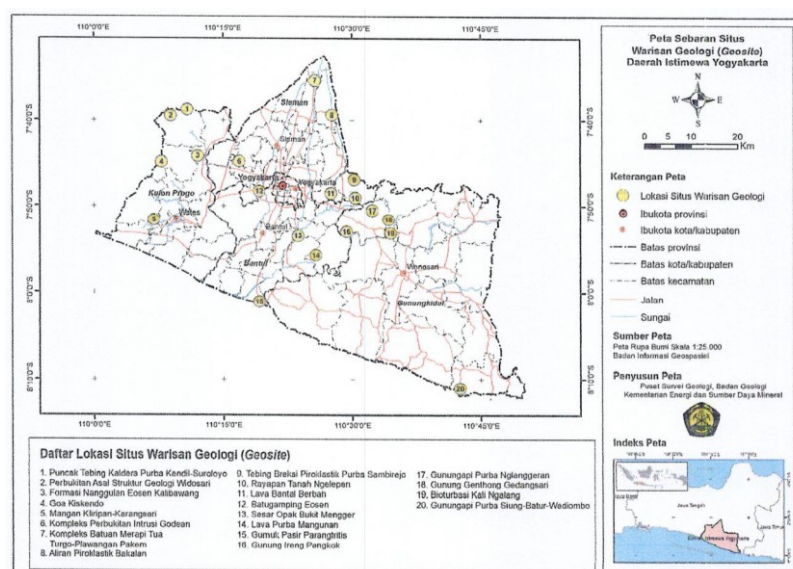


Figure 1: Locations designated as Geoheritage in Yogyakarta Special Region

Encouraged by the existence of the 20 Geoheritage sites, the government of Yogyakarta Special Region plans to turn the Yogyakarta area into a national-scale Geopark. The Yogya geopark area covers the areas of Sleman Regency, Kulon Progo Regency and Bantul Regency. In order for the Yogya Geopark proposal to be successful on a national scale, it is necessary to conduct a study of the geosite locations.

Some of these geosite locations have become locations for tourist visits, such as the Prambanan Breccia Cliff (Safira et al., 2023), Parangtritis Sand Dunes, and Pillow Lava (Prasetyadi, 2012). But not all locations become tourist destinations. The area that needs to be studied is the geosites in Kulon Progo. This is due to not being widely known by the public and not attracting high tourist interest (Pandita & Prabowo, 2022). Besides that, the geological phenomena that

developed in Kulon Progo are also interesting to study (Pandita & Hartono, 2019).

Understanding the need for support for each geosite in order to apply for a Yogya geopark, it is necessary to study the condition of the existing geosites in Kulon Progo. This research is aimed at finding out whether the condition of each geosite in Kulon Progo is in accordance with the needs of the Yogya geopark. This research is also intended to provide an overview of the extent of the need for geosite development in Kulon Progo.

## **LITERATURE REVIEW**

Geopark based on Government Regulation No. 19 of 2019 is defined as a single or combined geographical area, which has a Geological Heritage Site (Geosite) and valuable natural landscapes, related to aspects of Geological Heritage (Geoheritage), Geological Diversity (Geodiversity), Biodiversity, and Cultural Diversity, and managed for the purposes of conservation, education, and community economic development in a sustainable manner with the active involvement of the community and local government, so that it can be used to foster public understanding and concern for the earth and the surrounding environment (Tentang Pengembangan Taman Bumi (Geopark), 2019). This regulation from the government is close to the provisions of Unesco which is also referred to by several countries (Aziz et al., 2011; Semeniuk, 1998).

Referring to the definition of the regulation above, an area can be determined to become a Geopark if it has Geoheritage, Geodiversity, Biodiversity and Cultural diversity. The existence of these sites and culture can be managed and developed for education, conservation and economic empowerment.

The existence of the geopark itself is very dependent on the existence of geoheritage and also strengthens the existence of other diversity fields (Norhayati et al., 2011). The meaning of geoheritage was first introduced by (Bradbury, 1993) that introduced Tasmania Geopark. In Indonesia, geoheritage and geopark research has been going on since 2012 (Prasetyadi, 2012), who proposed several geoheritage locations in the Yogyakarta area. Sahara & Setiawan (2022) conduct a geoheritage study in the Solok area and its surroundings and propose a quantitative analysis method to assess its feasibility.

The Indonesian government through the Geological Agency has also issued technical guidelines for the Geological Heritage Resource Assessment in 2017 (Anonim, 2017). The technical guideline contains the requirements for a geological site to be recognized as a geoheritage.

Not much research has been done on geoheritage in the Kulon Progo area. This is because the echo of geoheritage only occurred after the establishment of several geosites in Kulon Progo in 2021. The research carried out so far has

focused more on geological conditions in general, such as those carried out by Harjanto (2011), Pandita and Hartono, (2019), and others.

## PROBLEMS AND RESEARCH OBJECTIVES

This research is focused on determining the condition of the Kulon Progo geoheritage in its readiness as part of the Yogya geopark proposal. The issues that will be raised in this study are: 1) What is the condition of public facilities at the geosite location; 2) Availability of Geology information boards; and 3) What are scientific value of the Geosites. The purpose of this study was to determine the readiness of each Geoheritage location to support the Yogya Geopark proposal on a national scale.

Investigations were carried out on five geoheritage in the Kulon Progo area (Figure 2). The five geosites are:

- i. The Ancient Caldera at Kendil-Suroloyo Peak
- ii. the Widosari Structural remaining hill
- iii. Kiskenda Cave
- iv. Eosen Nanggulan Formation Kalibawang
- v. Kliripan – Karang Sari Mangan Mining

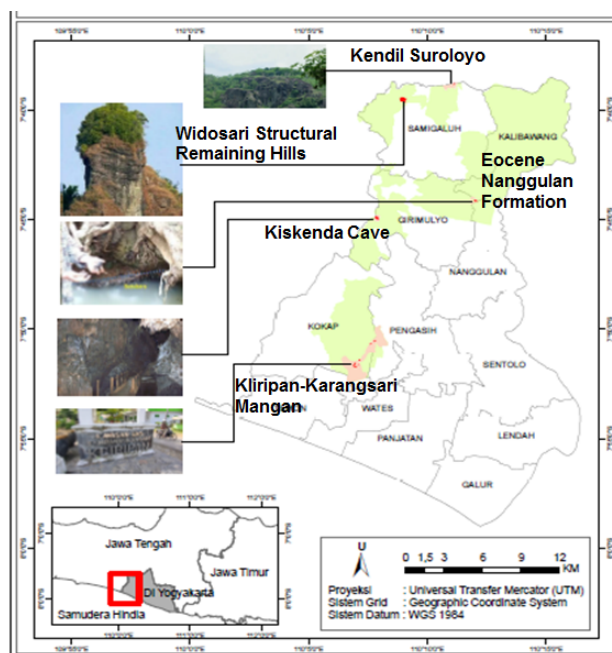


Figure 2: Location of the Kulon Progo Geoheritage



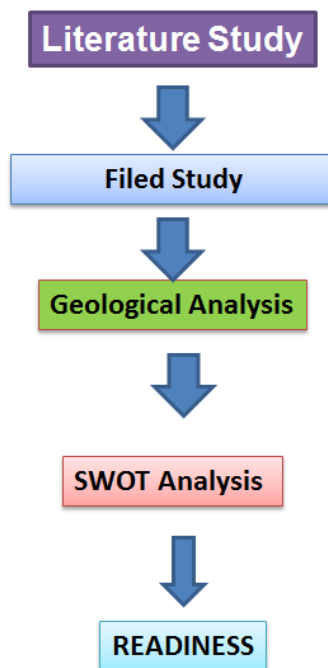
## **RESEARCH METHOD**

Research methods include literature review, field investigation, geological analysis, SWOT analysis and synthesis (Figure 3).

The literature review was carried out in the form of searching for references related to geoheritage locations in Kulon Progo. The results of this study are to determine the extent to which research on geoheritage locations has been carried out, so that it can be seen how far the benefits of these geosites are supporting research and education. Apart from that, other aspects of research in other fields can also be known but are still related to geoheritage locations.

Field investigations were conducted to collect data, including: 1) the existence of public facilities, 2) information boards, 3) geological conditions, 4) socio-cultural conditions. In addition, if necessary, take rock samples for the purposes of geological analysis. It is hoped that the results of the field investigation will also provide an overview for spatial planning around the geosite.

Geological analysis was carried out to determine the rocks, stratigraphy, geological structure and environmental geology. The final result of the geological analysis determines the value of its geological uniqueness and the potential for environmental management.



**Figure 3:** Research flowchart

SWOT analysis was conducted to determine the values of strengths, weaknesses/weaknesses, opportunities and challenges at each location. The final result of the analysis can identify the needs and level of readiness of each location.

## **RESULT**

The results of field observations at the five Geoheritage locations in Kulon Progo Regency can be described as follows:

### **The Ancient Caldera at Kendil-Suroloyo**

The peak of the Kendil-Suroloyo Ancient Caldera is located in the northern part of Kulon Progo district, bordering Magelang regency. Geologically, it is a cliff from the ancient caldera of Mount Menoreh. The incised volcano is thought to have formed approximately 12 million years ago (Widagdo, et al., 2019). The geological uniqueness of this location lies in the natural scenery that can be reached from the top of the cliff. Past volcanic processes are clearly well recorded. In the north of the cliff, the morphology of the dome is clearly visible, so it can be a good learning process (Figure 4).

The condition of facilities and infrastructure at the Kendil Peak location is still very minimal, but at the Suroloyo peak there are several public facilities. The condition of the access road to the location can be passed by mini bus vehicles with a passenger capacity of 15-25 passengers. However, the condition of the road is prone to landslides.



**Figure 4:** Natural Scenery at the Kendil-Suroloyo Peak

The socio-cultural conditions around Kendil-Suroloyo Peak are closely related to the name Suroloyo itself. The name Suroloyo is related to the palace where the gods live in wayang mythology. This place has also been used by the community for religious rituals, because there are offerings placed in one of the viewing posts. The placement of the Punokawan statues draws closer to the cultural meaning of wayang for this Puncak Kendil-Suroloyo site.

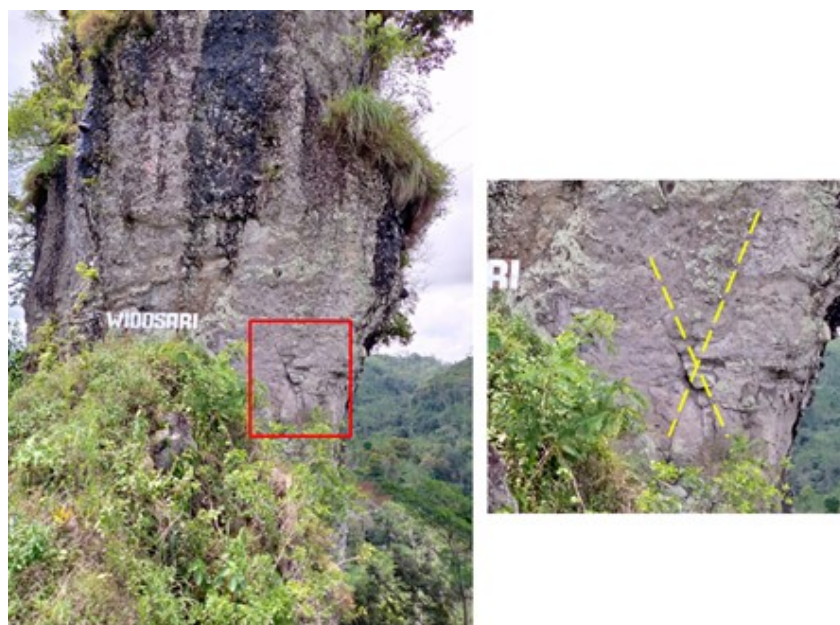
### **The Widosari Remaining Structural Hill**

The structural hill landscape of Widosari is an isolated hill that is higher than its surroundings. This hill is bounded by vertical cliffs resulting from erosion of joint areas and faults (Figure 5). The Widosari Hills are the remnants of the rocks from the Menoreh ancient volcano. It is composed of closed packed breccia with intercalated tuff of gravel and layered sandstone. The upper part of the Widosari hill is composed of breccia and gravel. The rock position is estimated to be N325°E/25°. Regionally, this rock is included in the Old Andesite Formation group. Based on the variation of the rock that developed, it is possible that it is the proximal-medial part. This is based on the slope of the rock which tends to the southwest.

Conditions of facilities and infrastructure are available, but still minimal. Parking lots and access roads are still through private land owned by residents. The location can only be reached by private vehicle, because the road width is not sufficient + 3m.

The biodiversity of Widosari Hill is close to the Nglingsgo tea plantation which has become a tourist destination, as well as other tourist locations. The viewing post facility on Widosari Hill offers quite a beautiful view, with cool air. The peak name Widosari has no special meaning. Widosari villagers also have the ability in culinary offerings in the form of Widosari Roasted Tea, Coffee, Enting-enting Ginger, Geblek, Palm Sugar.

Located near the Widosari Peak location is the village of Widosari which has various traditions. These cultures include dance, shadow puppets and the traditional arts of Bangilan and Lengger Tapeng. In addition, there are still Kenduri and Merti Desa traditions. In addition, there are handicrafts in the form of written batik, stamped batik, gradation batik, sandals made of corn chips, carved kentongan, wooden masks, and leather puppets.



**Figure 5:** Widosari Remaining Hill, Insert Photo saw a Fracture Deformation

### **Eocene Nanggulan Formation**

Eocene rock outcrops on the island of Java are only found in four locations, namely in the Ciletuh, Karangsambung, Bayat and Nanggulan areas. (van Bemmelen, 1949), so the Nanggulan Formation which is located in the Kalibawang area is worthy of being a Geoheritage location. The Nanggulan Formation is composed of quartz sand, claystone, silt and coal (Figure 6A). This location is also one of the biostratigraphic Mollusk levels (van Bemmelen, 1949).

The location is along the Kali Songgo river's, with surrounding morphology in the form of rice fields. The river is frequently flooded and has a high erosion rate. Access to see the outcrop or geosite is still inadequate. It can only be traversed on foot. Public facilities are not specifically available. Near the location is ITNY's field campus, and it has often been the place for field lectures from various universities (Figure 6B).



**Figure 6:** A) One of Eocene Nanggulan outcrop at Kalisonggo river's; B) Field Camp of ITNY at Banjararum Village, near Eocene Nanggulan outcrop

### **Kiskenda Cave**

Kiskenda Cave is a natural cave formed in a Karst landscape. This karst landscape results from the karstification process in the Jonggrangan Formation. The location of Jonggrangan Village and its surroundings is in a young karst stage, which is characterized by the formation of underground caves and rivers. The phenomenon of geological natural disasters that occur around the cave is an avalanche on the north side of the cave. The occurrence of this landslide indicates the potential for sink holes which are common in karst areas.



**Figure 7:** Facilities in Kiskenda Cave: A) Revitalization of the Amphitheater; B) Stairs into Cave.

The facilities available at this geoheritage location are quite complete, because they have been developed since 2005. Several facilities such as parking lots can accommodate small buses (15-25 passengers). In addition, there is an amphitheater which is used for Sugriwa-Subali ballet performances (7A). The

stairs and entrance to the cave have been repaired (B). The road to the location is adequate, although large buses (> 40 passengers) cannot pass due to the many uphill bends.

### **Mangan Kliripan-Karangsari**

It is a former manganese mining location, in the form of underground mining. Based on the regional geological map, the former mining location is in the Sentolo Formation, which is in the form of clastic limestones. The presence of manganese in this formation is the result of a sedimentation process, and is found in the form of nodules and layers (Harjanto, 2021). The rock conditions found are layered limestone with moderately weathered conditions on the surface (Figure 8). The Sentolo Formation at this location has an unconformity overlying with the Old Andesite Formation.

The facilities available at this geoheritage location are complete, but currently several renovations have been carried out. The access road to several holes is still a dirt road that can be passed by private cars. Some of the remaining mining buildings can be reached by private vehicles, located near the main road.

## **SWOT ANALYSIS**

Analysis was carried out on the results of identification of geological conditions and general conditions. The method used in the analysis of general conditions and strategic issues is SWOT analysis, namely: Strengths, Weaknesses, Opportunities and Threats.

### **Strengths**

The five geoheritage locations each have different geological characteristics. Some of the strengths that can be relied upon in the development of geoheritage areas can be described as follows.

- i. The Kliripan-Karangsari Manganese and Kiskenda Cave locations are Geoheritage locations that have been arranged and are supported by cultural diversity and biodiversity.
- ii. Two locations are good for learning about mining-geology there are Eocene Nanggulan and Kliripan-Karangsari Mangan.
- iii. Kendil-Suroloyo Peak and Widosari Structural Hill have very interesting views.

### **Weakness**

The five geoheritage locations each have different problems for their development. Weaknesses recorded from field survey data and FGDs are as



follows. The access road to the location is one of the deficiencies in the four locations.



**Figure 8:** A) Location of the mining cave entrance being renovated; B) The outcrop condition of the Sentolo Formation is strongly weathered.

Four locations, except Kiskenda Cave, do not yet have adequate facilities, such as food kafe, toilets, parking lots and praying place.

Kiskenda Cave and Puncak Kendil-Suroloyo are directly adjacent to other districts. It needs cooperation between local governments for their development.

Except for Manganese Kliripan-Karangsari, the other four locations do not yet have information boards explaining their geological phenomena.

### **Opportunity**

The five geoheritage locations have a number of opportunities to be developed in order to support the Yogya Geopark. Some of the opportunities that can be developed are as follows

- i. The five locations have the same opportunities to become geotourism locations, both in terms of educational tourism or to enjoy the beauty of nature. In general, compared to one of the other geoheritage locations in DIY, such as the Breksi Cliff, the Kendil-Suralaya Peak, Kiskenda and Widosari Caves have more charm of natural beauty and also knowledge of geology.
- ii. The Kulon Progo area has become an interesting location for learning the evolution of volcanoes and also field lectures. This condition allows geoheritage in Kulon Progo to be further developed into a natural laboratory or geopark. Several universities have made the geology of Kulon Progo a research and education object.

### **Threat**

As a Geoheritage area, the main goal is to conserve the area. Threats to this conservation process are more in natural conditions and also in society

- i. Natural disaster conditions such as landslides can occur at the five geoheritage locations.
- ii. The threat of conflict of interest within the community, given the status of land ownership. So that the status of land ownership needs to be resolved before planning the development of the area is carried out.

### **DISCUSSION**

Not all of the five Geoheritage areas in Kulon Progo are ready to support the Yogya Geopark. Only two locations have all the requirements to become geosites for the existence of a National Yogya Geopark. Therefore, it takes a lot of effort and a clear road map in structuring the Geoheritage area in Kulon Progo so that it can fully support the proposal to National Yogya Geopark.

Based on the SWOT analysis, it appears that there is a lot of added value that can be utilized by the existence of the Geoheritage site in Kulon Progo. As the main purpose of establishing a geoheritage area is to make the area protected, it is necessary to have a well-planned management. Currently, governance still overlaps between the Department of Tourism and the Office of Education and Culture.

Governance conditions that do not involve the community can be a separate obstacle. Therefore, it is necessary to realize community participation in the management of the Geoheritage area. This needs to be done because most of the land around the geoheritage area is owned by individuals and used as their livelihood. Location such as in Widosari where the entrance is through the residents' yard shows the need for cooperation between managers and residents. Until the FGD was held there was no agreement on the use of the land, this is a separate problem that must also be resolved.

### **CONCLUSION**

Based on the results of direct observations in the field and SWOT analysis, several conclusions can be drawn. The five Geoheritage areas in Kulon Progo still need a lot of improvement so that they can support the existence of a national-scale Yogya geopark. However, in a short time, two locations were ready to become part of the Yogya geopark proposal. The two locations are Kiskenda Cave and Mangan Kliripan-Karangsari. The other three locations still require additional public facilities, ease of access to the location and improvements to geosite management. For this reason, cooperation between various parties such



as the Regency Government, Provincial Government, Universities and Tourism Stakeholders needs to be realised in the near future.

For future development, the study of the added value of the geology of this geological site needs to be deepened at each location. The study of the Nanggulan Formation needs to be deepened so that its added value as a geosite can truly be justified. Kendil-Suralaya Peak also requires detailed unique geological information that is easy for tourists to understand. This also applies to the other three locations so that geological values can be further displayed at each location.

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## **AN ASSESSMENT OF SPATIAL SUITABILITY AND INFRASTRUCTURE SUPPORT OF CORAL REEF IN PROMOTING ECOTOURISM IN THE PAHAWANG ISLAND, INDONESIA**

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### **Abstract**

Unorganized and constant changes in land use heighten flood risk in a region. Flood issues in Snorkeling tourism, which offers a range of stunning undersea natural resources, is another popular activity on Pahawang Island. Marine tourism should adhere to the idea of environmental preservation, such as avoiding harming and polluting marine habitats, in addition to helping the economy. The goal of this study is to spatially assess the condition of suitability and infrastructural support needed for coral reef ecotourism on Pahawang Island. Line Intercept Transect, coral reef ecotourism carrying capacity calculations, ArcGIS spatial processing, and infrastructure observation were the techniques employed. The findings of this study show that the value of suitability index for ecotourism involving snorkeling and diving had an average value of 2.21, falling into the appropriate category (S2) with a carrying capacity of 3,614 persons per day on an area of 90.35 Ha. Coral reef transplants, which enhance coral reef coverage, can be done to fully utilize the potential in this location in order to preserve and enhance coral reef tourist potential of Pahawang Island. There are a few things that need to be fixed in order to build integrated coral reef ecotourism management although the infrastructure was fairly good according to the findings of direct field observations. The conclusion is that, from a spatial standpoint, the suitability index and the area of snorkeling and diving ecotourism carrying capacity, as well as the supporting infrastructure, are in good condition. To enhance and advance this, integrated management and governance are necessary.

**Keywords:** Ecotourism, Coral Reef, Suitability, Carrying Capacity, Infrastructure

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## INTRODUCTION

Pahawang Island tourism is one of the areas in tourism sector of Lampung Province that is now relatively well recognized. A marine tourism destination in the Teluk Lampung region, which is found in Marga Punduh District, Pesawaran Regency, is Pahawang Island (Badriawan, 2019). The island is also known for its snorkeling and diving tourism which presents a variety of beautiful underwater natural resources, especially in the coral reef ecosystem.

Coral reefs are ecosystem components that are composed of large-scale calcium carbonate lime (CaCO<sub>3</sub>) deposits or as a result of lime secretion by corals and other marine lives (Nontji 1993; Bengen 2002). Based on the main category, coral reefs are divided into acropora and non-acropora (Eriviana et al 2020; Suryanti et al 2011; English et al, 1997). Coral reefs have become an attraction for marine tourism with their beauty as their main point of interest (Zulfikar et al, 2011; Fajar et al, 2019). Coral reefs are beautiful because they have a selection of fishes, algae, shellfish, sea lilies, sea anemones and other marine lives around them. Various types of coral reefs additionally attract tourists. This is what makes coral reefs one of the tourist locations for diving and snorkeling or glass bottom boats, specifically seeing the beauty of coral reefs from a ship covered with glass on the floor.

Appropriate management of coral reef ecotourism can help local income and open up possibilities for economic growth for local communities (Manahampi et al, 2015). Marine tourism should adhere to the idea of environmental preservation, such as avoiding harming and polluting marine habitats, in addition to helping the economy (Abdul et al, 2020; Adhiyaksa & Sukmawati, 2021). Ecotourism is more than simply ecological and natural tourism, but instead a tourism activity to bolster obligation in protecting the environment and natural assets ecologically (Azwar et al, 2022; Junaid et al, 2023; Koroy et al, 2017). Therefore, an appropriate management of coral reefs is necessary so that the income of the local community may increase.

The suitability and carrying capacity values in Pahawang are not yet acknowledged with certainty. Therefore, studies are needed concerning the suitability and carrying capacity values of areas on this island so that the potential for marine tourism on the island can be advanced. The feasibility value of an ecotourism area can be assessed simply by looking at an information (spatial) map. Coral reef ecotourism suitability maps can be acquired through processing data from satellite imagery. However, the accuracy of course differs from situations in the field. Therefore, spatial data and information regarding the distribution of coral reefs and further in-depth research on Pahawang Island is necessary. With the utilization of Geographic Information System (GIS) technology, coral reef mapping can be executed by processing data spatially and translating it into a coral reef distribution map (Fuad et al, 2022). In addition, GIS

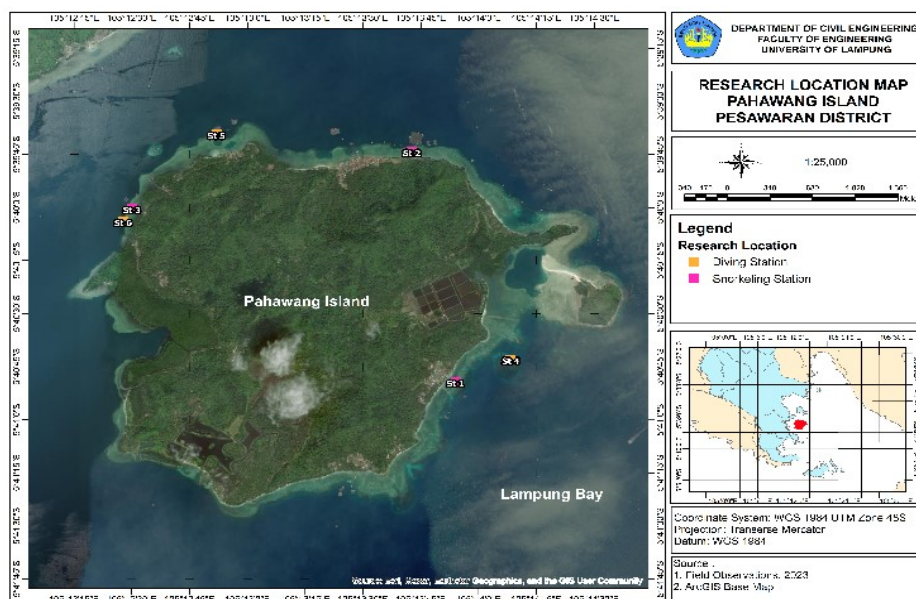
has the capability of gathering, storing, processing, analyzing, and visualizing any geographic information (Zulkifli & Mohd, 2016). Perhaps research into the suitability of ecotourism has often been carried out before. However, previous research has never been reviewed from the infrastructure aspect, thus making this study more sophisticated.

The goal of this study is to spatially assess the condition of suitability and infrastructural support needed for coral reef ecotourism on Pahawang Island. Therefore, it is expected that the value of the suitability and carrying capacity of the area as well as elements of its infrastructure that can increase its value and support the ecotourism area can be found from this research.

## LITERATURE REVIEW

### *Research Location*

Pahawang Island, Punduh Pidada District, Pesawaran Regency, Lampung Province was the location in this research. This island is geographically located at coordinates 05° 40'36" South Latitude and 105° 13'05" East Longitude. There were 6 stations in the east, north and west. See figure 1.



**Figure 1: Location Map**

### **Tools and Materials**

This research used tools such as a laptop for processing data, GPS for location marking, scuba diving for diving aids, a Secchi disk for measuring visibility, a roll meter and an underwater camera for collecting transect data.

The materials used in this research include previous research which was used as a reference in this research, sentinel 2A satellite image data and Google Earth to map location conditions, also assisted by ArcGIS software for spatial map processing with license code: EFL123456789.

## **RESEARCH METHODOLOGY**

### **Line Intercept Transect (LIT)**

To acquire information on the coral reef cover percentage rate, the LIT method is employed. The percentage of substrate cover using the LIT method can be calculated using the following formula (English et al, 1997; Fadhillah et al, 2021):

$$\%Coverage = \frac{Lifeform\ Category\ Coverage\ Length}{Total\ Transect\ Line\ Length} \times 100.....(1)$$

In LIT method, the part of sample being collected is not the field area, but transect line length (Fadhillah et al 2021).

There are advantages in LIT method according to (English et al 1997) in (Fadhillah et al 2021). One of which suggested that the data obtained through this method is better and more extensive due to it includes the length of coral colonies, presentation of community structure such as live coral coverage, dead corals, species richness, dominance, frequency of presence, colony size and species diversity in which can be presented comprehensively depending on monitoring needs and location. These data are shown in table 12.

### **Tourism Suitability Analysis (TSI)**

A scientific way to evaluate a tourist area's level of suitability or feasibility using objective criteria is the Tourism Suitability Index (TSI, also known as Indeks Kesesuaian Wisata or IKW). Snorkeling and diving are listed under the index of tourism suitability. The equation for tourism suitability index equation in this research is (Yulianda, 2019):

$$TSI = \sum (Bi \times Si).....(2)$$

Where:

TSI = Tourism Suitability Index

S1 (Very Suitable) :  $IKW \geq 2,5$

S2 (Suitable) :  $2,0 \leq IKW < 2,5$

S3 (Not Suitable) :  $1 \leq IKW < 2,0$   
 TS (Very Not Suitable) :  $IKW < 1$   
 $B_i$  = Parameter weight ke-i  
 $S_i$  = Parameter score ke-i

This suitability index assessment has parameters for individual tourism activity types. The matrix of tourism suitability for the snorkeling and diving categories is shown in table 1 and table 2.

**Table 1: Snorkeling Ecotourism Suitability Matrix**

Parameter	Weight	Category (S1)	Score	Category (S2)	Score	Category (S3)	Score	Category (TS)	Score
Coral Coverage (%)	0.375	>75	3	>50-75	2	25-50	1	<25	0
Lifeform Type	0.145	>12	3	<7-12	2	4-7	1	<4	0
Coral Fish Type	0.14	>50	3	30-50	2	10-<30	1	<10	0
Brightness (%)	0.1	100	3	80-<100	2	20-<50	1	<20	0
Depth (m)	0.1	1-3	3	>3-6	2	>6-10	1	>10;<1	0
Current Speed (cm/s)	0.07	0-15	3	>15-30	2	>30-50	1	>50	0
Expanse width (m)	0.07	>500	3	>100-500	2	20-100	1	<20	0

*Source: Yulianda (2019)*

**Table 2:** Diving Ecotourism Suitability Matrix

Parameter	Weight	Category (S1)	Score	Category (S2)	Score	Category (S3)	Score	Category (TS)	Score
Coral Coverage (%)	0.375	>75	3	>50-75	2	25-50	1	<25	0
Lifeform Type	0.145	>12	3	<7-12	2	4-7	1	<4	0
Coral Fish Type	0.14	>50	3	30-50	2	10-<30	1	<10	0
Brightness (%)	0.1	100	3	80-<100	2	20-<50	1	<20	0
Depth (m)	0.1	1-3	3	>3-6	2	>6-10	1	>10;<1	0
Current speed (cm/s)	0.07	0-15	3	>15-30	2	>30-50	1	>50	0

Source: Yulianda (2019)

## ANALYSIS AND DISCUSSION

### Area Carrying Capacity (ACC)

The definition of Carrying Capacity is a measurement of an area's maximum allowable usage based on its sensitivity or tolerance, which is affected by a number of natural elements, including the availability of food, living space, shelter, and water (Maldonado 2004). The ecological potential of visitors and area units from diving and snorkeling activities is shown in table 3 (Yulianda, 2019). To calculate the carrying capacity of an area, this research uses the formula from (Yulianda, 2007; Mutabarat et al, 2009; Muflih et al, 2015; Sukuryadi et al, 2020), which are as follows:

$$ACC = K \times \frac{Lp}{Lt} \times \frac{Wt}{Wp} \dots\dots\dots(3)$$

Where:

- ACC = Area Carrying Capacity
- K = Ecological potential of visitors per unit area
- Lp = The area/length of the area that can be utilized
- Lt = Unit area for particular category
- Wt = Time available for tourism activity in the area per day
- Wp = Time spent by visitors for particular activity



### Ecotourism Support Infrastructure

Tourism operations at a tourist destination must take into account the value of visitor demand and supply since ecotourism supporting infrastructure may add value and improve the excellence of a tourist attraction. Visitors can feel at ease while yet paying attention to the preservation of the ecosystem's natural resources thanks to the infrastructure that supports them.

**Table 3:** Diving Ecotourism Suitability Matrix

Activity Type	$\Sigma$ Visitor (K)	Unit Area (Lt)	Description
Diving	2	2000 m <sup>2</sup>	2 people in each area of 200 m x 10 m
Snorkeling	1	500 m <sup>2</sup>	1 people in each area of 100 m x 5 m

*Source: Yulianda (2007)*

### *TSI and ACC Data Analysis*

In this assessment, TSI and ACC values have been acquired which were presented descriptively. Then it was compared with the suitability and carrying capacity of coral reef ecotourism areas in other locations. The analysis was performed via looking at the existing parameters to see if there is a trend towards a better and more sustainable direction.

### *Integrated Coral Reef Ecotourism Management*

Observation and mapping methods, documentation, descriptions of useful objects, and aesthetics of coral reef tourist management were all employed in the earliest phases of collecting and studying the materials. In this study, comparative studies are used, especially when discussing the infrastructure that supports ecotourism. On the basis of this, infrastructural guidelines for ecotourism on coral reefs were proposed. These findings will serve as the foundation for the author's recommendations for more coral reef ecotourism management initiatives on Pahawang Island.

**Table 4:** Snorkeling activity transect data summary

Parameter	East	North	West
Coral Coverage (%)	45.60	85.20	68.50
Lifeform Type	8	8	8
Jenis Coral Fish Type	51	51	51
Water Brightness (%)	90	96	96

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Parameter	East	North	West
Depth (m)	3	3	3
Current Speed (cm/s)	30	15	17
Coral plains expanse width (m)	275	325	315

**Table 5:** Diving activity transect data summary

Parameter	East	North	West
Coral Coverage (%)	45.60	85.20	68.50
Lifeform Type	8	8	8
Jenis Coral Fish Type	51	51	51
Water Brightness (%)	90	96	96
Depth (m)	3	3	3
Current Speed (cm/s)	30	15	17
Coral plains expanse width (m)	275	325	315

### ***Coral Reef Ecotourism Suitability Analysis***

Based on the results obtained from the line intercept transect method in table 4, the index of tourism suitability value for snorkeling category can be calculated. The estimation results are shown in table 6.

**Table 6:** Diving activity transect data summary

Parameter	Weight	Location		
		East	North	West
Coral Coverage (%)	0.375	1	3	2
Lifeform Type	0.145	2	2	2
Coral Fish Type	0.14	2	2	2
Water Brightness (%)	0.1	2	3	2
Depth (m)	0.1	3	3	3
Current Speed (cm/s)	0.07	2	3	2
Coral plains expanse width (m)	0.07	2	2	2
<b>N Total</b>	1.00	<b>1.725</b>	<b>2.645</b>	<b>2.1</b>
<b>Category</b>		<b>Not Suitable (S3)</b>	<b>Very Suitable (S1)</b>	<b>Suitable (S2)</b>

The diving tourism suitability index is referring to (Yulianda, 2007). Tourism suitability index calculation data is shown in table 8, which was obtained from the method of line intercept transect in table 4.

Furthermore, from the TSI results, the TSI for snorkeling and diving categories on Pahawang Island can be mapped. See figure 2.

**Area Carrying Capacity**

The outcomes of the calculation of the carrying capacity of the diving and snorkeling activity areas are shown in table 7.

**Table 7: LP Calculation**

Activity	K	The Area of Activity Region(m <sup>2</sup> )			L <sub>t</sub>	Wt	Wp
		East	North	West			
Diving	2	272,100	200,500	89,200	2000	8	2
Snorkeling	1	185,000	115,500	41,200	50	6	3

**Table 8: Diving Category TSI Value Calculation**

Parameter	Weight	Location		
		East	North	West
Coral Coverage (%)	0.375	1	3	2
Water Brightness (%)	0.15	3	3	3
Depth (m)	0.15	2	3	2
Lifeform Type	0.135	1	1	1
Coral Fish Type	0.12	2	2	2
Current Speed (cm/s)	0.07	1	3	2
<b>N Total</b>	1.00	<b>1.57</b>	<b>2.61</b>	<b>2.015</b>
<b>Category</b>		<b>Not Suitable (S3)</b>	<b>Very Suitable (S1)</b>	<b>Suitable (S2)</b>

The ACC values result for snorkeling and diving categories is shown in table 9, while for the mapping combined with the TSI results, see figure 2

**Table 9: ACC Value for Snorkeling and Diving Category**

Area Carrying Capacity	People/Day		
	East	North	West
Diving	1,088	802	357
Snorkeling	740	462	165



Infrastructure	Villages on Pahawang Island				
	Suak Buah Pahawang	Penggetahan	Cukuh Nyai	Jeralangan	
Gift Shops	x	X	V	V	X
Clean Water	v	V	V	V	V

### ***Snorkeling and Diving Ecotourism Analysis***

The calculation of the sentinel-2a imagery analysis satellite image result shows that the coral reef area on Pahawang Island is 90.35 Ha, which was dominated by fringing coral types. With this area, the abundance of marine life such as various types of fish and coral became the main attraction of the island. Contained in a book with a similar discussion in the Australian Tropical Marine Park about the Influence of Snorkeling Routes on Coral Reefs, to maximize comfort for tourists, a variety of coral types is needed so that tourists can be interested in snorkeling and diving (English & Beker, 1997).

There are diving and snorkeling locations at these 6 stations, according to observations made at 6 stations in the villages of Suak Buah, Penggetah, and Taman Nemo. Tables 4 and 5 show specific coral cover, with station 2 having the maximum coral cover at 86.20%. Eight different life forms were identified overall, including coral branching (CB), coral foliose (CF), coral massive (CM), coral submassive (CS), coral encrusting (CE), coral mushroom (CMR), coral millepora (CML), and acropora branching (ACB). These life forms have beautiful colors causing visitors to feel attracted to them. Although this island's coral cover falls into the "good" category overall, there are two stations that indicate damaged coral reefs, which are shown at stations 1 and 4. With a cover percentage of 45.60%, station 4 has the lowest coral cover. The damage took place due to harming tourist behavior, extensive fishing, and fishing bombing by local communities. However, because of the growth of new coral colonies in this area, the state of the damaged coral reefs has started to improve. Additionally, coral reef transplants can be done to improve coral reef coverage in order to take full advantage of the potential in this region in order to preserve and enhance Pahawang Island's coral reef tourist potential.

Referring to the suitability analysis for snorkeling and diving activities, the suitability index for coral reef ecotourism on Pahawang Island is classified in the "suitable" category (S2). When compared with similar research in Tuapejat, the Mentawai Islands which used a similar analysis from (Yulianda, 2007) showed that the IKW results on the southwest coast of Tuapejat were 85.19% and were categorized as "Very Suitable" (S1) (Zulfikar et al, 2011). This is because the better percentage of coral cover, visibility, and the speed of current.

The diving and snorkeling carrying capacity can accommodate 3,614 people/day. The Mentawai Islands, which cover an area of 137.02 Ha, have an

area carrying capacity of 3,139 people/day, which is more than Tuapejat's carrying capacity (Zulfikar et al, 2011). In order to sustain and prevent harm to the coral reef ecosystem, management must supervise and inform tourists and local residents about snorkeling and diving activities.

***Integrated Coral Reef Ecotourism Management***

This analysis is assessed based on amenities and accessibility. The direct observations in the research location show that the infrastructure is good enough. However, there are several conditions that need to be improved so that integrated coral reef ecotourism management can be advanced. See table 11.

From the suggestions for infrastructure development, a master plan can then be created to produce orderly improvement so that it can rise the number of tourists on Pahawang Island. See figure 3.

This figure emphasizes the necessity for thorough development in each village on Pahawang Island. A mosque has to be built in Cukuh Nyai Village so that it may provide praying facilities for tourists, especially the local population, much as in Pahawang Village and Jeralangan Village. Both villages need road repairs and buildings at various spots. These findings may be taken into consideration by management or other relevant government bodies to ensure that both the quality and quantity of ecotourism infrastructure development on this island, particularly with regarding coral reef ecotourism, continues to improve.

**Table 10: Integrated Ecotourism Suggestions**

<b>Infrastruct ure</b>	<b>Parameter</b>	<b>Suggestion</b>	<b>Development Timeline Suggestion</b>
Clean Water	Clean water availability for tourists.	It is necessary to manage and control water resources according to the principles of sustainable conservation and tourism.	First Year
Security and Health Facility	Availability for security and health services for visitors.	Repairs and construction are needed at several points. Facilities are expected to always be active and can be visited at any time and maintain good communication with related parties.	First Year
Toilet and Public Bathroom	Availability and condition of toilets and public bathrooms to support sanitation and cleanliness.	It is necessary to build and repair toilets at several points so that cleanliness and sanitation management can be more optimal.	First Year

<b>Infrastructure</b>	<b>Parameter</b>	<b>Suggestion</b>	<b>Development Timeline Suggestion</b>
Praying Facility	Availability and condition of infrastructure to support praying activities of visitors and the community	It is necessary to develop and build in each area and repair praying facilities as well as increases supporting facilities.	Second Year
Recreational Support	Availability and condition of infrastructure for visitors to refresh body and mind.	It is necessary to build parks or special sports facilities for visitors in a local culture design.	Third Year
Information Center	Availability of infrastructure for services that make it easier for visitors to obtain information about tourist destinations.	It is necessary to develop, improve services, and active management of information centers.	Third Year
Gift Shops	Availability of conditions and infrastructure for visitors to buy souvenirs	It is necessary to build a creative space that accommodates the creativity of local communities	Fourth Year
ATM and Money Changer	Availability, conditions, and services of infrastructure for tourists to carry out financial transactions.	It is necessary to provide ATMs and money changer services in each destination area.	Fourth Year
Gazebo	Availability of infrastructure for tourists to relax and embrace the beauty of the island.	It is suggested to repair and increase this infrastructure.	Fifth Year
Road	Availability and condition of infrastructure makes it easier for visitors to access the location.	It is necessary to increase and build high quality roads as access for tourists.	Fifth Year

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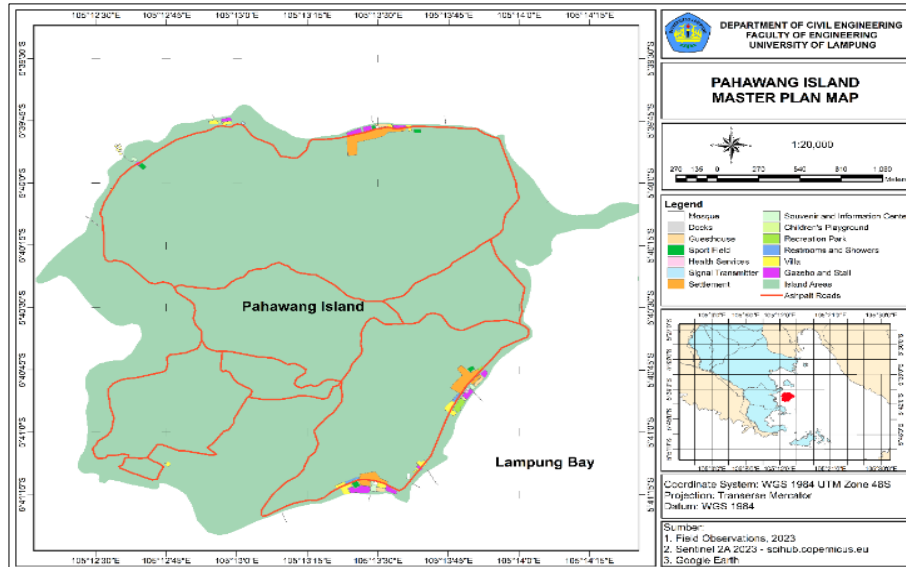


Figure 3: Pahawang Island Master Plan

## CONCLUSION

The conclusion is that, from a spatial standpoint, the suitability index and the area of snorkeling and diving ecotourism carrying capacity, as well as the supporting infrastructure, are in good condition. To enhance and advance this, integrated management and governance are necessary.

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## **IMPACT OF CHANGE ORDERS ON WASTE MATERIAL OF ROAD CONSTRUCTION PROJECT**

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### **Abstract**

Change orders in road construction project are a contributing factor to wastage, a concern underscored in recommendations for waste materials. The significant impact of change orders on waste materials becomes evident in various project phases, including implementation, handling, planning, procurement, and contractual aspects. Therefore, this research aims to explore the impact of change orders on waste materials, providing insights into the influential role across critical aspects of road construction projects. A dual approach was adopted, incorporating both interview and questionnaire methods, with the questionnaire's design established through the application of the Delphi method. The design was subsequently validated by experts following a series of tests, ensuring its effective distribution to a diverse audience, including consultants, contractors, and owners. The calculations were conducted using Factor Analysis and were analyzed with the assistance of SEM PLS 4.0. This comprehensive approach facilitated a thorough exploration of the research methodology and data analysis process.

**Keywords:** Impact of Change Orders, Waste Materials, Road Construction Project, Smart PLS 4.0, Factor Analysis.

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## **INTRODUCTION**

Change to work in construction contracts, commonly referred to as change orders, is prone to occur at any stage of the project, either at the commencement, during, or end of the project timeline. Change orders are documented agreements to modify, add, or otherwise change the work outlined in the contract document at the time of bid opening. It is crucial that any proposed change remains in the defined scope of the original project, otherwise a modification to the contract becomes essential (Fisk & W.D.Reynolds, 2014). In many construction projects, frequent design changes may negatively affect project performance, cost overruns, delays, and function failures (Ahmad Aqil Zaidi et al., 2023). The research conducted by (Waty, Sofia, Gondokusumo, & Sulistio, 2018) showed that waste materials occurred in 107 road improvement projects, primarily attributed to change orders. Subsequent research by (Waty & Sulistio, 2019) confirmed this result, recommending that reducing change orders would minimize waste materials.

Waste material significantly impacts construction project, constituting approximately 40-60% of the operation costs (Waty et al., 2018). This waste undermines project success and diminishes the profits of implementing contractors, a concern observed in various building and workshop projects in recent years. The volume of waste varies among tasks, with road project experiencing higher waste levels, such as 20% for aggregate B and A, along with other materials (Waty et al., 2018). The resultant material waste often leads to rework, accounting for 30% of expenditures in construction project (Porwal et al., 2020)

(Ismail Abdul Rahman, 2015) conducted research on the causes and effects of construction waste in Malaysia, using PLS Structural Equation Modeling (SEM). (Durdyev et al., 2018) tested data concerning labor productivity using SEM, while (Naji et al., 2022) performed research analysis on the impact of change orders on project success using PLS-SEM. Therefore, this research aims to ascertain the impact of change orders on waste materials in road construction project by applying PLS-SEM. PLS-SEM analysis was executed to test: firstly, the measurement model (was tested to validate the instruments) and secondly, the structural model (was examined to test the hypothesis). (Siti Fatimah Hashim et al., 2023)

## **RESEARCH METHODOLOGY**

This research included direct observations in the field and was achieved through interviews and discussions directly addressing the impact of change orders. Before data distribution, a Focused Group Discussion (FGD) was conducted with several experts to formulate the draft questionnaire. Trials were carried out multiple times until a pilot project was executed. The completed questionnaire was subsequently distributed to numerous proficient participants from various

competent stakeholders, including contractors, consultants, and owners. It used a comprehensive Likert scale ranging from 1 to 5, showing the extent of influence from very minimal to very significant.

***Draft Questionnaire***

Draft questionnaire assessing impact of change orders on road construction waste materials was developed, as outlined in Table 1.

**Table 1: Waste Material Variables and Indicators**

Num	Source	Causes
1	<b>Design</b>	1. Errors in contract documents. 2. Incompleteness of contract documents. 3. Ordering errors due to the selection of different product specifications. 4. Incomplete information on road design drawings. 5. Lack of coordination with contractors and insufficient construction knowledge. 6. Insufficient information on material types and sizes. 7. Uncertain quantity of required material due to improper planning.
2	<b>Procurement</b>	8. Ordering errors leading to excess or shortage. 9. Disadvantages of ordering in small quantities. 10. Procuring materials not meeting project requirements. 11. Delays in material arrival. 12. Inadequate packaging leading to waste.
3	<b>Handling</b>	13. Material damage during transportation to or at the project location. 14. Damage caused by incorrect storage of materials. 15. Careless handling during the unloading of materials for warehouse storage. 16. Unfriendly or rude attitudes and actions by the project team and the workers. 17. Incidents of theft. 18. Material damage occurring on-site. 19. Errors in spreading material in the field.
4	<b>Implementation</b>	20. Adverse weather conditions. 21. Use of incorrect material necessitating replacement. 22. Carelessness in mixing, processing, and using materials for warehouse storage. 23. Inaccurate dimension measurements to prevent excess volume. 24. Damages caused by unskilled workers. 25. Excess volume due to unclear planning.

Num	Source	Causes
		26. Reparation efforts.
		27. Delayed image distribution.
		28. Slow revision and distribution of drawings.
5	<b>Residue</b>	29. Leftover materials from the usage process.
6	<b>The others</b>	30. Inadequate control of materials on the project and management planning for residual materials.
7	<b>Behavior control</b>	31. Deviations in material scheduling control.
		32. Deviations in material cost control.

(Bossink, 1996); (Gul Polat et, 2004); (Gaviland&Reynold, 1994);(Teo & Loosmore,2001);(Ekayanake,2004); (Alwi et al, 2002)

Source: (Waty & Sulistio, 2020)

The following were the Impacts of change orders:

1. Increased project financing (Shrestha & Fathi, 2019).
2. Reduced project quality (Shrestha & Fathi, 2019).
3. Extended project implementation time (Waty & Sulistio, 2022)

### **Data Analysis**

#### *Factor Analysis*

Factor analysis was categorized into two types, namely Principal Component Analysis (PCA) and Factor Analysis (FA). Both analyses aimed to explain the structure of variations through a linear combination of the constituent variables. In essence, Factor Analysis or principal component analysis was desired to reduce and interpret data as a new variable in the form of a composite variable ( Muhammmuddin et al., 2023 ). Barlet test of Sphericity served as a statistical test to examine the hypothesis that variables were uncorrelated in the population. The accuracy of Factor Analysis was evaluated using the Kaiser-Meyer Olkin (KMO) index. It was considered suitable when the KMO value ranged from 0.5 to 1 and perceived inappropriate otherwise.

#### *Measure of Sampling (MSA)*

Measure of Sampling Adequacy (MSA) served as a comparison index among the partial correlation coefficients for each variable, facilitating the assessment of relationships. Factor Analysis was applied to streamline waste material indicators for road construction project.

#### *Partial Least Square 4.0 (PLS-SEM)*

PLS-SEM aimed to identify predictive relationships by testing the connections between constructs to determine the influence (Sarstedt et al., 2021). In this context, the analysis tested the relationship between the impact of change orders and waste materials in road construction project. PLS-SEM analysis comprised

two sub-models, namely the measurement or outer model, and the structural or inner model (Sarstedt et al., 2021).

#### *Initial Hypothesis*

The initial hypothesis showed that the impact of change orders on waste materials significantly affected various aspects, namely:

1. Material planning.
2. Material procurement.
3. Material handling.
4. Material implementation.
5. Residual material.
6. Other materials.
7. Controlling workers' behavior.

## **ANALYSIS AND DISCUSSION**

### ***Data Acquisition***

The questionnaire was returned by 700 respondents, including owners, consultants, and contractors from both the private and government sectors. Respondents had over 10 years of work experience, dominating at 63.14%, with project manager comprising 80% of the professional positions. According to (Zeng et al., 2021), the minimum number of respondents needed for research and data testing ranged from 25 to 1037, and the obtained 700 respondents were considered sufficient.

### ***Factor Analysis***

Based on Factor Analysis conducted, the following results were obtained.

#### ***Results from KMO and Barlett's***

KMO and Barlett's Test showed a result of 0.826, signifying the suitability for proceeding with Factor Analysis calculations. The significance value of 0.000 being less than 0.05, confirmed the viability of continuing the analysis. Therefore, Factor Analysis was adopted, facilitating advancement to the next step of the research.

Based on the results obtained from the Anti Image calculation, as seen in the Measure of Sampling Adequacy (MSA), all indicators were considered usable, with values above 0.5. The 32 indicators contributed to the understanding of factors causing waste materials.

#### ***Eigenvalue***

Based on the total variance results, as shown by the initial eigenvalue, it was determined that 9 factors were derived from multiple indicators, each surpassing

a value of 1. This constituted a cumulative percentage of 76.072% of the indicators contributing to the impact of change orders on waste materials, with the factors identified as follows:

1. Errors in contract documents, accounting for 11.238%.
2. Incompleteness of contract documents, representing 2.76%.
3. Ordering errors due to selecting different product specifications, accounting for 2.751%.
4. Incomplete information on road design drawings, signifying 1.759%
5. Lack of coordination with contractors and insufficient construction knowledge, representing 1.360%.
6. Insufficient information on material types and sizes in the documents, accounting for 1.261%.
7. Uncertain quantity of required material due to improper planning, signifying 1.131%.
8. Ordering errors resulting in excess or shortage, representing 1.071%.
9. Disadvantages of ordering in small quantities, accounting for 1.007%.

The results of the component transformation components showed that Factors 1 to 5 all had correlation values exceeding 0.5 and were considered feasible. Factor 6 was perceived to be not feasible, while 7 to 9 were declared feasible due to correlation values above 0.5.

Out of the 9 factors, only 8 were suitable to summarize the 32 indicators. Factor 8 could not be used as it only had 1 indicator, resulting in the application of 7 components with a total of 29 indicators. This discovery led to the change in the name and usage of the variables, resulting in the following grouping, namely Material Handling, Implementation, Contracts, Procurement, Planning, Usage, and Orders. Consequently, seven factors were considered suitable for processing in PLS-SEM, namely Factors 1, 2, 3, 4, 5, 7, and 9, generating new hypotheses as follows.

1. Impact of Change Orders on Material Handling with 3 indicators.
2. Impact of Change Orders on Material Implementation with 3 indicators.
3. Impact of Change Orders on Material Contracts with 11 indicators.
4. Impact of Change Orders on Material Procurement with 5 indicators.
5. Impact of Change Orders on Material Planning with 2 indicators.
6. Impact of Change Orders on Usage of Material with 2 indicators.
7. Impact of Change Orders on Ordering Material with 3 indicators.



**Table 2: New Waste Material Variables and Indicators**

Num	Variable/Indicator	
1	X1	<b>Handling</b>
	X1.1	Careless handling during material unloading for warehouse storage.
	X1.2	Unfriendly attitudes or actions of the project team and project workers.
	X1.3	Incident of theft.
	X1.4	Errors in field deployment.
	X1.5	Adverse weather conditions.
	X1.6	Damage caused by unskilled workers.
	X1.7	Excess volume due to unclear planning.
	X1.8	Material remaining from usage process.
	X1.9	Poor control and management planning for excess material.
	X1.10	Deviations in material scheduling control.
2	X2	Deviations in material cost control.
	X2.1	<b>Implementation</b>
	X2.2	Material damage on-site.
	X2.3	Impact of wrong storage of materials leading to waste.
	X2.4	Excess volume due to inaccurate dimensional measurements.
	X2.5	Slow revision and distribution of drawings.
3	X3	Impact of repair work.
	X3.1	<b>Contract</b>
	X3.2	Errors in contract documents.
	X3.3	Incompleteness of contract documents.
4	X4	Incomplete information on road design drawings.
	X4.1	<b>Procurement</b>
	X4.2	Impact of ordering errors resulting in excess or shortage.
	X4.3	Delay in materials arrival.
5	X5	Procuring materials not meeting project requirements.
	X5.1	<b>Planning</b>
	X5.2	Lack of coordination with contractors and insufficient construction knowledge.
	X5.3	
6	X6	Unknown amount of material required due to imperfect planning.
	X6.1	Insufficient information on material types and sizes on the contract document.
	X6.2	
7	X7	<b>Use of Materials</b>
	X7.1	Inadequate packaging leading to waste.
	X7.2	Use of incorrect material necessitating replacement.
		<b>Ordering Materials</b>
		Disadvantages of ordering in small quantities.
		Ordering error due to selecting different product specifications.

**Calculations with PLS-SEM**

In the initial model of this research, the results of stage 1 calculations identified an outer loading on indicator 7.2 did not meet the requirements, as the outer loading was below 0.6 (GHOZALI & LATAN, 2015), leading to the removal of the indicator. The model was subsequently reanalyzed, achieving outer loading satisfying all criteria. A more in-depth examination regarding multi-collinearity showed that indicator 1.7 exceeded the threshold of 5 and needed to be removed. Several additional indicators were excluded due to having VIF number exceeding 5. These exclusions were part of PLS algorithm calculations in stage 1, resulting in the generation of both outer and inner models.

**1. Outer Model**

The outer model comprised of the following compo

**Outer loading.** The outer loading results met the requirements, all being above 0.6.

**Construct Reliability.** The construct reliability results showed that Cronbach’s Alpha exceeded 0.65 and were considered acceptable ((J F Hair et al., 2019); (Sarstedt et al., 2020)

Stage 1(PLS Algorithm)

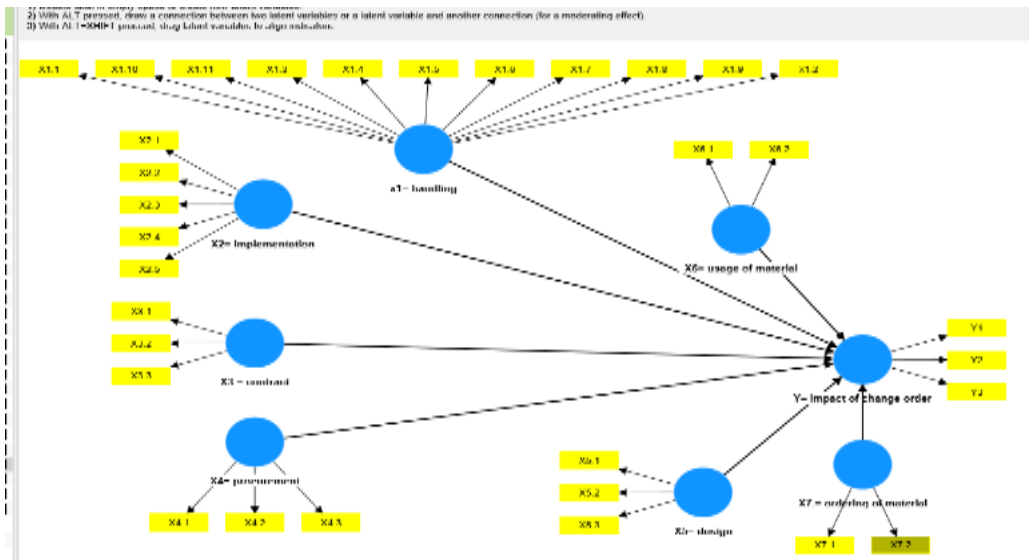


Figure 1. Initial model

**Discriminant validity** assessment included heterotrait-monotrait (HTMT) and Fornel Lacker Criterion.

**HTMT** results showed appropriateness since all were below 0.9. This outcome correlated with HTMT correlation ratio test, developed by (Henseler et al., 2016) which was used to evaluate the discriminant validity of SEM (variance-based). The test ensured the accuracy of measuring a specific correlation between two constructs. According to (Henseler et al., 2016) and (J. Hair & Alamer, 2022), for components in the model considered consistent, HTMT value had to be less than 0.90. Although HTMT value exceeded 0.9, the remaining values met the specified requirements.

**Fornel Lacker Criterion.** Fornel Lacker calculations showed that the computation of constructs X1 and X1 was higher than X1 and X2. For example, when calculating the construct X1 with X1, the result was 0.789, exceeding the comparison with X2, which was 0.514. Similarly, the calculation of construct X2 with X2 exceeded the values of X2 with X3 or X2 with X1, persisting until X7.

## **2. Inner Model**

The results of the inner model were as follows.

### **Adjusted R square**

Adjusted R square results showed a coefficient of determination of 0.733. This suggested that 73.3% of the impact of change orders on waste materials for road construction project could be explained.

According to (Chin, 1998) and (GHOZALI & LATAN, 2015), adjusted R square value of 0.67 was considered strong, 0.33 was moderate, and 0.19 was weak. Consequently, the results of this coefficient of determination showed a strong relationship, as the obtained value of 73.3% exceeded the threshold of 67%.

### **Feasibility of the Model**

The model fit results suggested that NFI was 0.626, showing a model closer to 1 was preferable. Additionally, SRMR was 0.090, below 0.1, signifying that the model was feasible.

### **Multicollinearity Test**

Multicollinearity test results showed that all indicators were below 5 (Christian M. Ringle, Marco Sarstedt, 2023). The final model for this research was depicted in Figure

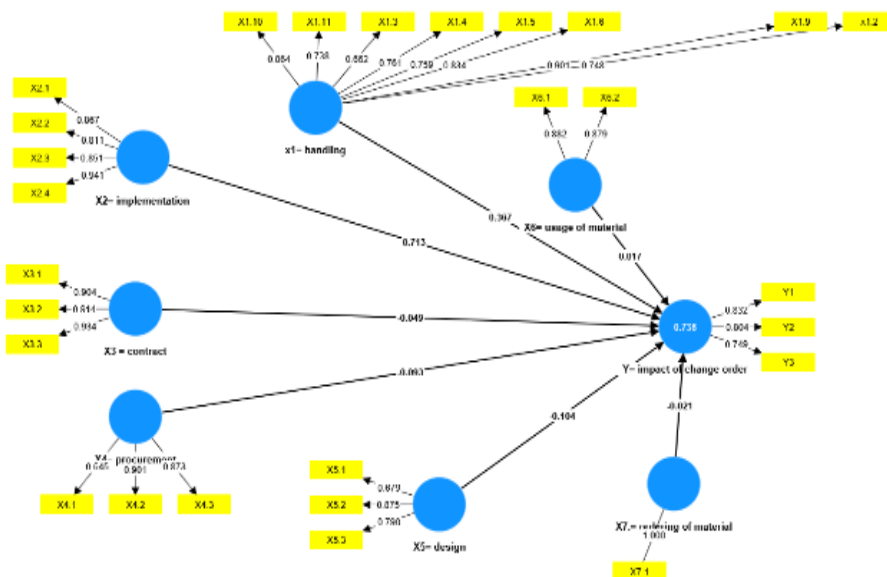


Figure 2. Final Research Model

**Bootstrapping Results (Stage 2)**

The second stage of calculation focused on examining the correlation or regression relationship of each latent variable, as shown in the following results. The specific outcomes of the relationship are presented in Table 3, focusing on the Path Coefficient.

Table 3: Path Coefficient

	Original sample (O)	Mean (M)	Standard Deviation (STDEV)	O/STDEV	P values
X2=implementation → Y=impact of change order	0,713	0,712	0,027	28,863	0,000
X3= contract → Y = impact of change order	-0,049	- 0,049	0,019	2,585	0,010
X4 = procurement → Y= impact of change order	-0,093	- 0,093	0,023	4,116	0,000
X5=design → Y =impact of change order	-0,104	- 0,104	0,024	4,377	0,000
X6= usage of material → Y = impact of change order	0,017	0,017	0,023	0,716	0,474

	<b>Original sample (O)</b>	<b>Mean (M)</b>	<b>Standard Deviation (STDEV)</b>	<b>O/STDEV</b>	<b>P values</b>
X7= ordering of material → Y = impact of change order	-0,021	-0,021	0,026	0,799	0,424
X1 = handling → Y = impact change order	0,367	0,367	0,029	12,746	0,000

The path coefficient results indicated that the regression relationship occurred as follows:

1. Handling at 0.367.
2. Implementation at 0.713.
3. Material Planning at -0.104.
4. Material procurement at -0.093.
5. Material contracts at -0.049.

Two Factors were rejected, indicating no relationship, namely Use of Materials and Ordering materials. Among the five variables with a relationship, a factor showed a strong connection, namely Implementation with a coefficient of 0.713, exceeding the threshold of 0.6 (J. Hair & Alamer, 2022). Consequently, when considering the 7 factors X, the following conclusions were obtained.

1. Five factors showed a direct and significant relationship.
2. Two factors had no direct and insignificant effect.
3. Five factors showed a significant relationship between waste material in road construction project and impact of change orders. Therefore, based on the results, five factors were identified, namely:
  1. Four X variables with a moderating effect based on the path coefficient.
    - a. Variable X1 signifying Handling (0.367).
    - b. Variable X4 indicating Design (-0.104).
    - c. Variable X5 representing Procurement (-0.093).
    - d. Variable X3 denoting Material Contracts (-0.049).
  2. One X variable with an influence based on the path coefficient
    - a. Variable X2 representing Implementation (0.713).

**PLS Predict Change Orders' Impact (CVPAT) Stage 3**

**Table 4:** PLS Predict Change Orders' Impact

	Q <sup>2</sup> predict	PLS-SEM RMSE	PLS-SEM MAE	LM RMSE	LM MAE
Y1	0,407	0,774	0,584	0,639	0,493
Y2	0,340	0,903	0,730	0,684	0,534
Y3	0,574	0,745	0,598	0,453	0,335

SEM PLS model prediction accuracy test results were presented in Table 4, where the model accuracy test showed predictions above 0.35 for two impacts in PLS Predict (CVPAT, Cross-Validated Predictive Ability Test) calculation. The impacts included Y1 (increase in project financing), Y2 (reduction in project quality), and Y3 (extended project implementation time).

Q square, used to determine the route model capacity prediction model accuracy (Joseph F. Hair et al., 2019), showed that both impacts were substantial due to change orders, with predicted capacity values of  $y_1=0.407$ ,  $y_2 = 0.345$ , and  $Y_3 = 0.574$ . The significant predictive capacity established a strong relationship, as each indicator surpassed the 0.35 threshold (Joseph F. Hair et al., 2019), both for Y1 and Y3. However, Y2 had a value of 0.34, which was close to a large predictive capacity. The model showed a substantial predictive relevance capacity for X1 to X7, contributing to a 72.9% impact of change orders regarding project waste materials, specifically Y1, Y2, and Y3.

**Hypothesis Test Results**

The results of hypothesis testing on the 7 variables were as follows:

- a. Five latent variables met the requirements, each with the respective indicators, namely:
  1. Handling with 8 indicators.
  2. Implementation with 4 indicators.
  3. Procurement with 3 indicators.
  4. Planning with 3 indicators.
  5. Contract with 3 indicators.
- b. Two variables did not meet the requirements. The total number of indicators generated that met the requirements was 21.
- c. Below were the Hypothesis test results.
  1. Impact of change orders had a significant effect on material handling.

2. Impact of change orders showed a significant influence on material implementation.
3. Impact of change orders suggested a significant effect on material procurement.
4. Impact of change orders indicated a significant influence on material planning.
5. Impact of change orders showed a significant effect on material contracts.
6. Impact of change orders did not influence material use.
7. Impact of change orders showed no significant effect on material orders.

### **Variables and Indicators Meeting the Specified Requirements**

The indicators below were arranged based on the largest to smallest t-statistic results for each variable.

1. Implementation Variable (X2) consisted of indicators ranked from highest to lowest including:
  - Slow revision and distribution of drawings (X2.4),
  - Material damage at the location (X2.1),
  - Inaccurate dimensional measurements resulting in excessive volume, and
  - Material storage errors causing material damage (X2.2).
2. Handling variables (X1) arranged from highest to lowest order.
  - Adverse weather conditions (X1.5),
  - Poor material control on the project and improper planning for remaining material (X1.9),
  - Deviations in material scheduling control (X1.10),
  - Material damage by unskilled workers (X1.6),
  - Deviations in controlling material costs (X1.11),
  - Errors in distributing materials on the field (X1.4),
  - Unfriendly attitudes or actions of the project team and workers (X1.2), and
  - Incident of theft (X1.3).
3. Material Planning Variables (X5) ordered from highest to lowest.
  1. Unknown amount of material required due to improper planning (X5.2),
  2. Lack of information on material types and sizes in documents (X5.3), and
  3. Lack of coordination with contractors and insufficient construction knowledge (X5.1).

4. Material Procurement Variable (X4) consisted of:
  - Procuring materials not meeting project requirements (X4.3),
  - Delay in materials arrival (X4.2), and
  - Impact of ordering errors resulting in excess or shortage (X4.1).
  
5. Material Contract Variable (X3) included:
  - Incomplete information on road design drawings (X3.3),
  - Incomplete contract documentation (X3.2), and the indicator analysis ranged from five highest to lowest, namely:
    1. Slow revision and distribution of drawings. This factor, identified as a major cause of change to work, led to change orders in the material implementation variable. In the research by (Valencia Livia, 2023), it was identified as a significant contributor.
    2. Material damage on-site. Damage to materials on site, categorized under the implementation variable, resulted from transportation to and from the project location, leading to waste materials, and was acknowledged as the cause of waste in (Valencia Livia, 2023).
    3. Inaccurate dimensional measurements resulting in excess volume were part of the material implementation variable to trigger change orders. The inaccuracy in dimensional measurements causing excess volume was recognized as a waste factor (Valencia Livia, 2023).
    4. Wrong storage of materials causing damage. Incorrect storage fell under the material implementation variable. The action led to the need for reordering, generating waste materials, and potential change orders. Research also stated the incorrect storage of materials as a cause of waste (Kaliannan et al.,2018)
    5. Poor control and management planning for excess material. This aspect, falling under material handling variables, resulted in change orders, rework, and construction waste (Kaliannan et al., 2018 ).

The impact of change orders on waste materials for road construction project was 73.3%. It showed a 71.3% influence on implementation, 36.7% on handling, -10.4% on design, -9.3% on procurement, and -4.9% on contracts.

## **CONCLUSION**

In conclusion, after processing and analyzing the original data, comprising 6 variables with 32 indicators, Factor Analysis was carried out. This process yielded 7 variables with 29 indicators, which were grouped and further calculated using SEM PLS 4.0, leading to a significantly improved model. The findings derived from this analysis were as follows:



1. Impact of change orders on waste materials for road construction project, analyzed from the highest to lowest based on statistical results (t-statistic) and the resulting path coefficient, included:
  - Variable X4 signifying Implementation (0.713),
  - Variable X3 representing Handling (0.367),
  - Variable X3 denoting Design (-0.104),
  - Variable X2 indicating Procurement (-0.093), and
  - Variable X1 representing Material contract (-0.049).
  
2. The impact of change orders on waste materials for road construction project was 73.3%, with an influence of 71.3% on material implementation, 36.7% on material handling, -10.4% on design, -9.3% on material procurement, and -4.9% on contracts. Additionally, the model prediction accuracy was 72.9%, resulting in the impact of change orders on increasing project financing, reducing project quality, and extending project implementation time.
  
3. There were 5 influential indicators, namely:
  - a. Slow revision and distribution of drawings,
  - b. Material damage on-site,
  - c. Inaccurate dimensional measurements resulting in excess volume,
  - d. Wrong storage of materials causing material damage,
  - e. Poor control and management planning for excess material,

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## **MOSQUE TOURISM IN THE DIGITAL AGE: EXAMINING GENERATION Y'S VIRTUAL REALITY EXPERIENCES**

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### **Abstract**

The rise in Muslim travelers and the swift evolution of virtual reality (VR) technology is fundamentally transforming the global tourism industry. This convergence underscores the immediate need for further academic exploration into the potential uses of virtual reality in the domain of Muslim tourism, creating a promising avenue for future research. In this vein, our study aims to evaluate how Generation Y perceives the concept of participating in virtual reality mosque tourism, considering both cognitive and emotional responses from this demographic's perspective. The primary goal of our research is to uncover Generation Y's genuine experiences in virtual reality mosque tourism. Our quantitative research methodology involved 100 Muslim travelers aged between 29 and 41 years. Data analysis was conducted using the IBM Statistical Package for Social Science (SPSS), encompassing both descriptive and Pearson correlation analyses. The findings of our analysis, which indicate that a significant majority of participants found the 360-degree Virtual Reality Mosque Tour enjoyable and captivating, have significant implications for understanding cognitive and emotional responses related to the intention to visit mosques in the tourism context. These findings could potentially shape the future landscape of mosque tourism, making our research a crucial contribution to the field.

**Keywords:** Mosque tourism, virtual reality, cognitive response, affective response

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## INTRODUCTION

Mosque tourism in Malaysia has witnessed a noteworthy surge, highlighting an emerging trend combining religious and cultural exploration with contemporary travel preferences (Azizan et al. 2023). Malaysia, celebrated for its abundant Islamic heritage and architectural wonders (Sukiman, 2023), has gained increasing popularity among tourists seeking a distinctive fusion of spirituality, history, and tourism. Additionally, Malaysia has witnessed a surge in curated mosque tour packages that provide comprehensive insights into religious sites' cultural and historical significance. These packages often include guided tours, informative sessions, and cultural performances, offering tourists a holistic understanding of Islamic heritage. Such curated experiences contribute to mosque tourism's appeal by providing visitors with a structured and educational context. The Malaysian government's efforts to promote religious tourism have also played a pivotal role in the upward trajectory of mosque tourism. Initiatives to improve infrastructure, enhance accessibility, and facilitate a welcoming environment for visitors have contributed to Malaysia's position as a preferred destination for those seeking spiritual enrichment.

One significant trend is integrating technology, particularly virtual reality (VR), to enhance the mosque tourism experience. Several mosques in Malaysia have begun integrating VR elements, enabling virtual tours that allow individuals to explore these sacred spaces remotely (Xian, 2019). Besides, the global pandemic heightened this innovation and has appealed to tech-savvy travelers, including the younger demographic, who seek immersive and interactive encounters. Digital media management, particularly Virtual Reality (VR), significantly enhances mosque tourism, offering immersive experiences that engage and captivate visitors in novel ways. The progress in digital media has transformed how tourists behave, making it the favored approach for travelers to plan, research, and make bookings for their journeys (Dewi et al., 2023).

In the past year, extensive research has primarily focused on the impact of mosque virtual reality on Generation Z's cognitive and affective responses, particularly regarding behavioral intention, as demonstrated by Sawari, Hussin, and Rahman (2021). This research investigates Generation Y's cognitive and affective responses toward their intention to visit virtual reality mosques for tourism purposes. Additionally, there is a significant focus on the use of virtual reality technology in the context of historical monuments, as exemplified by the development of a virtual reality use case for an interactive and multi-platform visit to the historical monuments of the city of Fez, mentioned by Maach et al. (2018).

Hence, this study aims to identify the characteristics of an authentic virtual mosque experience and analyze Generation Y's cognitive and affective responses concerning their intentions to visit. Furthermore, a recent study has explored the relationship between authentic experience, cognitive response,

affective response, and the intention to travel to the mosque. This academic discourse contributes to the growing body of knowledge regarding the application of virtual reality technology in various contexts and its potential implications for individual well-being and tourism industry practices."

## **METHODOLOGY**

This research employs a quantitative approach involving a larger sample size and a quicker data collection process. It often captures data on a surface level, overlooking a test-taker's emotional and interpretive aspects (Rahman, 2016). Quantitative research focuses on collecting data from individuals during the data-gathering stage, helping establish baseline information and reduce potential elitist bias. During the data analysis stage, quantitative data can aid in assessing the generalizability of qualitative findings and shedding new light on them (Johnson & Onwuegbuzie, 2007).

According to Xu and Felicen (2021), the quantitative approach offers the advantage of providing researchers with complex, objective data, which can be crucial in arriving at definitive conclusions. This method boasts several benefits, contributing to its popularity in research projects. Additionally, this research adopts a cross-sectional study design. As Kesmodel (2018) noted, a cross-sectional study examines a population at a specific time by gathering data from individuals within that population. This approach involves collecting data on various variables of interest from different individuals or groups within the population without following them over time (Hassandra et al., 2015). While cross-sectional studies have limitations in establishing causal relationships between variables, they serve a valuable purpose in research. In this study, the cross-sectional design will determine the influence of various variables on tourist visit intentions in 360-degree virtual reality mosque tourism.

### **Sample**

To ascertain the appropriate sample size, the initial step is to identify the population, focusing here on Malaysian Muslim tourists from Generation Y. The Generation Y population in Malaysia is of paramount interest due to its significant influence on various societal aspects. Unfortunately, specific data on the exact size of Generation Y in Malaysia is limited. Nevertheless, available sources suggest that Generation Y constituted a substantial segment, amounting to 13.44 million people or 42% of Malaysia's total population in 2018 (Memon et al., 2019; Jiang et al., 2022).

For data collection, researchers utilized a non-random sampling strategy, distributing an online questionnaire via Google Forms due to time constraints. This study seeks to assess the adequacy of a sample size of 100 responses for data analysis, aligning with Comrey and Lee's assertion that a sample size of up to 100 respondents, while considered weak, can still offer

valuable insights when analyzing extensive and informative data (Kubicová & Záhumerová, 2017). Determining an appropriate sample size is critical in research studies as it directly influences the validity and generalizability of finding.

## FINDINGS

### Descriptive Analysis

The data analysis in this part aims to identify Generation Y's authentic experience with virtual reality mosque tourism. The description is based on percentage mean values for each item underlying each specified variable.

**Table 1:** The percentages for the authentic experience

Items	Mean	Std. Deviation
Using the 360-degree VR Mosque Tour provided me with an authentic experience.	5.04	.909
Using the 360-degree VR Mosque Tour provided me with a genuine experience	5.02	1.004
Using the 360-degree VR Mosque Tour provided me with an exceptional experience	4.79	.945
Using the 360-degree VR Mosque Tour provided me with a unique experience	5.06	.972
Using the 360-degree VR Mosque Tour provided me with an interactive experience	5.07	1.056

In accordance with the data presented in Table 1 shows the mean value and standard deviation for each item under authentic experience. The item “using the 360-degree VR Mosque Tour provides me with interactive experience” was recorded as the highest with a mean of 5.07.

Subsequently, the item pertaining to “using the 360-degree VR Mosque Tour provide me with unique experience” ranks second, with a mean score of 5.06. Additionally, both items signifying “using the 360-degree VR Mosque Tour provide me with genuine experience” and “using the 360-degree VR Mosque Tour provide me with authentic experience” have garnered mean scores of 5.02 and 5.04, respectively. Lastly, it is discernible from the table that the item “using the 360-degree VR Mosque Tour provides me with exceptional experience” exhibits the lowest mean score of 4.79. Using the 360-degree VR Mosque Tour can provide tourists with an interactive experience.

**Table 2:** Cognitive response of Generation Y toward virtual reality mosque tourism

Items	Mean	Std. Deviation
I gain knowledge from using the 360-degree VR Mosque Tour	4.98	.974
Using the 360-degree VR Mosque Tour is useful for collecting information	4.86	.910
Using the 360-degree VR Mosque Tour sparked my imagination	4.80	1.005
Using the 360-degree VR Mosque Tour allows me to explore new Mosque destination	5.04	.983

Based on Table 2, “Using the 360-degree VR Mosque Tour allows me to explore new Mosque destination,” shows the highest mean of 5.04. Next, the item “I gain knowledge from using the 360-degree VR Mosque Tour” recorded 4.98. Moreover, the items “Using the 360-degree VR Mosque Tour is useful to collect information” and “Using the 360-degree VR Mosque Tour spark my imagination” with mean scores of 4.86 and 4.80 respectively. This shows that the 360-degree VR Mosque Tour allows tourists to explore new mosque destinations and gain knowledge.

**Table 3:** Affective response of Generation Y toward virtual reality mosque tourism

Items	Mean	Std. Deviation
I am completely involved in the 360-degree VR Mosque Tour	4.66	1.224
I am deeply impressed by the 360-degree VR Mosque Tour	4.96	.886
I feel spiritually connected with the 360-degree VR Mosque Tour	4.96	1.145
I am closely related to the content when using the 360-degree VR Mosque Tour	4.79	1.056
I am attached to using the 360-degree VR Mosque Tour	4.63	1.069
Using the 360-degree VR Mosque Tour is part of my life	4.63	1.268
Using the 360-degree VR Mosque Tour is essential to me	4.57	1.174
Using the 360-degree VR Mosque Tour makes me forget where I am	4.42	1.182
Using the 360-degree VR Mosque Tour is enjoyable for me	5.00	1.063
Using the 360-degree VR Mosque Tour is pleasurable for me	5.06	1.135
Using the 360-degree VR Mosque Tour keeps me relaxing	4.69	1.021



Items	Mean	Std. Deviation
Using the 360-degree VR Mosque Tour keeps me happy	4.88	1.165
When I am using the 360-degree VR Mosque Tour, I feel totally captivated	5.00	1.005
When I was using the 360-degree VR Mosque Tour, I forgot all the concern	4.77	1.013
When I am using the 360-degree VR Mosque Tour, time seems to pass very quickly	4.68	1.171

Table 3, “Using the 360-degree VR Mosque Tour is pleasurable for me where I am,” shows the highest mean of 5.06. Then, with a mean of 5.00, it was recorded for “Using the 360-degree VR Mosque Tour is enjoyable for me,” followed by “When I am using the 360-degree VR Mosque Tour, I feel totally captivated” with a mean of 5.00. Furthermore, “When I am using the 360-degree VR Mosque Tour, I forgot all concern” and “When I am using the 360-degree VR Mosque Tour, time seems to pass very quickly” recorded the mean of 4.77 and 4.68, respectively. Moreover, “I am attached to using the 360-degree VR Mosque Tour” and “Using the 360-degree VR Mosque Tour is part of my life” share the same mean of 4.63. Lastly, “Using the 360-degree VR Mosque Tour makes me forget where I am” recorded the least mean with 4.42. Based on the result, using the 360-degree VR Mosque Tour is more pleasurable and enjoyable.

### Pearson Correlation

**Table 4:** Pearson Correlations between mosque tourism

Variable	n	M	SD	1	2	3
Intention to travel to Mosque	100	4.996	.892	-		
Authentic experience	100	4.920	.889	.868**	-	
Cognitive response	100	4.780	.956	.784**	.812**	-
Affective response	100	4.774	.996	.893**	.868**	.818**

A Pearson correlation coefficient was calculated to assess the relationship between authentic experience and the intention to travel to the mosque. There was a significant strong positive relationship between the authentic experience and the intention to travel to the mosque,  $r(98) = .889^{**}$ ,  $p = 0.000$ . A Pearson correlation coefficient was computed to assess the linear relationship between cognitive response and the intention to travel to the mosque. This study reveals a strong positive correlation between cognitive response and the intention to travel to the mosque,  $r(98) > .956^{**}$ ,  $p = 0.00$ . A Pearson correlation coefficient was computed to assess the linear relationship between

affective response and the intention to travel to the mosque. This study indicates a robust positive correlation between affective response and the intention to travel to the mosque, with a correlation coefficient of  $r(98) > .996^{**}$  and  $p = 0.00$ . This study's results show a relationship between authentic experience, cognitive response, affective response, and the intention to travel to the mosque.

## **DISCUSSION**

The results obtained from the survey concerning the VR Mosque Tour indicate that most respondents have expressed agreement with using the 360-degree VR Mosque Tour to offer them an interactive experience. Additionally, these findings carry significant implications for the application of VR technology in the realm of tourism and its potential applications in various therapeutic and immersive contexts. These results are consistent with earlier research efforts that have demonstrated the potential of VR technology in providing vivid and immersive experiences (Fan et al., 2022), exemplified by using 360-degree tours in healthcare settings to alleviate preoperative anxiety (Surducan, 2023). These findings strongly suggest that integrating virtual reality technology into mosque tours can enhance visitor experiences and facilitate the dissemination of knowledge about religious sites.

Furthermore, this study shows that the 360-degree VR Mosque Tour allows tourists to explore new mosque destinations and gain knowledge. Incorporating the 360-degree VR Mosque Tour signifies a transformative avenue for tourists, offering the opportunity to explore previously inaccessible mosque destinations while acquiring fresh knowledge. This immersive experience transcends traditional boundaries, allowing visitors to engage with diverse cultural and historical aspects (Škola et al., 2020). Visually navigating these sacred spaces, tourists gain a deeper understanding of religious architecture, rituals, and the rich heritage associated with mosques. This novel approach enriches the tourism experience by providing unique insights and serves as an educational tool (Bell & Fogler, 1995), fostering cross-cultural understanding (Shadiev et al., 2021) and appreciation. Ultimately, the 360-degree VR Mosque Tour emerges as a catalyst for immersive and enlightening travel experiences.

Moreover, the study's findings suggest that employing the 360-degree VR Mosque Tour elicits a more pleasurable and enjoyable experience for participants. This positive response underscores virtual reality's immersive nature, enhancing users' engagement and satisfaction (Sann et al., 2023). The technology's ability to simulate a comprehensive exploration of mosque environments contributes to a heightened sense of enjoyment, surpassing traditional modes of engagement. As a result, the 360-degree VR Mosque Tour emerges as a compelling tool for its educational value and its capacity to elevate the overall tourism experience, providing users with a more gratifying and immersive encounter with mosque destinations.

The study's outcomes reveal a compelling interconnection between authentic experience, cognitive response, affective response, and the travel intentions of Generation Y toward mosques. This implies that the younger demographic's inclination to visit mosques is influenced by both genuine experiences and cognitive (Côté & Bouchard, 2009) and emotional responses (Gorini et al., 2009). The findings underscore the importance of creating authentic and meaningful encounters for Generation Y in mosque tourism initiatives. It is imperative that policymakers incorporate sustainable social elements into the planning procedure to ensure that these initiatives align with broader societal goals and values Taiwo, Samsudin, & Ayodele, 2021). Ultimately, these results contribute to a nuanced comprehension of the multifaceted factors shaping the travel intentions of Generation Y in the context of religious and cultural exploration.

## CONCLUSION

In summary, the confluence of rising Muslim travelers and the swift evolution of virtual reality (VR) technology are reshaping global tourism. This convergence emphasizes the imperative need for extensive scholarly exploration into the potential applications of VR in Muslim tourism, opening avenues for future research. This study, targeting Generation Y, scrutinizes their cognitive and affective responses to virtual reality mosque tourism. The quantitative methodology involving 100 Muslim participants reveals a noteworthy consensus, expressing admiration for the 360-degree Virtual Reality Mosque Tour as an enjoyable and captivating experience. These findings have substantial implications for understanding the cognitive and affective aspects influencing mosque tourism intentions, potentially shaping the future of this tourism domain.

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