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ROAD INFRASTRUCTURE DISTANCE INDICATORS AND RELATIONSHIP WITH AFFORDABILITY OF HOUSING

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ABSTRACT

This paper looks at the road infrastructure distance indicators and explores the relationship with the affordability of housing. This paper focuses on the aspect of the built environment in Malaysia, with some review of ASEAN and Asian regions. The paper aims to outline the road infrastructure indicators based on distance and find out its relationship with housing affordability. The objective of this paper is to provide road infrastructure indicators based on distance and affordability of housing. The methodology of this review paper is the implementation of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), and two main journal databases: Web of Science and Scopus. Based on the SLR conducted, the researchers have extracted seven main themes: traffic number, commute cost, vehicle mobility, travel time, workplace distance, road network distance and house desirability. The findings were then utilised in determining affordable

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housing relationships with the indicators and within the Malaysian context. The themes were then expected to become the basis for future data collection processes by the researchers.

Keywords: *Affordable of Housing, Distance, Road Infrastructure, Systematic Literature Review*

INTRODUCTION

The previous COVID-19 pandemic, which has affected the world from 2020 until 2021, has seen a significant decrease in workers commuting from their respective houses to their workplaces. This situation has been attributed to the in traffic numbers on the roads, as most workers were adopting the Work from Home policy to reduce the chance of contracting the disease. Now, as the world is recovering from the pandemic and entering the endemic phase, workers areinstructed to report back to offices and be present physically.Thus, contributes to the higher amount of traffic on the roads. Recent media reports, especially in Malaysia, have shown that traffic numbers in the Klang Valley has increased, thus contributing to the traffic jams in and out of the city centre (Zulkifli, 2022). The waiting time in traffic have grown exponentially from a typical 2 minutes per kilometre in the Klang Valley to around 5 minutes per kilometre. This has led to workers choosing to commute from their houses to their workplaces in the shortest time possible. For the purpose of this research, the researchers intend to outline the road infrastructure indicators based on distance and affordability of housing as this paper's aim. The objective of this paper is to provide the indicators as the basis for further measurement of affordable housing prices. These factors were important as residential houses with affordable prices were seen to be built further away from the city centre, with the higher distance of commuting affecting them (Chan & Adabre, 2019). This paper employs the Systematic Literature Review and aims to look at the road infrastructure indicators based on distance and its effect on affordable housing, sthe price of houses offered in Malaysia. The findings gathered will then be adopted as indicators in the next stage of data collection on chosen case studies in Malaysia. The implementation of SLR not only gives wide areas of the research scope but also helps in determining the most suitable indicators to be implemented and reviewed so that several themes can be

focused on afterwards.

LITERATURE REVIEW

The review conducted in the present study merely to obtain as many indicators for road infrastructure and how it affects the affordable housing provision and purchasing ability of people in Malaysia. These indicators based on previous research were then reviewed and analysed so that suitable and unsuitable indicator could either be included or excluded. For this SLR paper, the PRISMA system was adopted by Moher et al. (2010), and the description of the system was further elaborated and adopted by Mohamed Shaffril et al. (2019). The PRISMA system, which was primarily designed for medical studies, was peer-reviewed by an extensive number of researchers, and proven to be suitable to be implemented in various fields, including the transportation and built environment field which the researcher is focusing on. This was supported by other researchers such as Neilson et al., (2019) and Amiour et al., (2022) who adopted the SLR method in their respective research.

To get an overall comprehension of this research topic, the researchers need to review two main aspects of the research: the road infrastructure indicators based on distance and the affordability of housing. The first aspect related to road infrastructure means the actual physical infrastructure that was available on roads being built on physical lands, which can include whether public, private or even highway systems. Tokunova (2018) further cemented this idea by stating that investments conducted on road systems with various indicators are a catalyst for connectivity to places of work, leisure, education and residential. The researchers agree with this statement as, without roads, the mobility of humankind in the twenty-first century will be severely limited as people rely more and more on modern transportation to move from one point to another. In this aspect, the researchers focus more on vehicles, as this is the main transportation employed, especially in a developing country like Malaysia. Roosli et al. (2019), in their research, also supported this idea as transportation in the country is still dominated by the automobile, as compared to other forms of transportation like Bus Rapid Transit, Light Rapid Transit, Monorail, and cycling. As this situation is unlikely to change shortly, the researchers reviewed and decided to focus on the concept of the

automobile being adopted as the only transportation mode for this research. The following important aspect of this research is the incorporation of the affordable housing provision in Malaysia. The explanation for this is Below 40%, Middle 40% and the Top 20%. These classifications also differ from state to state and do not necessarily portray the same income level, such as comparing the federal territory of Kuala Lumpur and the state of Perak. The classification changes based on the actual location a person lives, and how much income they received in that particular state. Daud et al., (2022) also highlighted that affordable housing in Malaysia within that price range was affected by the policy, urban design and planning, demand and supply, the overhang of properties, financing availability, and the prices themselves. This shows that factors impeding affordable housing were abundant, and ultimately affects the population itself. Previous research, such as Masri et al. (2017), also showed that the locational aspect of the houses will affect the house prices, thus contributing to the population finding the best value for money houses that may be located further away from city centres and their workplaces. From the above statements, the novelty of this research to be conducted is to produce the road infrastructure indicators needed to measure their relationship with affordable house prices. The initial review of past researcher shows significant research gap to be filled through the implementation of this study.

In summary of the literature review, several factors affect affordable housing prices, such as their location and the road infrastructure linking the houses to the population's workplaces. Therefore, this research was carried out with the hypothetical theory that the further away houses are located, the more affordable the prices will be. This research also highlights the importance of having the road infrastructure indicators mapped out to determine their effect on affordable housing in the next study.

METHODOLOGY

As highlighted earlier, the methodology employed for this SLR is the adopted PRISMA or Preferred Reporting Items for Systematic Reviews and Meta-Analyses as developed by Moher et al. (2010). The adoption of this system helps simplify the work of the researchers and shows the important information that will be needed to be reviewed and assembled

quickly to determine the indicators used for the primary data collection stage conducted afterwards.

The researchers have identified two main databases for the review process: Scopus and Web of Science. Both databases provide a comprehensive journal collection that was peer-reviewed and consists of high-quality publications from academics all over the world. Mohamed Shaffril et al. (2019), in their research, already noted that 256 study areas were available from both databases, and the researchers confirmed this through the availability of transportation studies as well as built environment studies inside the databases. Other databases such as ScienceDirect, ProQuest and IEEE Explore were also considered, but due to the time limitation faced by the researchers, Scopus and Web of Science were selected due to their robustness in information searching and keyword searching ability for the results parameter. Both of these databases' access was provided by the affiliated university of the majority of researchers in this study which isUniversiti Teknologi MARA.

After both of the databases were selected by the researchers, now comes the aspect of identifying the prospective journals that will be incorporated in the SLR for this research topic. The search string used is outlined in table 1 below for further reference.

Table 1. Search String for the Study Topic

Database	Keyword 1	Keyword 2
WOS (Web of Science)	Road Infrastructure	House
SCOPUS	Road Infrastructure	House
	Road Indicators	Affordability

Source: Author

Based on this identification stage, the result showed around 1,294 articles based on the WOS database and 414 articles from the SCOPUS database. Both databases provided articles containing dictionaries, proceeding papers, journal papers, past researchers, book chapters and thesaurus definitions. The high number of articles obtained based on the keyword used in the topic searching section by both databases results in a high number of these articles, and the next stage of screening needed to be conducted to obtain the most relevant research materials for this research

topic.

Articles from both databases now amounted to 1,708 articles, and thus needed to be appropriately screened in this next stage of the methodology. For the first criterion of inclusion for the research, the researcher only focuses on journal papers as this is the most comprehensive literature containing empirical data and results being analysed with adequate findings. The journals chosen were all in English, and emphasis was given to articles from 2022 until 2007, providing a window of 15 years for the journal articles to be included in the research. The articles being chosen were also based on transportation studies, engineering studies, and built environment studies. Other fields obtained that were not relevant to these three main areas of study were then subsequently omitted. Based on this screening criteria, several 1,638 articles were omitted, and a total of 70 articles remained for the next screening stage. The limitation of the study includes on articles that were included in both of the databases only, and not including other sources.

In the third stage of screening, the remaining 70 articles were then reviewed through the skimming technique by the researcher, emphasising the keywords of road infrastructure indicators, distance, affordability and house prices. Based on this, 55 articles were omitted as they did not contain any empirical data analysis based on the four prescribed keywords earlier. In this final stage of eligibility, a total number of 15 articles were deemed eligible based on the criteria set out by the researcher and ready to be analysed thoroughly and rigorously. The selection process was outlined in figure 1 below.

FINDINGS AND DISCUSSION

Based on the obtained literature that was screened using the methodology outlined above, the researchers have concluded that there were seven main themes to be incorporated in the Systematic Literature review, namely relating to traffic number, cost of commute, vehicle mobility, travel time, workplace distance, road network distance and the desirability of the actual house. This has led to several findings based on the literature, and the researchers intend to discuss them according to the broken-down themes inside this research paper. The total number of papers incorporated based

on the methodology consists of fifteen articles and is deemed necessary to be discussed to derive the recommended indicators to be used in further research.

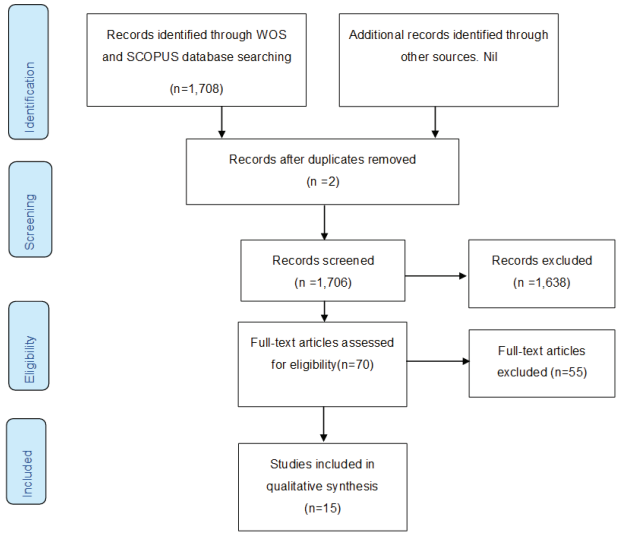

Figure 1. Diagram Flow of the Research
Adapted from Mohar et.al 2010

Theme 1. Traffic Number

This first theme is a regular occurrence in built environment factors affecting house prices that the researcher has found out in trying to determine the suitable road infrastructure indicators and how this can affect affordable house prices. Past research conducted from an Asian perspective, such as Zhao & Wei (2019) showed that high traffic number affects the prices of houses in China, especially in the region of Taiyuan, with an emphasis on the business centre, medical centres and educational facilities. This research was reviewed by the researchers agreed upon as high traffic number results in high travelling costs, and supported by research such as Kamarudin (2022) that showed high traffic number due to high vehicle ownership. Another study conducted by Ossokina & Verweij (2015) also showed that a 50% reduction in traffic density willat a 50% reduction in traffic density would result in a 1.4% increase in house price. The correlation is that less

crowded places were more desirable, thus contributing towards the higher prices of houses.

Nonetheless, this theory is more suitable towards normal urban sprawling in city centres, whereas in the Malaysian context, the largest urban area is the Klang Valley based in Kuala Lumpur, Selangor and to some extent towards Negri Sembilan. The researcher believes that for areas outside the region of Klang Valley, the prices of houses will be reduced because of its locational characteristic. This was supported by the research conducted by Masri et al., (2017) showing houses that were further away from city centres generally incorporate fewer facilities and amenities as compared to houses nearer to the city centres. The discussion on this resulted in the researchers' incorporating houses within urban areas for further research, and based on previous research, the correlation between traffic numbers and house prices is significant and will be incorporated further.

Theme 2. Cost Of Commute

Another worthwhile indicator found based on the review showed that the commute cost is another important factor to be followed up. In the year 2022, the rising cost of materials, fuel, and necessities attributed to the end of the COVID-19 pandemic burdened the livelihood of the general population in the Malaysian context and the global population generally. As major fuel producers face economic and international geopolitics difficulties, this also affects Malaysia, thus contributing to the higher cost of commuting using automobiles. Previous research such as Memon et al. (2021) sees this as a significant reason for the public to switch to public transport, alleviate traffic congestion and reduce the commute cost. This statement is suitable to be implemented if a country's public transportation system is in good condition and user-friendly, but this may not be the case in the Malaysian context. Roosli et al., (2019) state that from the year 2000 to 2010, the urban population of Malaysia increased from 10.2 million (43% of the total population) to 15 million (53% of the total population), thus showing that the country is nearing developed country status in terms of rural-urban migration theory. The higher number of people migrating to urban areas thus results in strained public transportation systems, and without proper planning and maintenance will be more of an inconvenience rather than convenience. Reporting done by automotive journalists Lim & Tan, (2021)

showed that the current active vehicles in Malaysia are around 23 million, as compared to the overall population of approximately 33 million on the latest Malaysian census estimate. Based on a simple calculation, the number of active vehicles is around 69% of the total number of populations. As with the resulting higher commuting costs and public transportation inconveniences, the population of Malaysia is seen as private vehicle dependent. Private vehicles give convenience, privacy, and social status, but ultimately led to higher costs to the population in urban and city centres as the road infrastructures cannot absorb the increased ridership. In summary for this theme, the researchers believe it will be a good indicator for the road infrastructure indicators and its effects on the affordability of housing.

Theme 3. Vehicle Mobility

In the previous theme, the cost of commute was discussed, and another theme was found: actual vehicle mobility. In the research conducted by Huang et al., (2018), it was shown in a small city centre of Singapore, the essential vehicle mobility of private vehicles was quite limited as the city centre focuses more towards reducing vehicle congestion. This research is suitable to be adapted in the Malaysian context, as urban city centre such as Kuala Lumpur also faces similar traffic congestion problems. A private vehicle such as an automobile can be rendered as not feasible when spending hours in traffic jams, compared to smaller private vehicles such as a motorcycle. Both vehicles have their advantages and disadvantages, but in terms of mobility, if traffic congestion is very high, both vehicles will be immobilised. Koryagin (2018) states that although private vehicles have more advantages, their convenience will be reduced drastically with their limited mobility in traffic congestion, and the eventual objective of transporting people from one point to another was not achieved. The researchers agree with this statement and include this indicator in further research.

Theme 4. Travel Time

Previous literature reviewed also helped to produce the next theme, the travel time of vehicles on roads. Ewing et al., (2015) have conducted in-depth research with results obtained from fifteen major cities within the United States, with the summary of shorter travel time in places with good

accessibility and vice versa. This might not be the case in the Malaysian context as places with good accessibility might result in the same congestion as the lower accessibility areas. Koryagin, (2018) argued that places with a higher distance from the city centre will result in longer travel time compared to housing areas nearby the city centre. In terms of this statement, the researchers agree with the latter as in the Klang Valley, all urban roads will eventually converge at the city centre of Kuala Lumpur. This was because Kuala Lumpur is the central financial district for Klang Valley, and is recognised as the economic capital of the country of Malaysia. The higher travel time because of the higher commute distance may contribute to the lower house prices in the suburban or rural areas, but the willingness of commuters also needed to be measured in the next further research. This idea of willingness to commute was also supported by previous research such as Valibeigi et al., (2019) and and (Koryagin, 2018).

Theme Five. Workplace Distance

As travel time was associated with the distance of houses in the previous theme, the researchers see that there was significance between the actual workplace distance for these commuters. In the Malaysian context, it is considered normal for commuters to travel on the roads for more than one hour every day in their morning and evening commute. This was supported by Rahman et al., (2015) that states Malaysian commuters usually spend excessive time travelling on roads, especially during peak hours. This condition was also seen in various urban centres around the world and is considered the norm in 2022. This snormalisation thus eventually results in commuting accidents reported by Aziz & Yusof, (2015), thus increasing the risk for commuters daily. The researchers also see that workplace distances that were too far away can have a detrimental effect on commuters as it results in higher pressure, fatigue, loss of time, loss of productivity and other increased health risks such as sitting too long in their vehicles. Thus, this indicator is an important aspect to be reviewed and brought into this research and future research.

Theme Six. Road Network Distance

The road network distance in Malaysia encompasses a total number of 144,000 kilometres based on the latest estimate by Data, (2022) and covers

both the Peninsular Region and the Borneo Region of Sabah and Sarawak. Based on this information, the Malaysian road network is considered extensive with both expressways and normal roads. Through the extensive road network coverage, the average Malaysian can commute in private vehicles from their houses to their workplaces. Hassan et al., (2021) showed that prices of affordable houses were determined by several factors such as location, accessibility and the overall income of the Malaysian household. In the research, the researchers see that for an average earning Malaysian to live comfortably, the distances taken from their houses to workplaces also increase exponentially. Previous research conducted by Saleh et al., (2017) also showed there are elements of housing mismatch in terms of affordable housing and the actual location they should be located. The previous researcher argued that lower-income Malaysian should be provided with more affordable housing near their workplaces, thus reducing the road network distance to be travelled in their daily commute, and will result in reduced commute cost. This was shown as good in theory, but applicability needs interventionist policy by the government as the private market may not be able to provide this due to lower profit margin for the development of their house. In summary, the road network distances needed to be used as an indicator as highly developed city centres results in higher house prices due to locational aspect affecting them as reported also by M. H. M. Masri et al., (2021).

Theme Seven. Houses Desirability

Based on all the outlined themes, the last theme to be included is of course based on the houses themselves. In this sense, the desirability of houses needs to be measured by respondents and conducted in further research. The concept of house desirability correlates with the actual ability to purchase them, and in this case, affordable housing is more suitable to be incorporated in the research for the average median income earners in Malaysia. Researchers such as Valibeigi et al., (2019), Narendra & Navitas, (2022) and Osman et al., (2020) in their research already showed affordable housing differs according to country, and regions in the country, such as different states due to differences in earning an income of each household. Reporting from the federal government in 2022 based on offering their affordable housing is now at the range of RM300,000 and below to be categorised as affordable housing. The issue with these affordable houses

is their availability in urban city centres is limited, and the prices offered in urban fringes were also the same due to the imposed price cap. Therefore, this makes affordable housing in city centres more desirable, as the affordable housing is located further away in the fringes. This condition was the highlight in the mismatch of affordable housing reported by Saleh et al., (2017). The researcher thus decides to include this indicator as part of the research in this review paper.

CONCLUSION

In concluding this review paper, the researchers have gone through the methodology to obtain relevant previous research to be incorporated and extracted the indicators for the eventual data collection procedure. Based on the systematic literature review conducted, seven extracted themes were deemed significant for further measurement in further research. It is important to gauge the actual sampled size afterwards, as the recommendations from further research can be sutilised by various stakeholders in determining affordable housing, with the improvement relating to road infrastructure indicators in the context of Malaysia. The themes reviewed also provided the researchers with an overall understanding of the willingness of commuters to travel long distances, endure traffic congestions, incur the high cost of travel and others. This showed that to fulfil the basic needs of owning houses that were affordable and comfortable, the average commuters were willing to endure hardships on the roads daily, taking risks that were deemed acceptable to them.

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AUTHOR CONTRIBUTIONS

All authors contributed to the design of the research, the questionnaire, and the write-up. The data extraction, data cleaning and tabulation were undertaken by Universiti Teknologi MARA and Wawasan Open University. All authors have read and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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