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Identification of Factors Affecting the Life Expectancy (LE) of Buildings in Malaysia

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Abstract

In Malaysia, building deterioration is always a national concern. Among the major causes is lack of maintenance which is further exacerbated by several factors that affect the building components throughout their life expectancy (LE). Nevertheless, given that the factors were considered dynamic in nature due to the changes in the people, process, environment, and technology surrounding the built environment's realm, a generic difference in terms of its concentration of impacts is expected. Therefore, a study on revisiting the factors of life expectancy (FLE) of buildings is conducted to identify and validate the factors that might be influential. To achieve this goal, this study used a mixed methodology; literature review through multi-layered thematic (MLT) document analysis and questionnaire survey to validate all factors that influence the LE. The findings show that there are differences in terms of FLE concentration (in rankings) towards different types of building materials (wood/timber, steel, and concrete). It is expected that the result will further help other researchers in pursuing LE numbers for building components, especially in the Malaysian context and others that share similar circumstances.

1. Introduction

The life expectancy (LE) of a building is a crucial matter that can be determined by various factors. It's a knowledge that should not be taken lightly by building owners and homeowners to prevent the upcoming losses for maintenance to cover or fix in the later days. To avoid such unpleasant surprises, it's beneficial to search for what causes the building to deteriorate faster. However, such a case has opened a suggestion to study this case to identify the factors affecting the building's life expectancy (FLE) in Malaysia. Additionally, through research conducted by [1], it is noted that the average LE were different according to building materials. Thus, it is paramount to further investigate the dynamic nature of the factor that impacted the LE regarding building materials – at least in the Malaysian context.

The concept of LE is the average number of years that consumers can expect from the house's components based on specific factors. The LE of a housing component is the period it has left before breaking, becoming damaged, needing extra maintenance, or needing to be replaced [1]. Between the ages of 10 and 12 years, it seems that a building's fabric begins to show signs of wear and tear, necessitating extensive repairs and renovations to maintain the building's economic viability [2]. Furthermore, FLE are those that may affect the LE of the house's

components, such as the impact on people, process, environment, and technology used [3]. Factors impacting life expectancy can vary not only between buildings but also inside the same structure.

For buildings in Malaysia, there are several classifications including landed-highrise buildings and residential-nonresidential buildings. For residential types, they are further classified as terrace or link houses, detached houses or bungalows, semi-detached houses, long houses, flats and apartments, condominiums, and shophouses. Additionally, there are two types of property: new-subsidiary developments. Apart, building materials for any developments are chosen based on project needs, financial constraints, aesthetic considerations, environmental concerns, and others. To design structures that are useful, long-lasting, and aesthetically pleasing, construction stakeholders have access to a vast selection of building materials. The stakeholders consist of among others; the architect who manages the owners' needs, as well as a designer, technical and construction staff, and consultants – such as structural engineers, mechanical engineers, and landscape architects [4]. On the other hand, building materials including generic items like concrete, steel, and wood were a prime selection in Malaysia's construction industry.

2. Methodology

In the study, the primary objectives are to identify the factors affecting the life expectancy of buildings and to analyse the influence of factors affecting the LE of buildings in Malaysia. A focus has been made towards several types of building materials, i.e. wood/timber, steel, and concrete. Therefore, a mixed methodology consisting of qualitative and quantitative approaches is selected (Table 1). For qualitative endeavour, document analysis through multi-layered thematic analysis (MLT) is applied to selected references mostly from the Researchgate (online repository). MLT is a process of producing result data from the filtration of a few layers with different themes. MLT is also a combination of systematic literature review and basic multiple-layer analysis [5]. As for the research, four (4) layers of filtration have been made – details can be perused in Fig. 1.

Meanwhile, the subsequent quantitative method of questionnaire surveys is conducted to randomly selected construction practitioners including developers/clients, consultants, contractors, manufacturers, and suppliers who reside within the southern region of Peninsular Malaysia. To ease the process, an online questionnaire using Google Forms is selected. Several constructs were conceptualized including the background of the respondent, the impact of life expectancy, and other variables influencing LE in Malaysia will all be included. The threshold of the respondents' number is 30 before the analysis process begins through SPSS.

Table 1 *Summary of the research methodology*

Obj.	Approach	Analysis	Tool	Result
1	Qualitative	Document analysis - Descriptive	MLT	List of FLE
2	Quantitative	Questionnaire analysis - Descriptive	SPSS	Rankings of FLE

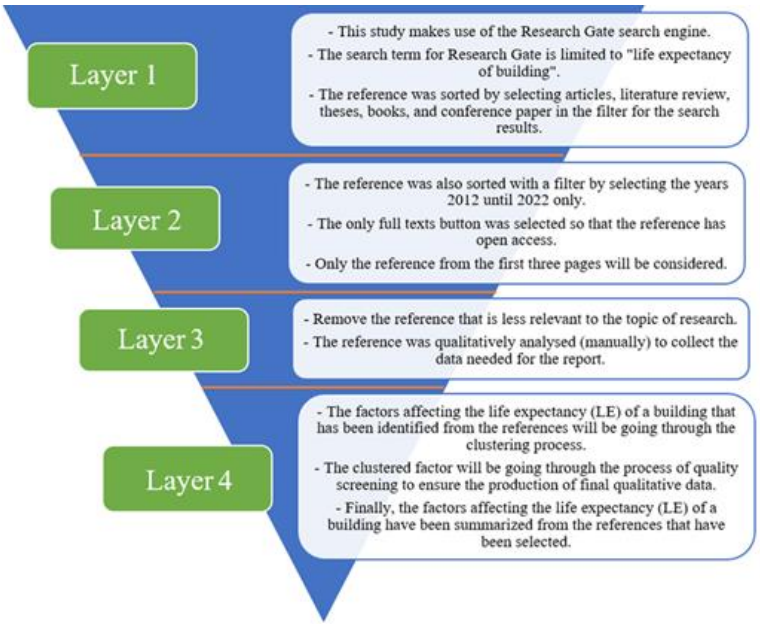

Fig.1 *Summary of the research MLT layers*

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3. Results and Discussion

The first objective of this study was to identify the factors that affect the life expectancy of buildings in Malaysia. The list of factors affecting the life expectancy of Malaysian buildings was obtained as a result. These factors played a significant role in achieving the second objective, which involved analyzing the influence of factors on building life expectancy based on the type of material used. It is worth noting that the buildings under consideration were constructed using three different materials: wood, steel, and concrete. Table 2 summarises the findings from the qualitative exercises – the research concludes on eight (8) major factors, consisting of, Weather and Climate Conditions, Design, Maintenance and Replacement, Intensity of Use, Quality of Materials and Products, Technological Obsolescence, Workmanship, and Insects Damage.

Table 2 *Summary of the FLE (according to frequency)*

No.	Factors List (from) [1][2][4][6][7][8][9][10][11][12][13][14][15][16][17][18]	Frequency
1	Maintenance and Replacement	12
2	Design	11
3	Technological Obsolescence	10
4	Quality of Materials and Products	8
5	Workmanship	8
6	Intensity of Use	8
7	Weather and Climate Conditions	7
8	Insects Damage	4

Meanwhile, for the second objective, complete feedback from 31 respondents has been collected. They consist of Construction Clients, Contractors, and Consultants (Table 3). Their responses were collated and further differentiated according to the building material, i.e. wood/timber (Table 4), steel (Table 5), and concrete (Table 6). According to Table 4, the factor that has the greatest impact on the life expectancy of wood/timber buildings with the highest mean value (3.7097) is weather and climate change, followed by the quality of materials and products. On the other hand, technology obsolescence, with a mean value of 3.000, represents the lowest rating among the factors considered. Apart, Table 5 (steel) shows the highest mean value received is the quality of materials and products, which is 3.6774. While the factor with the smallest mean is insect damage with a value of 2.1613 - the least favourable opinion out of the other factors. Finally, for the concrete-based building, Table 6 shows the highest mean value is the quality of the materials and the product (3.7097) and the least is the insect damage factor, which has a mean value of 2.2581.

Table 3 *Summary of Respondents*

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Client	6	19.4	19.4	19.4
	Contractor	16	51.6	51.6	71.0
	Consultant	9	29.0	29.0	100.0
	Total	31	100.0	100.0	

Table 4 *Data for Wood/Timber Building*

	Weather and Climate Change	Design	Maintenance and Replacement	Quality of Materials and Product	Intensity of Use	Insects Damage	Technological Obsolescence	Workmanship
Mean	3.7097	3.0323	3.2903	3.7097	3.3548	3.4194	3	3.4839
Median	4	3	3	4	3	4	3	4
Standard Deviation	1.0064	1.1686	1.2435	1.2164	1.0816	1.0886	1	1.1796
Ranking	1	7	6	2	5	4	8	3

Table 5 *Data for Steel Building*

	Weather and Climate Change	Design	Maintenance and Replacement	Quality of Materials and Product	Intensity of Use	Insects Damage	Technological Obsolescence	Workmanship
Mean	3.2903	3.0968	3.1613	3.6774	3.2903	2.1613	3.0323	3.5484
Median	3	3	3	4	3	2	3	4
Standard Deviation	1.1887	1.1062	1.0984	1.3263	1.1013	1.0032	0.9123	1.0595
Ranking	4	6	5	1	3	8	7	2

Table 6 *Data for Concrete Building*

	Weather and Climate Change	Design	Maintenance and Replacement	Quality of Materials and Product	Intensity of Use	Insects Damage	Technological Obsolescence	Workmanship
Mean	3.3226	3.2258	3.129	3.7097	3.2903	2.2581	3.0323	3.4839
Median	3	3	3	4	3	2	2	4
Standard Deviation	1.1072	1.0555	1.0244	1.0064	0.9728	1.0032	0.8932	0.9616
Ranking	3	5	6	1	4	8	7	2

To add value to the research findings, the respondents were asked if the are any other factors that impact a building's LE. It was discovered that most of the respondents answered no but some of them think that life span, use and time, natural disasters, modification to the material, finances and many more are other factors that can impact the LE (Fig. 2). Although some of the open-ended responses were debatable, nevertheless, further investigations are needed to confirm the said responses.

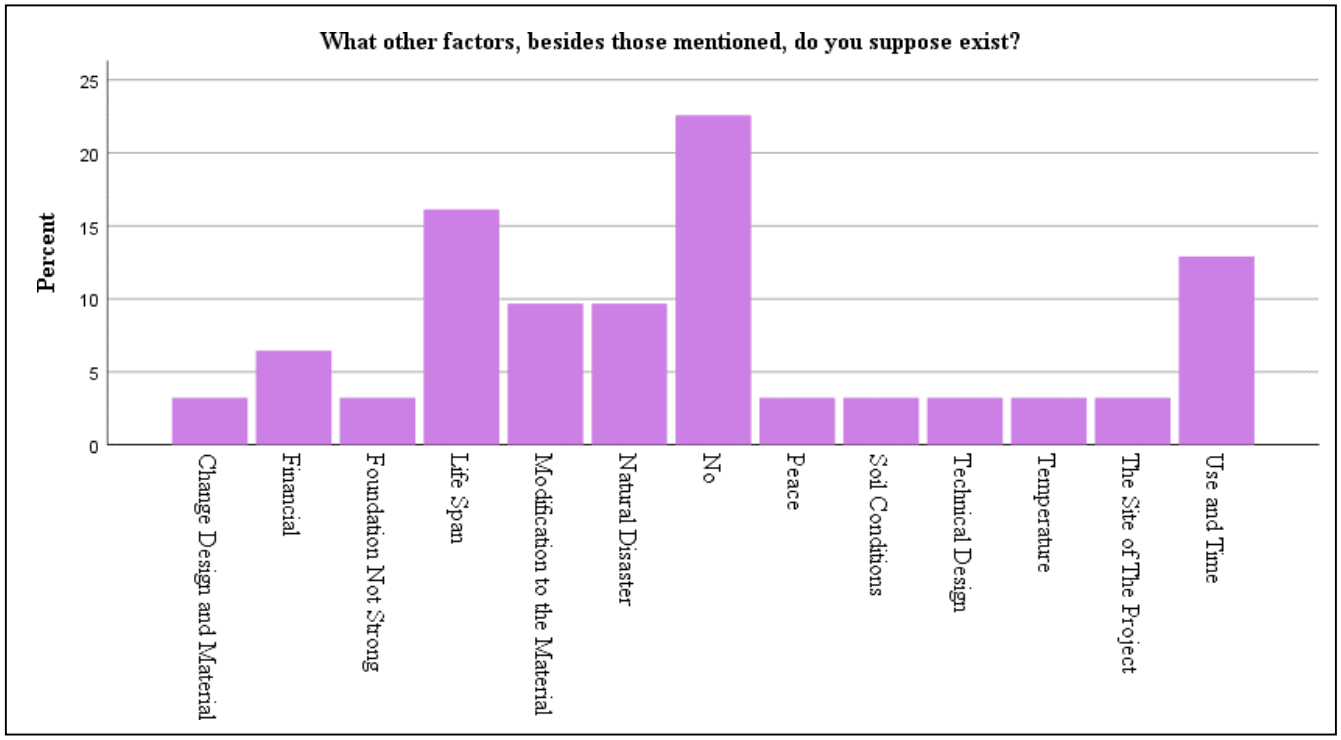

Fig. 2 *Percentage of the respondent answers*

4. Conclusion

In conclusion, the findings show that there are eight (8) generic FLEs according to numerous references. Notwithstanding its frequency of references, differences in terms of FLE concentration (in rankings) towards different types of building materials (wood/timber, steel, and concrete) were evidence. Therefore, a conjecture in determining the average LE should take into consideration the impact of those factors – an average LE is not average if it is based on the building materials only. It is expected that the result will further help other researchers

in pursuing LE numbers for building components, especially in the Malaysian context and others that share similar circumstances.

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Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of the paper.

Author Contribution

The author confirms sole responsibility for the following: study conception and design, data collection, analysis and interpretation of results, and manuscript preparation.

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