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A PRELIMINARY STUDY ON THE RELEVANCY OF SUSTAINABLE BUILDING DESIGN TO COMMERCIAL PROPERTY DEPRECIATION

W. N. W. Rodi[1,*], A. I. C. Ani[1], N. M. Tawil[1], K. H. Ting[2] and N. M. Mahamood[2]

[1]Department of Architecture, Faculty of Engineering and Built Environment, UniversitiKebangsaan Malaysia (UKM), 43600Bangi, Selangor, Malaysia

[2]Centre of Real Estate Research (CORE[Research]), Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia

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ABSTRACT

This preliminary study aims to explore the relationship between sustainable building design paradigms and commercial property depreciation, to assist in the understanding of sustainable building design impact towards commercial building value and rental depreciation. This study employs the qualitative method and analyses valuers' current perception of sustainable design and depreciation issues in Malaysia. The findings present evidence that the eleven factors of sustainable building design paradigms are relevant to commercial property depreciation and obsolescence as agreed by the sample as a whole. Nevertheless, the level of relevancy varied from one factor to another with sustainable HVAC system, sustainable building status and

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Author Correspondence, e-mail: hishamuddinrodi@gmail.com

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1. INTRODUCTION

1.1. Research Background

The rise of sustainability in built environment has contributed to the enhanced performance in the commercial property sectors. The increase of global awareness on the impact of global warming and depletion of natural resources [1-2] forces the policymakers and relevant authorities to find ways to reduce the negative impacts and to improve the quality of life for building occupants. Buildings are one of the main contributors to greenhouse emissions, accounting for approximately 20% [3]. Since conventional buildings consume large quantity of resources such as water, land, energy and raw materials during construction and operation [4], the introduction of sustainable buildings in the early nineties was expected to reduce these impacts by minimising on-site degradation, promoting the efficient use of natural resources and recycling construction waste [5] while enhancing the performance of buildings in terms of effectiveness and efficiency [6].The increased contribution of property sector to the economy of developing and undeveloped countries calls for the attention of sustainable buildings [7]. Commercial properties in Malaysia especially the office buildings has seen a drastic increase in the existing stock. According to Malaysia's Property Market Report, the total space for purpose built office (PBO) space in Malaysia has increased significantly from 19,553,129 square meters in 2014 to 20,131,812 in 2015. In Kuala Lumpur alone, there was an increase of 185,306 square meters of PBO in 2015 from 8,097,642 square meters in 2014. The introduction of sustainable or green buildings in 2009 has brought in a new generation of PBO to Malaysia's office space generally and Kuala Lumpur specifically. There were 15 PBO with green building certification out of 76 office buildings in 2015, concentrated in Kuala Lumpur Golden Triangle area (KLGTA).

In general, the issues of sustainability and obsolescence is of increasing importance due to the growing concern over the accelerated depreciation and obsolescence for non-sustainable building [8]. The downgrading of buildings due to the impact of depreciation and obsolescence may have originated from the introduction of sustainable buildings features and benefits in the commercial property market. These negative impacts may contribute to the faster rate of depreciation for standard commercial buildings in the property market. Although, there is a lack of research on the impact of sustainability on depreciation and obsolescence on commercial properties. The element of sustainability obsolescence is an important aspect of debate due to the changing requirements of buildings and increasing perspective of stakeholders towards the benefits of sustainability in buildings [9]. In the course of this preliminary study, this paper investigated to what level of relevance do the Malaysian valuers view the sustainable design paradigm to commercial property depreciation. Since property valuer has the necessary experience and knowledge about market value and rental of a commercial building in Malaysia, their views and information are needed in this particular rising matter.

1.2. Issues of Sustainable Depreciation and Obsolescence

Pioneering studies have found out that depreciation reduces the rental rate for commercial properties by 1.0% in 1981 [10], 3.3% [11] and 1.0% [10] in 1985, 2.7% [12] and 0.92% [13] in 1986, 2.2% [14] in 1996 and 2.45% [15] in 1999. The overall rental rate depreciation for UK offices between 1994 to 2009 was at 0.8% per annum [16]. According to [17], depreciation is defined as "the rate of decline in rental/capital value of an asset (or group of assets) over time relative to the asset (or group of assets) valued as new with contemporary specification".

This study has several issues for the standard building as a result of the introduction of sustainable buildings in the commercial real estate market. Firstly, standard buildings may experience technological obsolescence due to the inability to keep updated with the latest technology of sustainable buildings such as energy and water efficient features. Technological obsolescence occurred when building components and electrical systems are obsolete and inefficient [18].

With the introduction of sustainable buildings to the market, there is an improvement towards current building features and technologies standard. Existing building stocks that are irresponsive to these changes will experience loss of functions, technology and value [16]. Also, the functionality of buildings may reduce substantially that in turns increased the risk of losing tenants as a result of sustainability obsolescence [19] as they will search for other premises that can cater their occupancy needs. Not surprising that sustainable building is attractive to tenants as it provides lower operating cost and healthier indoor environmental against the standard building [20-21] originating from the updated technologies.

Standard assets could not compete in functionality, technology and usage with sustainable buildings. Building brand and image contribute to company's choice of office space [22] and influence the obsolescence of office building [23-24]. Standard buildings will suffer the loss of image and reputation with the introduction of a new green building grading system in Malaysia such as the Green Building Index (GBI) classifications, GreenRE ratings and Malaysian Carbon Reduction and Environmental Sustainability Tools (MyCREST) star ratings. Eco-label possesses marketing advantages to commercial buildings [25] and improved image [26-27]. On the other hand, conventional buildings without this recognition are viewed as a secondary class of structures. Thus, their reputation will fall short behind the sustainable buildings thus reducing its' investment potential of generating a higher return.

1.3. Review of the Sustainable Design Elements in Building

As discussed earlier, theinnovative and cutting-edge sustainable designs position sustainable buildings on a higher quality rating, separating it from standard buildings. There is a need to assess the buildings individually to identify the influence of sustainability on depreciation [28] as it influences the components of risk premium and property's cash flow model [29]. Therefore, it is crucial that the quality of sustainable or green buildings be represented by its' passive and active design. Review of literature for sustainable building suggests that active and passive design may drive the rental depreciation of commercial buildings.

Firstly, passive design strategy consists the use of green construction materials [5, 30]; low emissivity (Low-E) glass [1, 31] and, double glazing glass [31-33]; wall insulation from natural resources [4, 32, 34], low VOC paint or flooring [1, 4-5]; sustainable shape, orientation and envelope [35-36]; substantial use of day-lighting [37-38]; eco-void wall system, vertical pillars and external louvers [39]. In addition, for site and soil passive strategy, sustainable building has proper orientation to reduce solar penetration and glare [33, 40-42]; located near to mass transit, bicycle and pedestrian-friendly site [4-5, 19, 43]; consideration of seasonal and daily pattern of sun, wind-flow, shade pattern and water [4, 32]; sited in sedimentary rock and low noise level site or using soundproofing materials for high noise level site [32].

Furthermore, the sustainable building uses drought resistance grasses and native plants [4-5, 32]; specialised paving materials [5, 37]; water retaining pavements [39]; green roofs [19, 33, 41, 44-45]and green walls [41, 46-47]. Sustainable building also maximises the use of daylighting and natural ventilation through Atrium or Atria [5, 27, 31, 42]. Finally, sustainable building status such as green label and green ratings [19, 48-50] are also considered in the passive design strategy as it influenced the depreciation of property assets.

The Active design paradigm on the other hand, consists of Building Automation System (BAS) [33, 51-52]; Energy Management System (EMS) [37, 39]; Individual control for HVAC [4], Intelligent building control for HVAC [32]; Energy efficient and properly designed air conditioning systems and chiller plant system [1, 4-5, 34, 36,51]; Variable Air Volume (VAV) system [31, 36, 53-54]; Hybrid ventilation system [4, 42]; Daylight-responsive control and motion sensors lighting [1, 31, 33, 51]; Energy efficient tubes or LED light and high frequency or dimming ballasts [33, 37, 39, 51, 55].

Similarly, sustainable building is equipped with Water-efficient plumbing fixtures [1, 33, 37-38]; Gray water recycling system [4, 34, 37, 56]; Rainwater harvesting system [4, 28, 37-39]; Separate water meter connected to EMS [37]; Environmental Tobacco Smoke (ETS) system [37, 55, 57]; Carbon dioxide (CO_2) and Carbon monoxide (CO) monitoring and control system [37, 57]; Building Applied Photovoltaic system (BAPV) [19, 33, 39,58] and Building Integrated Photovoltaic (BIPV) system [1, 37, 59-60]. In summary, there are 52 design elements that are used as a proposed sustainable design framework for this study.

2. METHODOLOGY

Sixproperty valuers in the field of commercial valuation and property management were appointed to provide their perception on the relevancy of the sustainability design elements in impacting depreciation to commercial property. These experts were selected from the list of registered valuers and probationary valuers provided by the Board of Valuers, Appraisers and Estate Agents Malaysia.

Prospective participants were informed through a letter explaining the purpose of the study and to notify them that structured interview on sustainable depreciation and obsolescence would be approaching. Agreed participants were requested to provide the date and time for interview sessions and settings. During the interview, the participants were given 52 items of the sustainable design variables that might influence the depreciation of commercial property. The item pools were developed from the review of literature.

The participants were instructed to conduct relevancy analysis of each item by indicating whether the item can be used to measure the target construct. They were asked to rate each itemin the form of 'very relevant,''relevant,' 'moderately relevant,' 'slightly relevant' or 'not relevant' to the target construct based on their perspectives. The session for each reviewer were conductedseparately and they were not informed of the results by other participants. Participants were given a souvenir as a compensation for their time and effort in participating in this research study.

This study employs a qualitative approach using the interview as a means for data collection. The structured interview questionnaire was developed to collect information on the sustainable design elements construct and factors potentially associated with the rental income depreciation and obsolescence of commercial office buildings in Malaysia. For the purpose of this study, depreciation was defined as the rate of decline in rental value of an asset (or group of assets) over time relative to the asset (or group of assets) valued as new with the contemporary specification [17] and was included in the questionnaire for the participants.

The structured interview questionnaire included the subsets of items developed from literature and divided into two sections; Section A and B. Section A focuses on the relevancy assessment of sustainable design constructs, having 52 question items using five-point Likert scale in the form of 'very relevant', 'relevant', 'moderately relevant', 'slightly relevant' or 'not relevant'. Section B solicits demographic-related questions such as gender, job designation, working experience in the real estate sector. Understanding on commercial property sector in general and sustainable building questions was also included to observe their knowledge perception. Close-ended questions were used, whereas the participants were asked to select among the multiple choices.

3. RESULTS AND DISCUSSION

Descriptive statistics such as frequency, mean and standard deviation were used to analyze both sections in this questionnaire survey. The use of descriptive statistics was justified since this study is not a hypothesis testing study [61] and preliminary as in pilot study research should only perform the descriptive statistics [62-63] to clarify the purpose of certain incident or situation. Additionally, this type of analysis is straightforward and easily understood by the reader [64]. This study employs the IBM SPSS Statistics 20 software to conduct the analysis of data.

3.1. Participant's Background

The summary of the participant's background is shown in Table 1. The number of participants was dominated by a male group with 67% compared to the female counterpart. All respondents were recorded having more than five years of experience working in the real estate sector related professions. Likewise, all of the participants was observed knowledgeable in general commercial property sector and sustainable commercial buildings in Kuala

Lumpur.

Table 1. Participants' background data

Item	Particular	Frequency	%
Gender	Male	4	66.7
	Female	2	33.3
	n	6	
Working Experience (years)	More than 5 years	6	100
	n	6	
KL Commercial Property Sector knowledge	Knowledgeable	2	33.3
	Somewhat Knowledgeable	4	66.7
	n	6	
KL Sustainable Commercial Building	Knowledgeable	2	33.3
	Somewhat Knowledgeable	4	66.7
	n	6	

3.2. Ranking of Relevant Sustainable Design Items Relevant to Depreciation

Mean analysis provides insight into the ranking of the most relevant to less relevant sustainable design items that contributes to commercial property depreciation. Table 2 and Table 3 highlight the summary of mean, standard deviation and ranking for sustainable design paradigm based on the perception of participants. Firstly, Table 2 depicts the results for Sustainable Status, Materials, Presentation and Finishes and Design Configuration.For sustainable building status factor, the leading ranking is sustainable ratings with a Mean of 4.17 (SD = 0.75) followed by a sustainable label with a mean obtained 4.00 (SD = 0.00).

With a total average score of 4.09, conclusively there is a strong relationship between the sustainable status factor and commercial property depreciation and obsolescence. Secondly, for materials, presentation and finishes factor, the top ranking is Low emissivity glass (M = 3.83, SD = 0.75), followed by low-VOC carpet and flooring (M = 3.50, SD = 1.05) and Double glazing glass (M = 3.33, SD = 1.03). The lowest ranking factors with the mean of 3.17 (SD = 0.75), 3.17 (SD = 0.98) and 3.00 (SD = 0.63) were the used of Green materials [70-72] for construction, Sustainable wall insulation and Low VOC paint.

Table 2. Mean number and ranking for sustainable status, materials, presentation and finishes and design configuration

Main Factor	**No.**	**Sub-Factor**	**N**	**M**	**SD**	**Within Group Ranking**	**Main Factor Ranking**
Status	1.	Sustainable Label	6	4.00	0.00	2	2
	2.	Sustainable Ratings	6	4.17	0.75	1	
		Total		4.09			
Materials, Presentation and Finishes	3.	Used of Green Materials	6	3.17	0.75	4	11
	4.	Low Emissivity Glass	6	3.83	0.75	1	
	5.	Double Glazing Glass	6	3.33	1.03	3	
	6.	Sustainable Wall Insulation	6	3.17	0.98	4	
	7.	Low VOC Paint	6	3.00	0.63	5	
	8.	Low VOC Carpet/Flooring	6	3.50	1.05	2	
		Total		3.33			
Sustainable Design Configuration	9.	Extensive Use of Atrium/Skylight	6	3.67	0.52	2	8
	10.	Sustainable Building Shape	6	3.67	0.52	2	
	11.	Sustainable Building Envelope	6	4.17	0.75	1	
	12.	Design promoting the use of Daylighting	6	4.17	0.41	1	
	13.	Eco Void Walls	6	3.67	0.82	2	
	14.	Vertical Pillars	6	2.83	0.98	4	
	15.	External Louvers	6	3.50	0.84	3	
		Total		3.67			

The overall mean of 3.33 for materials, presentation and finishes factor suggests a less relevance level to commercial property depreciation and obsolescence. Thirdly, within the Sustainable design configuration factor, the highest ranking are the sustainable building envelope (M = 4.17, SD = 0.75) and design that promote daylighting (M = 4.17, SD = 0.41), followed by an extensive use of atrium or skylight (M = 3.67, SD = 0.52), sustainable building shape (M = 3.67, SD = 0.52) and Eco-void walls (M = 3.67, SD = 0.82). The lowest rank with means of 3.50 (SD = 0.84) and 2.83 (SD = 0.98) are the external louvers and vertical pillars. In general, with a total mean of 3.67, sustainable design configuration factor has a moderate relationship to depreciation and obsolescence.

Table 3 depicts the results for Site and soil characteristics, Rooftop andon-site greenery. For Site and soil characteristics, the top ranking are dominated by five elements including Sustainable site orientation (M = 4.00, SD = 0.63), Site near to mass transit (M = 4.00, SD = 0.89), Non-toxic soils (M = 4.00, SD = 0.63), Low risk of landslide (M = 4.00, SD = 0.63) and Low noise level or provide soundproofing materials (M = 4.00, SD = 0.89). Next ranking are designated to Consideration for shade pattern (M = 3.83, SD = 0.41), Non-spongy soils (M = 3.67, SD = 1.03) and Consideration forseasonal & daily sun pattern (M = 3.50, SD = 0.84). Although, the lowest rank consist of Consideration of wind flow (M = 3.33, SD = 0.82) and Consideration of water around and through site (M = 3.33, SD = 0.52). With the average total mean of 3.76, it shows that there is a moderate relationship between the sustainable site and soil characteristics and depreciation and obsolescence.Lastly, the highest ranking item from the rooftop and on-site greenery consist of Water retaining pavements with the mean obtained 4.00 (SD = 0.89), followed by Green walls (M = 3.70, SD = 1.03), High solar reflectance paving materials (M = 3.50, SD = 0.84) and Green roofs (M = 3.50, SD = 0.84). The use of Drought-resistant native plants item is the lowest ranking with the mean obtained 3.00 (SD = 0.89). With a total mean of 3.54, it shows that rooftop and on-site greenery factor is moderately relevant to depreciation.

Also, the results for Active sustainable design paradigm whereas consists of six main factors are depicted in Table 4 and Table 5. In Building system, both subfactors; Building Automation System (BAS) and Energy Management System (EMS) with mean obtained 4.00 (SD = 0.89) and 4.00 (SD = 0.89) dominate the highest ranking. In brief, building system factor is strongly relevant to depreciation with a total mean of 4.00. Secondly, HVAC system for sustainable buildings was also analyzed to obtain the mean for six items falls under this feature.

Table 3. Mean number and ranking for sustainable site and soil characteristics and rooftop and on-site greenery

Main Factor	No.	Sub-Factor	N	M	SD	Within Group Ranking	Main Factor Ranking
Sustainable Site and Soil Characteristics	16.	Sustainable Site Orientation	6	4.00	0.63	1	6
	17.	Site Near to Mass Transit	6	4.00	0.89	1	
	18.	Pedestrian/Bicycle Friendly Site	6	3.67	0.82	3	
	19.	Consider Seasonal and Daily Sun Pattern.	6	3.50	0.84	4	
	20.	Consider Wind Flow Around and Through Site	6	3.33	0.82	5	
	21.	Consider Shade Pattern	6	3.83	0.41	2	
	22.	Consider Water Around and Through Site	6	3.33	0.52	5	
	23.	Non-toxic Soils	6	4.00	0.63	1	
	24.	Non-Spongy Soils	6	3.67	1.03	3	
	25.	Low Risk of Landslide	6	4.00	0.63	1	
	26.	Low noise level or provide soundproofing materials	6	4.00	0.89	1	
		Total		3.76			
Rooftop and On-site Greenery	27.	Drought Resistant native Plants	6	3.00	0.89	4	9
	28.	High Solar Reflectance Paving Materials	6	3.50	0.84	3	
	29.	Water Retaining Pavements	6	4.00	0.89	1	
	30.	Green Roofs	6	3.50	0.84	3	
	31.	Green Walls	6	3.70	1.03	2	
		Total		3.54			

The results suggest that the highest ranking are the Energy efficient HVAC (M = 4.50, SD = 0.84) and properly design HVAC (M = 4.50, SD = 0.84), followed by the Intelligent control (M = 4.17, SD = 0.75) and Hybrid ventilation system (M = 4.00, SD = 0.89). The lowest rankings are the Variable air volume (VAV) and Individual control for Air Conditioning with mean obtained 3.83 (SD = 0.75) and 3.67 (SD = 0.82). Overall, HVAC systems for sustainable buildings is strongly relevant with a total mean of 4.11.

Table 4. Mean number and ranking for sustainable building system, HVAC and lighting system

Main Factor	**No.**	**Sub-Factor**	**N**	**M**	**Within Group Ranking**	**Main Factor Ranking**
Building System	32.	Building Automation System (BAS)	6	4.00	1	3
	33.	Energy Management System (EMS)	6	4.00	1	
		Total		4.00		
HVAC System	34.	Individual Control	6	3.67	5	1
	35.	Intelligent Control	6	4.17	2	
	36.	Energy Efficient HVAC	6	4.50	1	
	37.	Properly Design HVAC	6	4.50	1	
	38.	Variable Air Volume (VAV)	6	3.83	4	
	39.	Hybrid Ventilation System	6	4.00	3	
		Total		4.11		
Lighting System	40.	Daylight Responsive Control	6	4.00	2	5
	41.	Motion Sensor Control	6	4.12	1	
	42.	Energy Efficient Light Tubes	6	4.00	2	
	43.	High Frequency/ Dimming Ballasts	6	3.50	3	
		Total		3.91		

For the lighting system factor, the leading ranking is the Motion sensor lighting control with a mean obtained 4.12 (SD = 0.98), followed by Daylight Responsive Control (M = 4.00, SD = 1.26) and Energy Efficient Light Tubes (M = 4.00, SD = 0.89). High Frequency or Dimming Ballasts falls under the lowest ranking with a mean of 3.50 (SD = 1.05). Conclusively, with a total mean of 3.91, lighting system factor is moderately relevant to commercial property depreciation and obsolescence.

Table 5. Mean number and ranking for water conservation design, indoor environmental monitoring system, and on-site renewable energy system

Main Factor	No.	Sub-Factor	N	M	Within Group Ranking	Main Factor Ranking
Water Conservation Design	44.	Water Efficient Plumbing Fixtures	6	4.17	1	4
	45.	Gray Water Recycling	6	3.83	3	
	46.	Rain Water Harvesting	6	4.00	2	
	47.	Separate Water Meter connected to EMS	6	3.67	4	
		Total		3.92		
Indoor Environmental Monitoring System	48.	Environmental Tobacco Smoke System (ETS)	6	3.17	2	10
	49.	Carbon Dioxide (CO2) monitoring system	6	3.67	1	
	50.	Carbon Monoxide (CO) monitoring system	6	3.67	1	
		Total		3.50		
On-site Renewable Energy System	51.	Building Applied Photovoltaic (BAPV) system	6	3.83	1	7
	52.	Building Integrated Photovoltaic (BIPV) system	6	3.67	2	
		Total		3.75		

In reference to the Table 5 above, Water conservation system factor having four items was also analyzed. Specifically, with a mean obtained 4.17 (SD = 0.75), Water efficient plumbing fixtures is the highest ranking followed by Rain water harvesting (M = 4.00, SD = 0.63). Items such as Gray Water Recycling and Separate water meter connected to EMS are at the lowest with mean obtained 3.83 (SD = 0.41) and 3.67 (SD = 0.82). The relationship between water conservation system and depreciation constitutes a moderate relevancy with a total mean of 3.92.

Additionally, Within the factor of Indoor Environmental Monitoring System (IEMS), the highest ranking is the Carbon dioxide (CO_2) monitoring system and Carbon monoxide (CO) monitoring system with mean obtained 3.67 (SD = 0.52) and 3.67 (SD = 0.52). The lowest ranking is the Environmental Tobacco Smoke System (ETS) with a mean obtained 3.17 (SD = 0.75). Hence, there is a moderate relationship between Indoor Environmental Monitoring System (IEMS) factor and commercial property depreciation, with total mean obtained 3.50.

Finally, the highest ranking item in on-site renewable energy system is the Building Applied Photovoltaic (BAPV) system with mean obtained 3.83 (SD = 0.75). The lowest rank is the Building Integrated Photovoltaic (BIPV) system with a mean of 3.67 (SD = 0.52). Therefore, with a total average score of 3.75, it can be proven that there is a moderate relationship between on-site renewable energy system and commercial property depreciation.

3.3. Comparison with Some Selected Previous Study

This section compares the results obtained in general with the results from the previous study. Since the previous study on the relationship between sustainable design and commercial property depreciation and obsolescence is still lacking, the comparison was made to the closest research study in the area of sustainable building features performance towards rental and market value of commercial buildings.

Overall, the results show that eleven factors of sustainable building design paradigms are relevant to commercial property depreciation and obsolescence as agreed by the sample as a whole. The level of relevancy varied from one factor to another with sustainable HVAC system leading the ranking, followed by sustainable building status, building system, water conservation design, sustainable lighting system, sustainable site and soil characteristics, on-site renewable energy system, sustainable design configuration, rooftop and on-site greenery, indoor environmental monitoring system and lastly, sustainable materials, presentation and finishes.

In regards to the top ranking, participants as a whole agree that sustainable building's HVAC systems are the most relevant factor that should be considered influencing commercial property depreciation largely to the accrued benefits it produced to commercial buildings. Based on the findings using Principal Component Analysis (PCA), it was found out that valuers perceived air conditioning plan for the sustainable building to highly significant to property value [58]. Sustainable building HVAC also promotes better temperature, air quality and comfort to the occupants, thus contributes to the agreement among participants for the most relevant factor in commercial property depreciation. The previous study conducted also discovers that sustainable buildings temperature, air quality and comfort achieved better score against conventional buildings based on the perception of building users [65]. With sustainable HVAC systems, the rate of depreciation and obsolescence for commercial buildings can be deaccelerated due to better performance as to compare with the conventional commercial assets.

Secondly, this study has found out that the sustainable building status whereas consists of eco-label certification and ratings obtained the second highest ranking from the overall factors of sustainable building that are relevant to commercial property depreciation and obsolescence. This result supports the study wherein there is a strong impact of sustainable status such as eco-label towards the value and rental of commercial property [27, 48, 66]. It clearly shows that the participants acknowledged the impact of sustainable status in increasing the building image, hence reducing the rate of depreciation and obsolescence of commercial building by attracting prospective tenants and investors.

The third significant factor of sustainable that is relevant to commercial property depreciation; building system contributes to the major findings. Building system is the brain of the whole building operation where it integrates and controls the other system components such as the HVAC and communication. Intelligent BAS system in sustainable building operates by occupancy and energy demand and at the same time monitor and rectify systems performance. These core functions contribute to the perception of participants in this study to view building systems as the third most relevant to commercial property depreciation. Having high-techsystems such as the BAS and EMS contributes to energy efficiency inside building [52], hence significantly influence commercial property depreciation.

Result also suggests that water conservation design is ranked fourth from the overall ranking. Participants perceive this factor as relevant since the use of water-efficient plumbing fixtures,and rainwater harvesting for water conservation design promotes efficient water consumption that directly reduces the operational cost. A similar result from the investigation of valuer perception has found out that water conservation contributes to a positive impact on market value of property [67]. Specifically, reduced water consumption was found significant to property value within the cost saving factor having primary factor loading of 0.552 [58].

On the other hand, in [58, 68] found no significant relationship between rainwater harvesting and property value, contra to the finding of this preliminary study.

On the other hand, a lighting system for a sustainable building is also considered relevant as it produces better performance regarding theadequate level of lighting between natural and artificial light and glare in sustainable building. The previous study indicates that occupants perceived overall sustainable building lighting performed better with mean obtained 5.15 compare to lighting inside conventional buildings with mean obtained 4.32 using a 7-point scale [65]. Sustainable site and soil characteristics are ranked at six, followed by on-site renewable energy system, sustainable design configuration and; rooftop and on-site greenery. Sustainable site features such as near to mass transit or main road and pedestrian or bicycle friendly site contributes immensely to the value of commercial property and agreed by participants as moderately relevant. This study supports the findings that the elements of mass transit[66], pedestrian friendly area [69] and distance to main or secondary road [27, 69] influenced the market and rental value of commercial buildings. Buildings without these features will experience site obsolescence as the demand from tenants' falls.

Similarly, on-site renewable energy system is viewed as moderate relevant by participants. Having this system enhances the energy saving trait of the building since the electricity can be harvested from solar energy. Judging from the results of [58], this sustainable feature falls within the second highest factor namely 'cost saving factor' with a primary factor loading of 0.824. While, another study suggests a strong positive relationship with property value between 5 to 6 from the overall 7-point scale [67]. Hence, it is one of the highest significant factors that influenced property value.

On the other hand, sustainable design configurations is also moderately relevant to depreciation as it promotes energy efficiency through shape, envelope and others. The extensive use of Atrium item, view as moderately relevant is consistent with the study by [48] where the Atrium variable was found significant to rental value. Also, in[68]discovers the design flexibility in the sustainable building were significant to property value based on the perception by Malaysian Valuers. Finally, the Rooftop and on-site greenery, Indoor environmental and monitoring system fall within the bottom three from the overall ranking based on the participant's perception. Surprisingly, materials, presentation and finishes occupy the lowest ranking of relevancy to commercial property depreciation. In conventional valuation, building materials and finishes are well known to influence the property price significantly. This contradicting result suggests the participants view sustainable materials and finishes as less relevant to commercial property depreciation and obsolescence thus, drives the obtained result.

4. CONCLUSION

In brief, this study has successfully identified and analysed the relevant sustainable design factors that most likely contributes to the commercial property depreciation and obsolescence. In view of this, the sustainable design element needs to be integrated as a new variables in commercial property depreciation assessment in Malaysia. Further study using market based evidence is needed to investigate the direct impact of sustainable building design paradigm towards commercial property depreciation in Malaysia.

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