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Architectural Building Safety and Health Performance Model for Stratified Low-Cost Housing: Education and Management Tool for Building Managers

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***Abstract*—**The safety and health performances aspects of a building are the most challenging aspect of facility management. It requires a deep understanding by the building managers on the factors that contribute to health and safety performances. This study attempted to develop an explanatory architectural safety performance model for stratified low-cost housing in Malaysia. The proposed Building Safety and Health Performance (BSHP) model was tested empirically through a survey on 308 construction practitioners using partial least squares (PLS) and structural equation modelling (SEM) tool. Statistical analysis results supports the conclusion that architecture, building services, external environment, management approaches and maintenance management have positive influence on safety and health performance of stratified low-cost housing in Malaysia. The findings provide valuable insights for construction industry to introduce BSHP model in the future where the model could be used as a guideline for training purposes of managers and better planning and implementation of building management.

***Keywords*—**Building management, stratified low-cost housing, Safety and health model.

I. Introduction

URBANISATION has brought about changes in real estate development patterns. In 2000 and 2010, the urbanization rate was 62% and 71% respectively, with the urbanization rate in Peninsular Malaysia expected to rise further to 75% in 2020 [1]. This situation boosts demand for high rise (stratified) housing to meet the needs of the high density urban population. Thus, high-rise property development is a sustainable development pattern that has been widely accepted as part of urban living. The shared facilities in this type of housing must be used responsibly and considerately to ensure well-maintained buildings, public facilities and the environment in general. Current development trends such as gated communities, mixed/integrated developments and service apartments inherently require the sharing of services and facilities [2]. Therefore, laws and regulations related to maintenance and management of stratified buildings needs to be clear, orderly and effective to ensure residents' safety and health.

For that reason, facilities management was introduced in Malaysia in mid-1990 to ensure the well-functioning and a maximum life span of public facilities [3]. Facilities management is widely practiced in organizations with real assets, including management bodies of stratified residential buildings, which have common properties as its assets. Fig. 1 shows facilities management services that Joint Management Bodies (JMBs), made up of representatives from the developers and residents, must undertake [4]. Clearly, the safety and health factor is an important element that needs to be managed professionally to balance the needs of the various residents' interests. In short, a safe and healthy building is a built environment that optimizes building performance and satisfies the requirements of performance, namely: structural integrity, fire resistance, optimum building services, safety in operation and management, safety from external hazards, air quality, thermal comfort and acoustical and visual comfort [5], [6], [33].

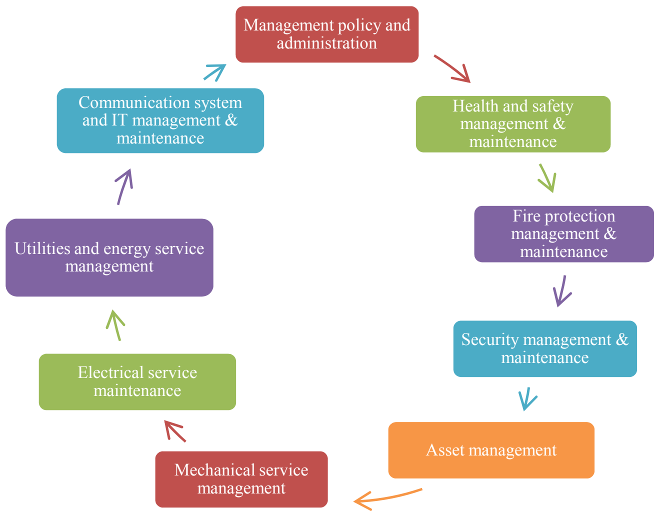

Fig. 1 Facilities Management Services [4]

II. Stratified Building Management in Malaysia

On 26 November and 19 December 2012, the 2012 Strata Management Bill was passed, respectively, in the House of Representatives and the Senate, to replace the Building and Common Property Act (Maintenance and Management) 2007 (Act 663) [7]. Besides that, a new act known as the Strata

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Management Act 2013, or Act 757, is already in place. This new act provides for the powers and responsibilities of the developers and the JMB to maintain and manage buildings or properties during the early and transition periods. It outlines the length of transition periods and the procedures which must be adhered to by both parties in the maintenance and management of the buildings. Between the date of the handing over of vacant possession and the issuance of the strata title, buildings and common properties will be maintained and managed by three parties: the developer (in the beginning), the JMB (in the interim) and the management corporation (MC) (at the end) [8].

However, various issues and problems related to the maintenance and management of stratified low cost buildings related to financial, maintenance work and administration [9]. Financial problems are more critical in many low-cost stratified properties compared to medium and high-cost ones. Issues in maintenance work and administration are largely due to the lack of skills, experience and professionalism on the side of the building managers, the JMB and the MC. According to [10], although developers are aware of the rising issues of sustainability, they make very little effort to address them. Therefore, there are buildings with special design characteristics and with special function, but is normally hard to maintain. Subsequently, poor maintenance management systems has resulted in a myriad of building problems such as structural deterioration, deficiencies in fire safety provisions, building structural failures and slope failures. In another study conducted on the conditions of low-cost housing buildings in Kuala Lumpur, [1] found that many buildings face maintenance problems that need urgent attention in order to preserve them from further deterioration and decay. Hashim [11] and Mohammed and Hassanain [12] found that a lack of cooperation between the parties, especially between the facility manager and the design professionals at the design stage, may be a major contributor to maintenance problems. These problems are clearly detrimental to the safety and health of the occupied buildings.

Because of this, various initiatives have been undertaken by the government to address the above problems. The Ministry of Urban Wellbeing, Housing and Local Government has proposed an amendment to the legislation that would provide the powers to the JMB and the MC to appoint qualified building maintenance agents to maintain and manage the buildings and common properties efficiently [7]. The control of building managers through the registration of certified bodies is the only way to address current shortfalls and to ensure professionalism in the maintenance and management of buildings and common properties. As such, the Ministry has requested the Board of Values, Appraisers and Estate Agents Malaysia to work on the unregistered building managers so that there can be a quality control of building managers to ensure the good and orderly provision of management services. In the same way, this research is conducted to provide a new mechanism to improve the quality of building safety and health, apart from to improve the system of stratified building management in the country. Quality control in building management is important to enable stakeholders to distinguish high quality buildings from low-quality ones. This process begins with an empirical investigation to identify factors that affect building safety and health. Through this approach, building safety and health assessment schemes can be established to evaluate the quality level of any building.

Subsequently, an assessment of the quality of building safety and health is important to classify buildings according to grades, such as grades A, B or C. The classification would provide stakeholders with valuable information and signals. For example, house buyers can use the information to determine the quality of the buildings before making a purchase decision. The government can also identify problematic buildings based on the assessment. Similarly, property management companies can use the assessment results to evaluate the performance of the properties in their portfolios, while simultaneously indicate their management performance. A good building management would enable a healthy growth of the construction industry and to bring value-add to properties. Therefore, this research aims to develop a building safety and health performance model (BSHM) to determine the factors affecting stratified building safety and health in Malaysia. Doing so would be a starting point to the development of stratified building quality assessment schemes in the country. Furthermore, the model could be used to educate and create awareness among building management and construction personnel to ensure sustainable building management practices.

III. Building Safety and Health Performance Model

It is worth studying the factors of building safety and health performance that have been identified by previous studies. This study used the five dimensions identified as the starting point for setting the boundaries of the safety and health constructs. The literature [5], [6], [13] have also pointed out that building design and management plays an important role in affecting building safety. Therefore, the building safety and health performance modelling in this study focuses on design and management process and is underpinned by five constructs, namely: Architecture, Building Services, External Environment, Operation and Maintenance, and Management Approaches.

A. Studies Related to the Variables Analyzed

Architecture

Architecture has a closer role to safety and health performance. For the reason, the inclusion of architecture in the current study model is of paramount importance to achieve building sustainability, thus helping to reduce environmental, safety, and health hazards in buildings. A vast amount of research was dedicated to the identification of architectural performance and ways to eliminate architectural defects [14], [16]. Ramly [14], for example, found that 47% of architectural defects are caused by design defects, 17% from materials, 15% from construction, 18% from misuse of facilities, 15% from poor maintenance, and 5% from vandalism. Isa [16] also found that the majority of the defects identified are related to poor architectural works, followed by poor electrical works and civil and structural defects. These findings suggest that defects could have been prevented if consideration is given to the architectural elements. Chohan [15], for example, pointed out that architects need to prevent these defects by using more appropriate materials and a better design and layout. Importantly, it is hoped that the findings of the studies could be extended to enhanced safety and health performance of building. For the purpose, the following hypothesis was proposed:

H1. There is a positive relationship between architecture and safety and health performance of building.

Building Services

The importance of information available for building services is particular essential to affecting one's decision to purchase the product. The importance of information available for building services is particular important as an indicator to the safety and health performance of the building. The rationale of suggesting the construct was aimed at enhancing of our understanding pertaining to the impact of building services on the safety and health performance. Similar to architecture, building services are required for a safe, comfortable and environmentally-friendly operation of buildings. Building services refer to the design, installation, operation and monitoring of the mechanical and electrical systems such as electrical supply, lighting, ventilation, plumbing and sanitary, fire services, and lifts [17]. An assessment of building services conditions is important to safeguard the safety, health and well-being of people and to protect the environment [18]. A study done by [19] proved that physical housing conditions contribute to mental health dysfunctions such as depression, anxiety, sadness and helplessness. Thus, housing does have a significant impact on safety, health, and behavior of residents [20]. As such, the present study expects that building services will affect the safety and health of building. This has led to the following hypothesis.

H2. There is a positive relationship between building services and safety and health performance of building.

External Environment

Safety and health measures should include the protection against additional hazards introduced by the external environment. The major categories of environmental hazards are natural hazards (e.g. floods and landslides), technological hazards (e.g. hazardous materials, industrial failures, unsafe public buildings and facilities) and context hazards (e.g. environmental degradation and air pollution) [21]. The study by [22], which assessed physical environmental parameters such as noise, air pollution and traffic volume, highlighted several inadequacies of the living environment in the Taman Melati residential area in Kuala Lumpur. In another study, [1] measured the quality of the surrounding environment by air quality and peace level. They found that the surrounding environment has a significantly positive correlation with the health status and the overall quality of life. Both studies reported that external environmental was a strong factor of safety and health performance of building. Given these studies, it is hoped that the importance of the construct could be extended to safety and health performance context. For the purpose, the following hypothesis was suggested:

H3. There is a positive relationship between external environment and safety and health performance of building.

Operation and Maintenance

Operation and maintenance of use is the another factor to be empirically examined. The studies by [11] and [12], [34], [35] discussed the issue of maintenance management in Malaysia's low-cost housing. They noted that problems in facility maintenance are often caused by limitations in design and materials used a lack of construction knowledge and inadequate inspection and/or maintenance. They also identified that a lack of cooperation between the parties, especially between the facility manager and the design professionals at the design stage, may be a major contributor to maintenance problems. Based on case studies conducted on the conditions of low-cost housing buildings in Kuala Lumpur, [1] found that many buildings face maintenance problems that need urgent attention in order to preserve them from further deterioration and decay. Inherent maintenance problems in facilities are also found to have a significant relationship with respondents' physical health status. This has been highlighted by [13] which identified that overcrowding and stress can be linked to adverse physical health conditions. Based on these studies, a hypothesis is formulated as follows:

H4. There is a positive relationship between operation and maintenance and safety and health performance of building.

Management Approaches

For instance, [18] attempted to examine the building users' perceived importance of five aspects of facilities management services, which include security, cleaning, repair and maintenance, landscape and leisure and general management. Nik-Mat, Kamaruzzaman and Pitt [23] examined the relationship between facilities management and customer satisfaction and found that there was a significantly positive relationship between the performance of maintenance management and the type of maintenance management system applied. The above studies all share a common focus, which is on assessing the quality of the delivered service to ensure that building facilities work well and has a maximum life span [24]. A widespread tolerance towards poor maintenance management systems will lead to unnecessary increases in maintenance costs, low user satisfaction and a shortened building's effective life span [3], [18], [25].

H5. There is a positive relationship between management approaches and safety and health performance of building.

IV. Research Methods

A. Sample and Data Collection

The unit of analysis in this study is all construction practitioners in Malaysia. The construction practitioners involved in low-cost housing projects are mainly architects, engineers, quantity surveyors, building surveyor and developers. Consequently, the sampling procedure used in this research is the multistage cluster sampling technique where the specified groups have heterogeneous members. The advantage of employing this sampling method is that it is not necessary to employ all units in a selected group given that either the researcher cannot easily identify the population or the population is extremely large [26].

Seven hundred (700) self-administered questionnaires were used for gathering data from the respondents. A multiple method of data collection was employed, whereby some questionnaires were mailed to the respondents, some were e-mailed and some were personally administered. A total of 308 were received and used for this analysis which translates to about 44% response rate. Table I shows the demographic profile of the respondents. Majority of the respondents were male (67.9 %), engineers (33.4%) and came from the private (80.5%) organization. It seems that 100% of the respondents are involved in the construction of 'High Rise Flats' project and very experienced in the construction industry, with almost 87% of the sample having served for more than 10 years.

B. Empirical Analysis

A structural equation model is a combination of structural model (inner model) and measurement models (outer model) leads to a complete structural equation model [27]. Model validation was conducted using SmartPLS 2.0, a structural equation modelling tool that utilises a component-based approach to estimation. SmartPLS 2.0 takes a two-step approach to data analysis. First, the measurement model was used to evaluate and to develop the reliability and validity (i.e. convergent and discriminant validity) of the research instrument (Fig. 2). Second, after the adjustment of items and acceptance of the measurement model, the structural model was evaluated to assess the hypothesized relationships between the constructs in the conceptual model.

TABLE I
PROFILE OF RESPONDENTS

	Number	Percentage (%)
Gender		
Male	209	67.9
Female	99	32.1
Organization		
Developers	28	9.1
Architects	88	28.6
Engineers	103	33.4
Building Surveyors	32	10.4
Others	57	18.5
Category of Organization		
Government	55	17.9
Private	248	80.5
Joint Venture	5	1.6
Others	0	0
Type of Project		
High Rise Flats	308	100
5 Storey Flats	202	66.0
Terrace	151	49.0
Others	40	13.0
Year of Service		
31-35 years	30	9.7
26-30 years	65	21.1
21-25 years	72	23.4
16-20 years	51	16.6
11-15 years	50	16.2
5-10 years	36	11.7
Others	4	1.3

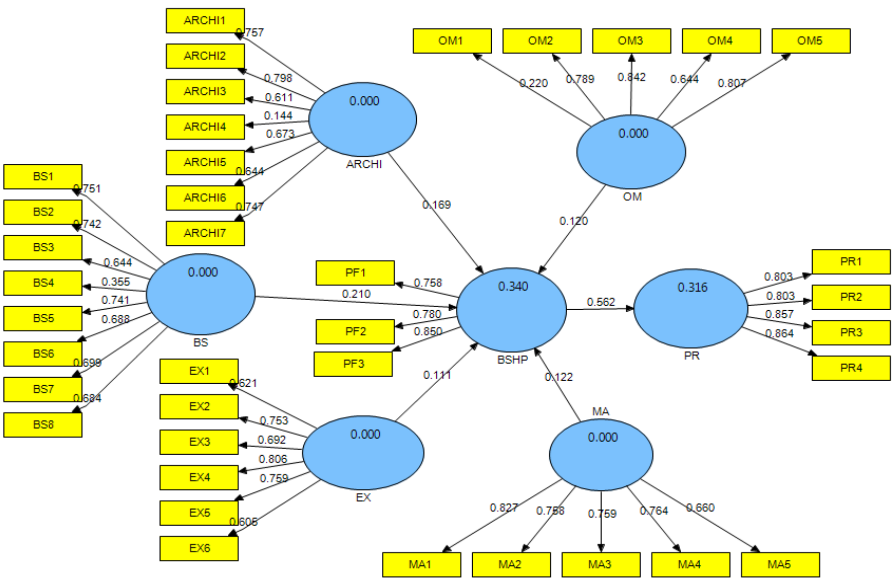

Fig. 2 Architectural BSHP model run in SmartPLS for measurement model

TABLE II
DISCRIMINANT VALIDITY OF CONSTRUCTS

Measurement Items	Iteration 1				Iteration 2			
	Item	Loading	CR	AVE	Item	Loading	CR	AVE
Architecture								
Means of Escape	ARCHI1	0.757			ARCHI1	0.757		
Means of Access	ARCHI2	0.798			ARCHI2	0.797		
Structural and Finishes Integrity	ARCHI3	0.611			ARCHI3	0.618		
Building Material	ARCHI4	0.144	0.828	0.432	ARCHI4	Omitted	0.857	0.502
Amenities	ARCHI5	0.673			ARCHI5	0.676		
Space Functionality	ARCHI6	0.644			ARCHI6	0.644		
Fire Resistant Construction	ARCHI7	0.747			ARCHI7	0.743		
Building Services								
Electricity System	BS1	0.751			BS1	0.757		
Lighting	BS2	0.742			BS2	0.740		
Ventilation	BS3	0.644			BS3	0.651		
Air Conditioning	BS4	0.355	0.866	0.454	BS4	Omitted	0.877	0.505
Plumbing	BS5	0.741			BS5	0.733		
Sanitary Services	BS6	0.688			BS6	0.686		
Fire Services	BS7	0.699			BS7	0.706		
Lift Services	BS8	0.684			BS8	0.695		
External Environment								
Emergency Services	EX1	0.621			EX1	0.621		
External Hazards	EX2	0.753			EX2	0.753		
Location	EX3	0.692	0.858	0.504	EX3	0.692	0.858	0.504
Air Quality	EX4	0.806			EX4	0.806		
Peaceful Environment	EX5	0.759			EX5	0.759		
Aesthetics	EX6	0.606			EX6	0.606		
Operation & Management								
Building Peripherals	OM1	0.220			OM1	Omitted		
Structural and Finishes Integrity	OM2	0.789			OM2	0.789		
Building Services Conditions	OM3	0.842	0.810	0.489	OM3	0.844	0.856	0.601
Alteration of Building	OM4	0.644			OM4	0.645		
Fire Compartment Integrity	OM5	0.807			OM5	0.807		
Management Approaches								
Emergency Evacuation Plan	MA1	0.827			MA1	0.827		
Documentation and Evaluation	MA2	0.758			MA2	0.758		
Safety Education	MA3	0.759	0.869	0.571	MA3	0.759	0.869	0.571
Security Management	MA4	0.764			MA4	0.764		
Occupant Safety Management	MA5	0.660			MA5	0.660		
Personal Responsibility								
Personal Responsibility	PR1	0.803			PR1	0.803		
	PR2	0.803	0.900	0.693	PR2	0.803	0.900	0.693
	PR3	0.857			PR3	0.857		
	PR4	0.864			PR4	0.864		
Performance								
Performance	PF1	0.758			PF1	0.758		
	PF2	0.780	0.839	0.635	PF2	0.780	0.839	0.635
	PF3	0.850			PF3	0.850		

TABLE III
DISCRIMINANT VALIDITY OF CONSTRUCTS

Construct	ARCHI	BS	BSHP	EX	MA	OM	PR
ARCHI	**0.709**						
BS	0.478	**0.711**					
BSHP	0.468	0.479	**0.797**				
EX	0.608	0.545	0.467	**0.710**			
MA	0.482	0.625	0.446	0.488	**0.756**		
OM	0.642	0.411	0.444	0.632	0.459	**0.775**	
PR	0.478	0.499	0.563	0.390	0.423	0.441	**0.832**

1. Measurement Model

Establishing convergent validity assures the researcher that all the measures of the construct do measure the same construct or concept and move in the same conceptual direction. Convergent validity was assessed using indicator reliability, internal consistency reliability and Average Variance Extracted (AVE). The measurement model was assessed by examining the following criteria: (1) All items should be statistically significant with loading 0.60 or higher [27]; (2) The composite reliability (CR) must exceed 0.60 [27]-[29]; and (3) The average variance extracted (AVE) should exceed the generally recognized 0.50 cut-off point [27]. From Table II, it can be seen that loading values of all items are higher than the required value ranging from 0.611 to 0.864. CR values which depicts the degree to which the construct indicators indicate the latent [27], construct ranged from 0.810 to 0.900. The AVE values were in the range of 0.504 and 0.693. However, results of the ARCHI4 (Building Material), BS4 (Air Conditioning) and OM1 (Building Peripherals) constructs has a factor loading and AVE lower than minimum acceptable threshold value, ranging from 0.144-0.355 and 0.432-0.489 respectively. Hence, this construct should be considered for modification on iteration one analysis.

The modification involves the elimination of items with poor factor loadings (ARCHI4, BS4, OM1). This follows [29], where reflective indicators with outer loadings of less than 0.4 are eliminated from the measurement model. Reflective indicators may also be eliminated if by doing so substantially increases CR and/or AVE values. These results indicate that the suggested modifications have achieved the intended outcome. The factor loadings of each measurement item on its respective construct are ranging from 0.606 to 0.864. The CR values for ARCHI, BS and OM constructs have been increased by 2.9% (0.857), 1.1% (0.877) and 4.6% (0.856) respectively. Likewise, there are increases in AVE values for ARCHI (0.502), BS (0.505) and OM (0.601) constructs. Hence, the convergent validity is confirmed and no further modification is required.

After establishing convergent validity, the researcher assesses the model's discriminant validity based on the Fornell-Larcker criterion. The assessment is to ensure that the diagonal elements were significantly higher than the off-diagonal values in the corresponding rows and columns. The diagonals represent the square root of AVE while the remaining entries represent the squared correlations. The results in Table III show that for all constructs, AVE values were higher than the construct's highest squared correlation with any other latent constructs. The researcher also considers adequate discriminant validity when constructs have AVE loadings of greater than 0.5. In other words, at least 50% of measurement variance is captured by the construct [27]. Hence, the researcher has demonstrated that the measurement model used in this study exceeds the requirements for convergent and discriminant validities.

2. Structural Model

Having examined the outer model in terms of reliability and validity, the researcher now assesses the inner model (i.e. the structural model). With regard to H1 – H5, the results provide an evidence for a significant relationship between Building Safety and Health Performance (BSHP) and all of the five proposed outcomes of the conceptual framework. There is evidence for a significant relationship between Building Safety and Health Performance (BSHP) and Architecture (ARCHI) (H1, $\beta = 0.155$; $p < 0.05$), Building Services (BS) (H2, $\beta = 0.212$; $p < 0.01$), External Environment (EX) (H3, $\beta = 0.117$; $p < 0.1$), Operation and Maintenance (OM) (H4, $\beta = 0.128$; $p < 0.1$) and Management Approaches (MA) (H5, $\beta = 0.124$; $p < 0.1$). The PLS results also show that the building safety and health performance factors strongly and significantly influence a construction practitioners responsibility (PR) towards building safety and health performance (H6, $\beta = 0.563$, $p < 0.01$). In conclusion, the results provide sufficient evidence to support all the hypotheses (H1, H2, H3, H4, H5 and H6) tested in this study, as summarised in Table IV.

As well as, the findings of this research indicated that the constructs namely architecture, building services, external environment, operation and maintenance, and management approaches impacted on building safety and health performance. Building services factors showed the strongest impact in BSHP. This finding implied that the better the building services are (β= 0.212) in building, the higher is the extent of safety and health performance. Good building services can lead to improved building performance in the construction industry. This finding corroborates with the findings from [17]-[19]. Continuous monitoring of the building services performance according to the legal requirement results in better building safety and health condition to safeguard the safety, health, and well-being of people and to protect the environment.

The second highest was the architecture construct (β= 0.155). This notion makes sense as construction professionals must be committed to forging good long-term architecture design to achieve success for the construction industry in general and for low-cost housing in particular. As an example, the focus of safety and healthy building architecture needs to incorporate better design detail as well as aesthetic aspects. The findings support the recommendation made earlier by researchers such as [30], [16], and [15]. They suggested that in order to have successful architecture building performance, structural design, architectural building elements, space accessibility, and amenities are necessary factors so that occupants can live safely, healthily, comfortably, and efficiently.

Thirdly, operation and maintenance was found to be related to building safety and health performance success (β= 0.128). This finding indicates that mutual dependencies between safety and health performance would increase when the level of operation and maintenance is improved. Additionally, operation and maintenance is an important factor for future sustainable building maintenance management works because of the shared responsibility, information, policy, technology, benefits, and risks involved in the process [16], [18]. Understanding clients' expectation and communications between facility manager and design professionals in providing these services will lead to a viable construction industry [12].

Fourthly, management approaches were significantly and positively related to safety and health performance of low-cost housing in Malaysia (β= 0.124). Management can create effective management systems through emergency evacuation plan, documentation and evaluation, security management, occupant safety management, and waste and cleaning services that address staff at all levels of the firm. A bad management performance can lead to accidents (safety issue) and pollutions (health hazard and environmental issues) besides encouraging an unhealthy work culture and environment [25], [3], [18], [23]. As [23] pointed out, the ability to establish effective management approaches across organisations or across functions requires three important aspects of maintenance namely functional, technical, and image, as contained in the BSHP model. In fact, to gauge the effectiveness of building management system, it is necessary to reach an understanding of the current conditions of the facility and to make changes in management practices in order to achieve the desired performance [3]. Therefore, BSHP model is the basic concept of safety and health and these factors increase performance in the low-cost housing construction and eventually lead to management approaches success.

Lastly, external environment also has a significant relationship with safety and health performance of low-cost housing in Malaysia (β= 0.117). External environment is a critical situation that allows information flow between different parties during different stages of building life cycle [1]. In essence, consideration to the external environment factor assists the organisations to communicate their wants and needs accurately to ensure the safety and health of the occupants. Therefore, organised planning can be done right at the design stage of a building construction. This practice will prevent loss of time, life, and wastage of resources thus leading to a better low-cost housing performance. Therefore, the existence of BPSH is vital in planning, goal setting, implementation, and coordination and performance evaluation.

In the same way, extent of safety and health performance has a significant impact on their responsibility towards BSHP among the construction professionals. The result also concurs with the study by [17] that was conducted in Hong Kong. The study found that safety and health significantly predicted both design and management factors. However, the study by [11] on the factors influencing performance of Malaysian low-cost public housing found that a better safety and health performance could not adequately explain such factors unless the respondents' past experience and their perception of its responsibility towards safety and health performance were also incorporated in the model. Responsibility was found to have the greatest impact in accomplishing the main purpose of the construction industry, which is to build sustainable construction to both client and end users [31]. This finding was consistent with earlier findings by [6] and [32]. The researchers also believed that responsibility to enhance safety and health performance can be improved through clear job description and communication among all the players in the construction industry [36], [37].

TABLE IV
RESULTS OF PATH COEFFICIENTS

Hypothesis		Beta (β)	Rank Order	Standard Error (STERR)	t-value	Decision
H1	ARCHI -> BSHP	0.155	3	0.071	2.193	Supported
H2	BS -> BSHP	0.212	2	0.068	3.123	Supported
H3	EX -> BSHP	0.117	6	0.063	1.867	Supported
H4	OM -> BSHP	0.128	4	0.070	1.819	Supported
H5	MA -> BSHP	0.124	5	0.073	1.684	Supported
H6	BSHP -> PR	0.563	1	0.041	13.875	Supported

V. CONCLUSION

The study set out to develop an architectural safety and health performance model for stratified low cost housing in Malaysia, as a lack of understanding on its measure has led to a need for a guideline for practitioners. Architectural BSHP model was developed as the basic concept of safety and health, where these factors increase performance in the low-cost housing construction and eventually lead to building management success. Safety and health include social, environmental, economic, and ethical issues bundled together as a highly interconnected and inseparable element of social life that both impact and are impacted by social structures. This research contributes to the theoretical knowledge by developing a reliable and valid scale to measure architectural safety and health performance which contributes towards a more holistic safety and health performance dimension. The construction of the research instrument provide measurement scales in order to operationalise the safety and health performance that will spark further interest and research in this area.

Moreover, there is a lack of job responsibility and description among construction practitioners in Malaysia leading to the need for a systematic approach to describe and evaluate the safety and health performance. This research offers measurement scales to operationalise the safety and health performance construct. As the BSHP model remains a rather underdeveloped research area in the literature of low-cost housing, the development of this model offers initial insights in developing a building performance framework that would encourage better assessment practices.

With regard to the practical implication, there has been a growing awareness for the need of building performance evaluation and assessment systems in the past decade as evident from the literature review. Therefore, a validated model can be used by construction practitioners in Malaysia as an assessment instrument to evaluate safety and health performance of low-cost housing and to predict future impact that would help organisations and market players in decision making. In addition, complete yet simple and easy-to-use instruments will be useful in the long term in facilitating the benchmarking of safety and health assessment for both mandatory and voluntary building inspection schemes for better community building management.

Furthermore, the findings from this research has enhanced knowledge on determinants of building safety and health and the findings will be useful to the societies especially occupants, construction practitioners, and government agencies in developing countries such as Malaysia to educate, disseminate, and inculcate a culture of safe and healthy built environment among local citizens. Thus, this research contributes towards the achievement of the highest standard of quality, safety and health, and environmental practices in the construction industry, as aspired by the Construction Industry Master Plan (CIMP) 2006-2015 (Construction Industry Development Board, 2007).

The model development efforts encompass important aspects of building construction and management namely, design, operation and maintenance. To date, there has yet to be a performance-based building model developed in the Malaysian contexts. The BSHP model for low-cost stratified housing is the first of its kind in Malaysia. Overall, this model can make positive contribution to society through the value added construction industry. The model is expected to be not only a useful performance measure for building health and safety but is also as a tool for creating awareness on the interactions between the various factors that contribute to safety and health performance of stratified low cost housing.

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