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Analysis of homeowners' behaviours in housing maintenance

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Abstract

The demand for sustainable buildings is driven by increasing energy and water costs, high reduction of carbon emission and pollutions, and the need for social integration. Sustainability requirements in buildings are intensifying the need for building maintenance. However, attempts to increase 'sustainable maintenance practices' in residential buildings have not yielded positive results, yet the behavioural components in maintenance are considered to have the potential to increase household sustainable maintenance practices. This study explores the behaviours of homeowners to motivate the demand side in the sustainable supply chain and marketplace. This study based on a cross-sectional survey questionnaire found that 95% of the survey respondents measured that 16 'incentives' would facilitate homeholders' engagements with sustainable maintenance practices. The Kaiser-Meyer-Olkin measure of sampling adequacy indicated that the strength of the relationships among the variables were very strong (KMO=0.879). Bartlett's test of sphericity, which tests the overall significance of all the correlations within the correlation matrix, was significant χ^2 (120) = 1057.557, p<0.001). The major incentives that would stimulate homeowners to practice sustainable maintenance are increase in regulations on manufacture and sales of eco-friendly products, the setting of sustainable maintenance standards for the maintenance organisaton/department. The self-belief that the increasing destruction of the environment is a serious threat to sustainability was found to be incentive to engage on sustainable maintenance practices by the homeowners. A conceptual maintenance behavioural model was presented to encourage sustainable maintenance practice among homeowners. With the model it was demonstrated that technical sustainability depends on non-technical sustainability to succeed. This study contributes original information on the need for qualitative aspects in maintenance management market. Facilities managers, maintenance managers and clients could use this information to enhance their maintenance service delivery. The results suggest many complex maintenance behavioural factors could enable householders make sustainability choices. It will provide feedback and feed ward loops to designers. These results may be relevant to the housing market in other countries.

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Keywords: Sustainability, motivation, maintenance literacy, homeowners, rethinking maintenance-plan.

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1. Introduction

Governments around the world have set climate change, pollution, resource depletion, energy and water targets. At the micro level, the concern for sustainability is now part of consumers' decision making plans. Homeowners, now check the carbon emission, water, and electricity consumption rates of products and equipment before deciding on a product or service. In Malaysia, government aims to reduce energy intensity ratios to less than 1.0 from the current 1.3; the global average is 0.73 [1]. The government aims to lower carbon intensity by 40% by 2020 compare to 2005 levels [2] and reduce energy consumptions by 40% by 2050. It has set a goal of 22% household recycling rate, reduce non-revenue water to 25% by 2020 [2] and increase Solar PV usage to 21.4 MW in 2050 from 1 MW in 2011 [3]. However, a significant problem within these targets lies in the existing housing stock. The housing stock in Malaysia is 4,928,883 thousand with an annual growth rate of about 2.2% [4] and the demolition rate is less than 1%. Therefore, more than 80% of the housing stock that will remain by 2050 has already being built and more than 95% were neither designed nor constructed to sustainability compliance. Expenditure on housing (including rent, maintenance, utility bills) is economically substantial, amounting to approximately RM1400 monthly per household. Thus, if the government commitment and targets for sustainable development are to be positive, the maintenance of existing housing stock required systemic considerations. Climate change, acid rain, resource depletion, deforestation, degradation, loss of biological diversity and social disparities caused by housing maintenance activities and its effects are uncertain, but with the increase in the number of homes and poor housing operations, the effects are high and increasing. This poses risks for the future. The lifespan of houses is high, during which they consume energy and water and release CO_2. A lot of wastes are generated during house maintenance. The environment will 'receive', 'store' and/or 'process' the waste generated in the production and operation of the house. Therefore, if residential housing is maintained to reduce energy and water consumption, curtail carbon emissions, and increase building performance, this will lower CO_2, pollution, waste, save costs, and enhance household comforts and productivity.

Many researches have verified the contributions of maintenance to sustainability (5, 6, 7, 8, 9, 10] but have not clearly distinguished the roles and behaviour of householders in sustainable maintenance practices. No attempt has been made to integrate this behaviours-motivation concept within a formal sustainable housing and maintenance model. Many researches involve the applications and prospects of sustainable technologies for new construction, retrofitting and maintenance to address climate change, waste, water, energy and pollution [9, 11, 12, 13, 14, 15]. Implicit in these researches and publications is the notion that the sustainable products are able to solve the problems. However, there have been empiricist backlashes against technology-based solutions. Best and De Valence [16] noted that the driving force behind resource depletion and pollution is attributed to a self-perpetuating revolution in technological advancements. This is because there are overestimations in the capabilities of technologies [17]. Theory and practice show that even with buildings designed and constructed to comply with sustainability, there is a wide gap between designed requirements and actual performance. The gap is largely associated with the behaviour of building operators and occupants [6, 8, 12, 18]. Research conducted show that price reduction and technology could not result in energy reduction for long time [19]. Emphasis must shift to household behavioural measurements to make meaningful progress. Responding to this need, this study examines household maintenance behaviours that help save energy, water, material, reducing waste, pollution and emission in houses. However, one of the most significant barriers for achieving housing sustainability is the lack of knowledge on the roles and behaviour of householders practicing sustainable maintenance. The conceptual framework developed for this study is presented in Figure 1.

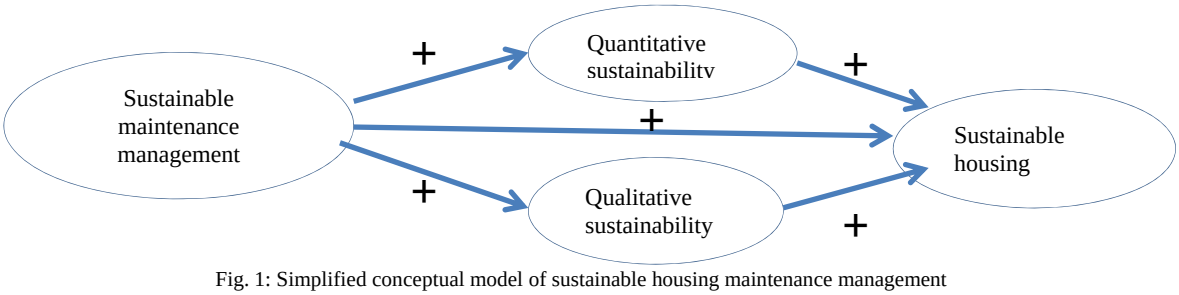

Fig. 1: Simplified conceptual model of sustainable housing maintenance management

This model consists of three arguments. Firstly, sustainable buildings are achievable only if the maintenance practice is sustainable. Secondly, both the quantitative sustainability and qualitative sustainability requirements must align in decision making. Thirdly, qualitative sustainability proceeds quantitative sustainability.

2. Housing, maintenance and sustainable development

RM1.7 trillion is required annually by 2050 to mitigate the effects of climate change [20]. The impact of buildings on climate change, resource depletions, waste, pollution, and social integration is enormous. Buildings consume more than 40% of the world energy, released 1/3 of CO_2, use about 25% of harvested woods, release about 50% of fluorocarbons, produce 40% landfill materials, use 45% of energy in operations, emit 40% of carbon emissions, and accounts for about 50% of all extracted materials and use 15% of the world's useable water [21]. When other $C0_2$ emissions in building materials and components manufacturing and transportation are included, the impact on sustainability will increase. Housing stock is a significant part of this profile. Housing stock involves approximately 95% of the buildings in Malaysia. Perhaps only about 1000 buildings complied with sustainability criteria in their design and construction, with about 5% replacement rate, the need for maintenance will only intensify. Houses require maintenance to ensure their availability, durability, reliability, safety, and optimum performance to meet the value system of the homeowners. This study defines housing maintenance as the required processes and services to preserve, protect, improve, and care for a building's fabric, structure, and engineering services after completion, and refurbishment or replacement to current standards to enable it to serve its intended functions throughout its entire life span without drastically upsetting its basic (physical) forms and use [22]. Sustainable design and construction are not enough, because a poorly maintained housing will be too expensive to operate, consumes more water and energy than required, generates more wastes, causes sick building syndrome, will be unsafe, and poses risk to the users and the entire community. According to Harding, et al., (2007), lack of maintenance depreciates the value of building by 2.5% annually [23].

Maintenance comprises two major aspects: the technical maintenance and the non-technical maintenance. Similarly, Jenks and Jones [24] identified technical or quantitative sustainability and qualitative sustainability. While technical or tactical maintenance is congruent with technical sustainability, the behavioural /qualitative sustainability aligned with the non-technical maintenance. But most authors have classified sustainability into: economic, social and environmental sustainability. While these later classifications are also accepted and meaningful, it is not useful for our current purpose. Thus preferring the technical and non-technical sustainability here is to facilitate understanding and ease of categorisations. The different between the technical sustainability and qualitative sustainability is while the former focuses on materials, technologies and designed feature that contribute to sustainability directly on the own right, the qualitative sustainability relates to the actions and reactions of the users [24]. Close to this grouping is dichotomy between the energy efficiency and energy conservation. Existing literature primarily focuses on technical sustainability [25, 26] neglecting the qualitative or specifically the behavioural aspect. The proliferations of sustainable materials and products have caused some, including designers and manufacturers, to believe that the solutions to sustainable buildings lie with the adoption of technical sustainability. Yet, despite the huge supply of these materials and products, their adoption and use is relatively slow primarily because behaviour issues are neglected. Activities that is dependent on the users' behaviour, like decisions on when, why and how to maintain the building, have the potential to save energy, water, and reduce pollution. In qualitative sustainability, feeling, attitude, mood are convey in the information whereas in quantitative sustainability, information are convey without sentiment, emotion, hence are denotative. This study examines the behavioural issues in sustainable maintenance of residential buildings, with specific reference to the motivation of homeowners in sustainable maintenance practice. Householders required motivation to maintain their houses sustainably.

3. Housing Improvements/Maintenance Behaviours and Motivation

Human behaviour is a person's action (and reactions), activity, or process and reaction. These actions, activities, and processes are usually initiated in response to a situation or agent which could be internally or externally induced [27]. Behaviour may be automatic, intuitive, systematic, control, conscious and rational or may be the opposite of

these. Behaviour is triggers by a motivator (situation, event). In standard economic theory, the basis of behaviour is grounded in ration choice [27]. That is the choice that individuals make based on cost and benefit. This model is sometimes referred to as the Expected Utility Model. Implicit in the rational choice models is the stability of consumers' preferences and adequacy and accessibility of information to users [27]. Most human behaviour is irrational and habit driven. The choices that individuals make are not always linear, resulting in 'information deficit model'. The housing improvement or maintenance behaviour involves both standard economics factor notably the maintenance cost and the associated benefits as a result of the maintenance. In a purely economic standing, for households to maintain homes, it requires a sacrifice of income. Thus maintenance cost and income is a major decision that will influence behaviour under the rational choice model. For instance, if household income is cut or affected, maintenance activities are deferred until a later date in future.

However, many other factors that influence maintenance behaviour are within the scope of behavioural economics. Galster [28] identified neighbourhoods' experience and attachment as major factors influencing the maintenance behaviour of housing. According to Hills and Worthing [29], owners maintain their house as compared to tenants. A tenant occupied house depreciates faster than owner-occupied homes by approximately 0.5% per annual values [30]. Mobility also influences maintenance behaviour and the possibility of inheriting the house are also cited as influencing the maintenance behaviour of the 'privilege tenant' [31]. According to Meeks and Firebaugh [32], maintenance skills and the time available to do repairs are possible factors that influence household maintenance behaviours. Households also maintain their home for safety, comforts, and aesthetics in Malaysia [33]. Collectively, academic literature revealed that age, household income, saving, household gender composition, owners proximity to the houses, tendency to move, cost of maintenance, tenure, locations, government policies (i.e. incentive to carry out maintenance), neighbourhoods, and future expectation motivate household maintenance behaviours. Contained in this plethora of factors and discussions is that the extents to which households choose to maintain their housing are reflections of their attitude and resources. These then dictate their motivations. Thus, household maintenance behaviour has been subject to extensive research, especially in the US and Europe for more than 40 years. In developing countries like Malaysia, the efforts are only recently gathering momentum.

The motivational component of behaviour is a common issue in behavioural economics. Motivation involves the biological, emotional, social, and cognitive forces that trigger, direct, and sustain behaviour. Motivation is considered as the whys of behaviour, because it is the mediating variable in attitude and behaviour relationship (27]. While behaviour is what is displayed outwardly, attitude is concealed in the mind-inwardly. Put in another word, to change someone's behaviour, the person's attitude must first be influenced. Psychology theories including the Rogers' Protection Motivation Theory, Theory of Reasoned Action, Needs Opportunities and Abilities Model and Rogers' Protection Motivation Theory greatly discussed the roles of motivation in determination of behaviour. The contextualisation of Information–Motivation–Behaviour Skills model here is that despite the amount of information or awareness on household on embarking on maintenance to save energy, water, and materials and at the same time reduce waste generation and CO_2 emissions, households may not undertake maintenance for these purposes. Implicit in these studies is that household motivations are significant. This current study examines what motivate households to engage in sustainable maintenance practices. This is lacking in the current literature.

4. Research Design

Primary data is collected based on convenience sampling. In convenience sampling, a survey is administered on the respondents who are easily accessible, available, or willing to participate. It is an appropriate method where sufficient information on population size is not available but like other nonprobability sampling, but its findings may not be generalisable. However, where the respondents are carefully selected and with sufficient size, the findings could be representative [34]. Altogether, three similar housing units were selected for this study. The housing units were located in the cities of Selangor and Penang. These states have the highest development and boom property market. The units were approximately 20 years old. The units have their separate maintenance organisations to cater for maintenance complaints from users. It could be argued that the housing units might not be designed to comply with sustainability requirements the aim of this study was not to finding out if the units meet sustainability requirements. The survey commenced on 20 October 2014 through to 15 January 2015. The survey was close ended,

but empty spaces were provided for respondents to add additional information they considered significant. Initially, literature review was conducted to find questionnaires that are similar to the aim of this research for possible adaptation. However, the attempt failed as there is no similar previous research that is directly related or suitable to this research. Hence, a new survey questionnaire was designed. However, connected to the questions asked are the performance questions for buildings in the context of sustainability that was developed by Preiser and Vischer [35]. RICS' researches also guide in developing our survey questionnaire [36, 37]. Yet, our survey questionnaire is not a hybrid of those researches. The motivation factors are measured on a five continuum scale where 5 denotes extremely agree, and 1 denotes not agree at all. Two, 3 and 4 are located in between. All motivations were positively worded, and higher scores indicate higher incentive.The degrees at which the factors can motivate homeowners are determined by the Average Relative Index. Data were analysed with SAS Enterprise Guide 7.1.

5. Findings On Household Maintenance Behaviours

In the following paragraphs, the issues, profiles and measurements of the homeowners attitudes is provided.

5.1. Profiles of the respondents

A total of 150 questionnaires were administered on the household of which 124 useable responses were returned. This leaves a total of 124 useable questionnaires for this study with a valid response rate of 94.67%. The high response rate can be explained by the method of administering the survey. More than 80% response rate is common for the hand delivery method (34]. The following tables contain the physiognomies of the surveyed respondents. Majority of the respondents were those living in terrace houses (44%) followed by those who reside in high-rise buildings (36%). Only a small group lived in detached homes. More than 90% of the respondents owned their house (Table 1). In Turkey [31] and UK [29], ownership and type of home affect maintenance behaviour. For those who own their houses, maintenance activities are generally easy and faster to execute since consent is not required. Owner occupiers tend to use high-quality materials and employed experienced labour for their repairs as compared renters.

Table 1. If respondent own or rent the house they are living in

Ownership	Frequency	Percentage
Own	114	91.1
Rent	9	8.9

The households were asked whether the current maintenance practices complied with sustainability. This question sought to examine if the householders considered that their existing maintenance approaches contributing to sustainable development. Most (42%) of the respondents agreed that it only marginally conforms to sustainability requirements. 10% of respondents believed it does not contribute at all to sustainability but about 20% of them measured that their maintenance practice was largely sustainability-focused. The findings are interesting as most owned their house. Owners are expected to engage in sustainable maintenance practice as compared to tenants. However, it was interesting that more than 80% of the respondents agreed that maintenance is very important or an important tool for creating sustainable homes (Table 2).

Table 2: If respondent considered maintenance as important in sustainable residence

Range	Very important	Important	Slightly Important	Less important	Total
Frequency	38	66	18	2	124
Percentage	30.6	53.2	14.5	1.6	100.0

Majority of the respondents spent about 8% of their house rental value to maintain their homes. Some 19% spent more than 11% of house rental values to maintain their residences. The mean score and standard deviation are 2.22

and 1.33, signifying that most of the homeowners spent between 6% and 10% of rental value to maintain their homes. Majority of those who spent less than 5% are in the income range of USD610 to USD976 monthly. This is consistence with findings in other countries that indicate maintenance behaviour to be determined by household income [38]. Some of the respondents who provided the nature of items they replaced or maintained in the last three years indicated that the maintenance involved mainly repairs on doors, door locks, painting, wall decoration, fans, air conditioning units, water heaters, piping, taps, tiles, lighting and fittings. However, to test the hypothesis that income and maintenance expenditure is related, a chi-square test was performed and revealed that no significant difference was found in the relationship between household income and maintenance expenditure (chi square = 33.75, df= 30, p>0.05). The correlation results while not significant (0.324), show they are poorly (0.090) related.

5.2. Analysing the results on incentives for sustainable maintenance practice

Reliability and validity tests were performed to determine the strength of the data. The reliability test results revealed that the Cronbach's alpha for all the motivators were excellent, with a cumulative score of 0.916 (or 92%). The validity test, using the 'commonalities', produced an average 0.618 for all factors. More than 0.05 is sufficient for the validity or reliability tests. Furthermore, to measure whether the factors are related toward an aim or objective, both KMO and Bartlett's Test were computed (Table 3). The results returned an excellent Bartlett's (0.000) score signifying that the factors are highly related. The statistics are also indications on whether the respondents were from the same population. It also means that the factors can motivate sustainable maintenance behaviours or practices of the homeowners or behaviours. Table 4 contains the statistics for the measurements of the motivators. For each motivator, the null hypothesis was that the motivator was unimportant incentive (H_0: $U=U_0$) and the research hypothesis was that the motivator was important incentive (H_r: $U>U_0$). U_0 is the population mean. 3.0 [in 5 point Likert scale] was set as the critical level. In other words, the population mean is 3. 3.0 was set because the research is exploratory in nature. For a confirmatory research, 3.5 (or 70%) more than would be desired. The standard deviation for the motivators, being less than I.0 is an indication on consistency. Furthermore, a small standard errors, in this case close to zero suggest that the measurements of the homeowners with respects to the motivators are reflections of the population. The significance (i.e. p – value) of each of the motivator (H_r: $U>U_0$) show that all the motivator are significant. Consequently, all the motivators could stand as incentive to encourage homeowners to engage in sustainable maintenance practices. However, it is imperative that it mentioned that, when 3.5 was set as the critical level, only seven of the 16 incentives were significant. The significant level of the other failed between 0.06 and 0.202. "I will replace worn out component in my house to reduce/avoid noise pollution" obtained the 0.202. The average cumulative score for the motivator is 0.711. 70% of households measured that all the motivators could facilitate sustainable maintenance practices (4.28). More than 90% of the homeowners accepted that the incentives are critical in sustainable maintenance practices. Explicitly, 14% of the responding households 'extremely agreed', 39% highly agreed, while another 39% only agreed to some extent.

Table 3 KMO and Bartlett's Test[a]

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.879
Bartlett's Test of Sphericity	Approx. Chi-Square	1057.557
	df	120.000
	Sig.	0.000

Altogether the motivators are critical, with the scores ranging from 0.6421 to 0. 0.795. Although there is no similar study against which to compare these findings, but based on recent survey these scores are considered sufficient to examine the usefulness of incentives in Malaysia. However, this study supports and extends previous research that has examined the roles of behavioural-motivational on improvement and maintenance practices [29]. Consistent with theoretical arguments and research [5,6, 39] one way maintenance could contribute to resolving global environmental problems of climate change, fossil fuel depletion, and degradation is by making certain that buildings are in optimal performance throughout life span. One approach to attain this is for the households to

replace defective components and appliances with those that comply with sustainability when the needs for maintenance arise. The households' attitudes and behaviour towards this objective is fascinating. About 94% of them indicated their willingness to replace worn out components to save energy costs. In tandem with the requirement to maintain home appliances and fittings to save energy cost, 90% of the homeowners further measured that they would replace fittings and components to save water. Water crisis is now acute in Malaysia. About 80% of water in Malaysia is for domestic consumption [8]. The significance of the water wastage is attributed to users' behaviours. Overtly, high water wastage is associated with faulty building services.

Many of the maintenance organisations are not sustainability conscious. But sustainable housing demand 'sustainable' organisations as well as 'sustainable' users. Therefore, preference should be accorded to sustainable maintenance organisations. About 43% of the respondents agreed that it is very important or important to engage experienced maintenance personal to execute maintenance works. 45% measured that it is only important to some extent. Maintenance is contagious and if carried out by inexperienced maintenance organisations, it affects maintenance-span, incurs a lot of unnecessary costs, and poses threats to the environment and social fabrics. The 3R of reuse, recycle, and reduce has long been identified as a method for sustainability. Using recycled materials for maintenance is a niche homeowners are yet to come into terms with. Recycling materials and components is important because the rate at which earth's resource is being consumed is reaching a point that the earth can no longer repairs itself. For this purpose, it is important to maintain housing with reuse recycles materials. Hence, it is interesting to find that 78% of the homeowners will maintain their house with recycled materials. 93% of the homeowners considered environmental protection to be a significant issue in maintenance practices. This finding is encouraging because households are now cognisant of the collateral implications of maintenance activities on their surroundings [12, 28]. Construction waste in Malaysia is surging unabated. Therefore, it is worthy that the homeowners are consider waste management as an approach towards sustainability. About 90% measured that if the government does not offer incentives, they will practice sustainable maintenance. The Malaysian government provides tax incentives and tax exemptions for developers who use sustainable materials and components for their constructions. Similar incentives are also provided for homeowners particularly on energy and water consumptions. However, such incentives or initiatives are mainly for new construction works. Some 64% of the responding household measured that the government should set sustainability standards for the maintenance organisations. For instance, about 90% of the responding homeowners would practice sustainable maintenance if the government set maintenance standards.

One obvious finding here is that there is an absence of regulations. However, there are some guidelines and incentives for new construction by government and regulating bodies like CIDB (Construction Industry Development Board, Malaysia), and professional bodies like GBI (Green Building Index Malaysia), and MGBC (Malaysia Green Building Confederation). Unfortunately, none of these bodies have specific guidelines for sustainable maintenance. Hence, it does not come as a surprise that the responding households argued that 'the government should exercise more responsibility regulating the advertisements, sales and marketing activities of manufacturers who produce eco-friendly products'. These results supported Boardman's [12] on regulations of energy households' energy usage. Approximately 65% of the surveyed homeowners considered the destruction of the environment a serious concern and another 33% measured it as slightly important. To interpret, the concern for environmental protection would motivate them to observe sustainable maintenance. While the exact impact of maintenance on pollution is uncertain, its negative implications are on the increase. Buildings that are not well maintained will consume more energy and water and generate more pollution and emit more toxics. While 50% of the households will certainly replace worn out components, 40% agreed they could be incentivised by the effect of pollution to exercise sustainable maintenance by replacing worn out components likely to lead to pollution. Sustainable maintenance could be energised by regulations or the market. However, some homeowners embark on sustainability on account of ethics. In fact organisation now combined profitability with sustainability as part of their corporate social responsibility strategy [35]. Therefore, it is not surprising that most of the households agreed that their personal gratification to sustainable development would also motivate them towards sustainable maintenance with 7%, 37% and 47 for very important, important, and slightly important respectively. The results of the survey of revealed that some 50% of the homeowners would be motivated to practice sustainable maintenance by market requirements, regulations and ethical issues. In fact, most spent less than 10% of their rental values for maintenance.

Table 5: Distribution of One-Sample Test statistics and ranking for motivator / incentive in sustainable maintenance.

Incentives	Test Value = 3.0								Weightage
	Std. Deviation	Std. Error Mean	t	df	Sig. (one-tailed)	Mean Difference	95% Confidence Interval of the Difference		
							Lower	Upper	
The government should increase regulations on the sales and manufacturers of eco-friendly products	0.840	0.075	6.30	123	0.000	0.475	0.3264	.6252	0.795
The government should set standards for organizations which manage residential buildings	0.868	0.078	5.16	123	0.000	0.403	0.2488	.5577	0.781
The increasing destruction of the environment is a serious concern to me	0.849	0.076	4.44	123	0.000	0.338	0.1877	.4897	0.768
It is important for me to protect the environment during the maintenance of my home	0.854	0.076	3.15	123	0.000	0.241	0.0901	.3938	0.748
I will replace worn out component to save energy	0.762	0.068	1.65	123	0.000	0.112	-0.0225	.2484	0.723
I will replace worn out component to save water	0.804	0.072	1.45	123	0.000	0.104	-.0382	.2479	0.721
I will increase my knowledge on sustainable issues	0.744	0.066	1.21	123	0.000	0.081	-.0517	.2130	0.716
I will replace worn out component in my house to reduce/avoid noise pollution	0.964	0.086	0.83	123	0.000	0.072	-0.0988	.2440	0.715
I will use recycle materials to maintain my house	0.973	0.087	-3.32	123	0.000	-0.290	-0.4634	-.1173	0.642
If the government does not offers incentives, I will practice sustainable maintenance	0.836	0.075	-1.18	123	0.000	-0.088	-0.2374	.0599	0.682
I am personally obliged to practice sustainable maintenance management	0.756	0.067	-1.07	123	0.000	-0.073	-0.2070	.0619	0.686
I wish my home to be rated based on Green Building Index	0.947	0.085	-.85	123	0.000	-0.073	-0.2409	.0958	0.686
It is expected of me to practice sustainable maintenance	0.785	0.070	-1.372	123	0.000	-0.097	-0.2364	.0428	0.681
I will consider the community wellbeing when the need to maintain my home arise, even if it required a bit of extra cost	0.784	0.070	-1.49	123	0.000	-0.105	-0.2442	.0346	0.679
I will always use experience maintenance personnel even if it will take extra cost and efforts	0.803	0.072	-1.56	123	0.000	-0.112	-0.2557	.0299	0.677
I will put extra efforts [i.e. money & times] to practice sustainable maintenance	0.857	0.076	-1.89	123	0.000	-0.145	-0.2975	.0072	0.671

This is somewhat surprising as it is widely considered that sustainable buildings are more expensive compared to conventional buildings. It was also found that most of the homeowners will spend more to maintain sustainably.

However, there is no difference between sustainable maintenance expenditure and those who did not practice sustainable. The latest findings contradict this general stereotype. The latest report from BREEAM and co-authored by Sweett Group, based on three large case study buildings comprising an office, a secondary school, and a community healthcare, established that though the initial cost of sustainable buildings is more, cost increases are less than 2% [40]. But their study found that this will be paid back by the utility costs while the buildings are in operation within two to five years. The survey found that the residents would perform maintenance based on the GBI guideline. While this is interesting, the GBI tool is for new construction. From the survey reports, community wellbeing was found to a critical motivator or incentive for sustainable maintenance. This finding is interesting because neighbourhoods affect housing maintenance behaviour [28]. Owners of adjoining properties and the general public influence the standards of buildings. Buildings are a representation of the owners and the communities wherein they are located. Apart from the waste that buildings generate, maintenance or lack of it on a building has psychological implications on the users and public. According, to Seeley [41], a poorly maintained building is irritating and unsightly and dangerous to use. Thus not surprising that 95% of the homeowners considered it very important or important to consider community wellbeing in maintenance.

6. Conclusion

This study detailed households' perceptions on how housing maintenance can contribute to the sustainability objectives. Obviously, there is a requirement for a shift in the maintenance delivery process. However, for now, the household require some incentivises because of the weaknesses the marketplace and ethical forces, because regulations alone will not be able to provide a systemic basis for the homeowners to procure sustainable maintenance. Homeowners are now questioning the sustainability credentials of the maintenance organisations' methods of delivery. Yet, the current argument in favour of sustainable maintenance is largely theoretical. While making decisions on sustainable housing maintenance, a mechanism is required to actively consider both strategic and tactical issues including users and their value system, set sustainability as the objective of maintenance, the roles and impact of other stakeholders, issues including waste, eco-system, the local community, aesthetic degradation, embodied energy, health risks, transport, pollution, and labour. The initial hypothesis that necessitated the study was presented in Figure 1. As noted within this study, the conjecture is validated theoretically. An important consideration in any sustainable maintenance is to initially clear the behavioural aspect without which the adoption and use of the technical sustainability is only possible if the users' behaviour is influence. The government needs to increase households' awareness of sustainability and the usage of reused / recycled materials for maintenance. For this to happen, the government directly or indirectly needs to create the market for these products. The growing market for green homes, though currently still low at about 5% is growing fast. Costs of green materials will reduce as technologies improve. However, in the formulations of the policies, households and manufacturers engagement are actively require and feedback should be incorporated. In this research we have only focused mainly on how household behaviour would contribute to sustainability through maintenance, future research may consider the reasons for such behaviours. Future research may wish to consider examining the influence maintenance organisations on maintenance behaviour, and to verify the model proposed in this study.

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