[CON 2] EXPLORATORY STUDY ON GREEN MATERIALS FOR SUSTAINABLE CONSTRUCTION

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ABSTRACT

This is an exploratory study on green materials for sustainable construction. The focus is on student's awareness to influence construction industry the way how the project should be carried out to balance between conserving the environment and maintaining prosperity in development. Since it has a direct effect on the environment, therefore green materials should be considered. For that reason, this study explores the relationship between performance expectancy (PE), effort expectancy (EE), social influence (SI), facilitating conditions (FC) towards behavior intention (BI) and use behavior (UB) using UTAUT and to know the level of acceptance uses of green materials for sustainable construction among students. The data will be collected through a unified theory of acceptance and use of technology (UTAUT) questionnaire survey. The statistical tools used to analyze the data is the Statistical Package for the Social Sciences (SPSS). It was found that, behavioral intention gives a large influence to use behavior at 42.9%. This study has contributed by using green materials can ensure the availability of resources for the future generations.

Keywords: *green materials, sustainable construction, Malaysian construction, technology acceptance, UTAUT*

INTRODUCTION

DuBose et al stated sustainability offers a way to interact with our world that reconcile with the ubiquitous human desire for high quality of life to the context of the realities of the world. It requires a unique solution to improve the welfare of us and not harm the environment and impact badly on the welfare of others (DuBose et al., 1997).

Sustainable construction refers to the implementation of materials, construction methods, and building designs that are environmentally pleasant. Another means of using resources and materials which ease to be had in many sources from sustainable supplies (Building and Construction Authority, 2007). At the beginning proposed, the term of sustainable construction is to clarify the responsibility of the construction industry in conducting sustainability. They have singled out 4 attributes of sustainability - social, financial, biophysical and technical - to strengthen knowledge of the concept of sustainable construction (Hill and Bowen, 1997).

Sustainable construction will improve the durability of our construction industry and building by using sources and materials which are easy to find from many sources in any nation. It demanding situations our builders to apply green product and materials

meet the ever-developing best expectations in their clients. With sustainable construction, more materials may be simply reused and recycled for the similar cause might be used. This reduces leftover and encourages an ecological sustainability (Building and Construction Authority, 2007). Therefore, the objective of this study is to explores the relationship between performance expectancy, effort expectancy, social influence, and facilitating conditions towards behavior intention and use behavior using UTAUT and to know the level of acceptance uses of green materials for sustainable construction among students.

PROBLEM STATEMENT

Construction has an instantaneous effect on the surroundings because of subsequent causes such as noise pollution because of uses heavy vehicles, emissions from vehicles, generation of waste substances, machinery, releases of wastes and pollutants into water, ground, and environment and lastly, construction machinery. Sustainability assessment of construction initiatives is essential to the truth that it does now not create any harmful results at the living environment at the same time as optimizing the cost of construction. That is to ensure the provision of resources for the future generations. However, sustainable construction can be achievable and only happen when all of designers, developers, suppliers, stakeholders, and builders identify and value its significance. We need altogether parties to make a sensible judgement to accept the usage of green materials in their constructing project. Also want to train and lift recognition of client on sustainable construction considering the fact that in the long run, it's consumers' demand for that will encourage or even dictate the construction's trend (Building and Construction Authority, 2007). In spite of the growing popularity of the ideas of sustainable building, there nevertheless remains a massive venture against of lengthy-time period training and extensive acceptance, and regardless of the developing consciousness of green products, high-performance technologies and sustainable practices in construction and constructing design, many worries that there remains a loss of accurate through quantifiable fact concerning and to the economic and financial consequences of high performance of buildings in the construction industry. Further, there are likewise leaps with regards to the impression of cost, which has turned into a hindrance in the faster acceptance of green building ideas (Vanessa, 2008).

LITERATURE REVIEW

The UTAUT in Figure 1 recommends that four variables such as performance expectancy, effort expectancy, social influence, facilitating conditions are direct influence towards behavioral intention and user behavior, and that those variable are thusly directed by means of age, gender, voluntariness of use and experience (Venkatesh et al., 2003). It's far argued that through examining the presence of each of these variables in a "real world" surroundings, practitioners and researchers might have the capable of evaluating an individual's aim to apply a particular framework, as a result along these lines taking into account the identification of the key impacts on acceptance in any given setting. The discussion as follows:

Performance expectancy is how much her or him expectations that applying the framework will benefit them to achieve picks up in job execution (Venkatesh et al.,

2003). The green building materials performance, as with traditional building products, relies on the suitable application, right renovation and durability of the product. Regularly, green building materials are given greater scrutiny than their traditional material counterparts due to the fact they tend to be more modern with much less proven performance. The previous case study indicates that green building materials had been and getting used efficaciously in sustainable construction tasks demonstrating that product with recycle content or minimal chemical emissions can carry out as properly better than conventional products. As an example, green building product had been effectively carried out into The Ridgehaven Green Office Building, the honor-winning economical and sustainable renovation of an existing 6000m² (73,000 ft²) office building for the city San Diego Environmental Services Department in California. This sustainable facility showcases environmentally pleasant building materials, healthful IAQ and resource efficiency via reuse and recycling (Froeschle, 1999).

Effort expectancy is the quantity of convenience perceived for the utilization of a framework (Venkatesh et al., 2003). Sustainable construction begins with arranging and design. The designer's and developer's parts are consequently crucial. In any case, as sustainable construction includes pre-assembled product, it is valuable to acquire relevant specialists and suppliers early inside the layout level. Execution down the whole construction value chain is also essential. There might be a requirement for sharing of expertise and knowledge in layout and the utilization of such materials (Building and Construction Authority, 2007). The material utilized in a sustainable construction reduce life cycle natural effects together with resource depletion, human toxicity, and global warming. Ecologically leading material have a reduced impact on human well-being and the surroundings and make contributions to progressed employee welfare and healthiness, decreased disposal cost, decreased liabilities and success of natural dreams (WBDG Sustainable Committee, 2015).

Venkatesh et al. stated that with the social influence, they supposed by way of the degree to which her or him perceives that other ones are significant to them the utilization of new framework (Venkatesh et al., 2003). The need to reason in phrases of sustainable development also impacts issues about the drift inside the greenhouse impact and weather change. Sustainable development is not a transient trend, these days it is an imperious necessity and an economic fact that increasingly number of local authorities and businesses are beginning to keep in mind of their strategies and movements. Definitely, green building is on the ascent as worldwide tendencies trendy. As indicated by the World Green Building Trends overview, 51 percentages of respondent corporations devoted to consolidating sustainability into more than 60 percentages in their labor by way of 2015. The identical record additionally recognized the favor of green building that calls these organizational businesses into sustainable construction: Better healthiness and productiveness in the top list of societal motives processes in corporations practicing environmental awareness of their construction (Triple Pundit, 2015).

Facilitating conditions refer to the degree to which her or him sees that specialized and authoritative framework required to apply gathered framework are accessible (Venkatesh et al., 2003). Becoming environmentally feasible brings a large group of points of interest that business genuinely can't disregard. In the meantime, as some green construction advance expense more ahead of time, organizations receive rewards over the long run. Besides, sustainable construction technology is consistently being

created for broad scale and additional low-cost circulation, the growing interest in green building that supports the idealistic standpoint for the future of green building (Triple Pundit, 2015). The robust era innovations and applications are getting streamlined within the production manner and this year we will expect one step further. Numerous models are becoming advanced for the complete to ease down the total drift of the construction process. As an example, Building Information Modeling. It's the usage of digital model in construction. This software is constantly evolving and is now seeing a convergence of the gaming tech as nicely. This system aids constructing design at every level of construction. With this 3D modeling tool, you may evaluate the modern 3D building reputation resulting in a quality control system which further removes pricey and time-consuming emend. We are able to absolutely anticipate further technological innovation like this in 2016 for sure (Wienerberger India, 2016).

Behavioral intention to utilize a fresh out of the box new framework is incited by clients' state of mind and saw helpfulness of the framework (Venkatesh et al., 2003). Mostafa (2007), for instance, characterized the behavior of green purchase as environmentally friendly purchasing behavior or the utilization of item or material that benefits in the responsive conservation, environment, recyclable, and delicate to the need of environmental topics. Chan (2001) described it as naturally pleasant behavior said by way of buyer in showing their enthusiasm for the course of the naturally though whereas Nik Abdul Rashid (2009) defined it because the chance and ability of the individuals who offer tendency to items that join highlights which may be ecologically lovely when contrasted with the buy of other routine items. There's a wealth of empirical evidence from studies performed in evolved and developing countries worldwide that advise that green purchase behavior is prompted with the aid of a number of things like the subculture, cost orientation, environmental challenge, knowledge, mindset and demographic elements (Kauffman et al., 2012).

Use behavior was measured clients' real frequencies of innovation utilize (Venkatesh et al., 2003). The possibility of particular practices being more and less green is risky in light of the fact that there is as often as possible a distinction between natural inspirations and results, and a definitive supportability of a behavior relies on upon comprehension the whole procedure of utilization and how singular demonstrations of utilization consolidate to frame a way of life. The demand for the green product can range because of differences in ethical ideas and people’s lively participation on environmental troubles. As user mindfulness, information and dispositions turn out to be more tuned toward sustainability, we spend and discard items and vitality all the more carefully. Post buyer behavior incorporates both item utilization behavior and manner or disposal behavior. More practical item utilization may incorporate behavior, for example, turning down indoor regulators or joining car trips for more noteworthy proficiency. More economical attitude or disposal behavior would incorporate fertilizing the soil vegetable waste and reconsidering before relegating anything to a junk sack bound for the landfill. In our item disposal behavior, user have chances to decrease waste and coordinate significant assets over into the production network through reusing. Previous study findings concerning user attitudes towards eco-friendly products are conflicting, for example, some studies found that user think conventional products have high quality compared to eco-friendly ones but in other studies results show the opposite (Vernekar & Wadhwa, 2011).

THEORETICAL FRAMEWORK

In this section, we use UTAUT to explores the relationship between performance expectancy, effort expectancy, social influence, facilitating conditions towards behavior intention and use behavior, and to know the level of acceptance use of green materials for sustainable construction among students. The UTAUT purpose of clarifying user intention to apply for an advance and following by usage behavior. The hypotheses hold that four key variables; performance expectancy, effort expectancy, social influence, facilitating conditions are a direct influence of user intention and behavior. Below is a framework of the key construct in Figure 1.

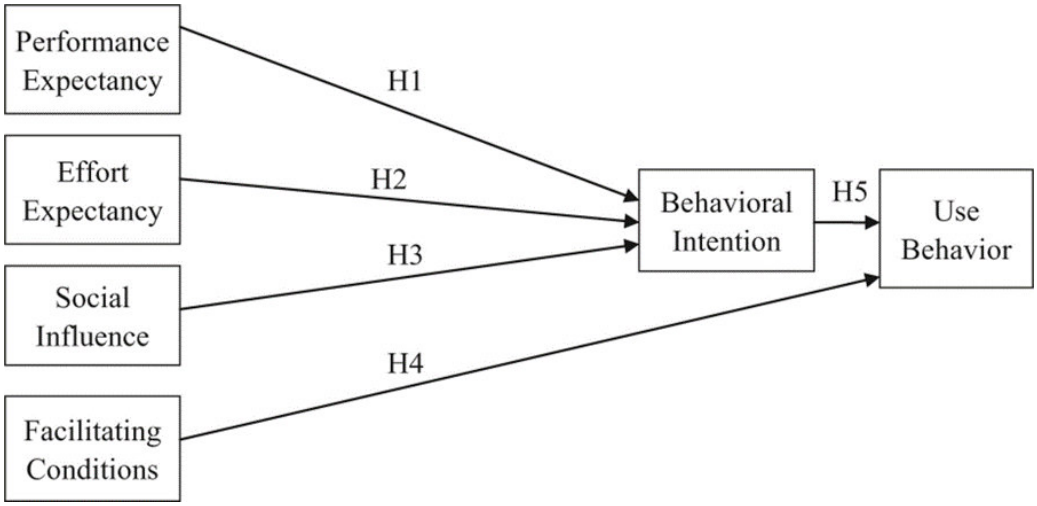

Figure 1
Green materials technology acceptant framework

HYPOTHESES

The following hypotheses are proposed:

The evidence in, Venkatesh et al. (2003), Taylor and Todd (1995), Davis et al. (1989) propose that user has more plan to utilize a fresh out of the box new data innovation if this data innovation can help enhance their general execution. In this way, we hypothesize:
H1: Performance expectancy has a positive influence on behavioral intention to use green materials.

Venkatesh et al. (2003) and Agarwal and Prasad (1998) and have called attention to that user have extra intention to use a brand new data innovation if it is easy to function. Therefore, we hypothesize:
H2: Effort expectancy has a positive influence on behavioral intention to use green materials.

The evidence Venkatesh et al. (2003), Karahanna et al. (1999), Agarwal and Prasad (1998) prompt that user has a more significant aim to apply another data innovation if individual vital to them think it is essential for them to receive the new innovation. Therefore, we hypothesize:

H3: Social influence has a positive influence on behavioral intention to use green materials.

Venkatesh et al. (2003) and Taylor and Todd (1995) have specified that user will utilize another data innovation all the more regularly and certainly on the off chance that they comprehend rich resources for utilization of this innovation. Therefore, we hypothesize:
H4: Facilitating conditions has a positive influence on use behavior to use green materials.

Venkatesh et al. (2003) and Venkatesh and Morris (2000) support that better behavioral expectation prompts to a superior recurrence of utilization. Therefore, we propose:
H5: Behavioral intention has a positive influence on use behavior to use green materials.

RESEARCH METHODOLOGY

This study is to explores study on green materials for sustainable construction and will be held in Universiti Utara Malaysia (UUM), Sintok, Kedah. The study will be conducted within a specified time-period, just in one week. The data of analysis is will be quantitative. Data was collected through a questionnaire design in two parts. The first part was to gather demographic questions and the second part is five-point Likert scale, UTAUT model question that consists six sections such as performance expectancy, effort expectancy, social influence, facilitating conditions, behavior intention and user behavior. The five-point Likert scale ranges from 1 to 5 representing strongly disagree and strongly agree respectively, 2 and 4 represent disagree and agree while 3 represent neutral. A total 100 questionnaires were distributed and delivered by hand. Students in UUM is contributed as respondents. Statistical Package for the Social Sciences (SPSS) were the statistical tools used to analyze the data.

RESEARCH ANALYSIS AND FINDINGS

This section will discuss the result and findings with respect to all variables of the proposed UTAUT such as performance expectancy, effort expectancy, social influence, facilitating conditions and their relationship with direct dependent variable, user intention, and behavior.

Descriptive analysis

In Table 1, the gender of respondent on this study are 10% male and 90% female. For others, general information can refer the table below.

Table 1
General information

		Frequency	Percentage (%)
Gender	Male	10	10
	Female	90	90
Age	19-21	25	25
	22-24	74	74
	25 and above	1	1
Race	Malay	87	87
	Chinese	11	11
	Other	2	2
Nationality	Malaysian	100	100
Level of education	Undergraduate	100	100
College	CAS	19	19
	COB	74	74
	COLGIS	7	7

Test of normality
As we can see, all the variables are normal because of $p < 0.05$ between 0.001 – 0.022. Refers Table 2 for more details.

Table 2
Shapiro-Wilk

	Shapiro-Wilk		
	Statistic	df	Sig.
PE	.964	100	.008
EE	.947	100	.001
SI	.970	100	.022
FC	.966	100	.011
BI	.971	100	.026
UB	.967	100	.012

Reliability analysis
In Table 3, all the variables are reliable because $\alpha > 0.7$ between 0.7 – 0.836. Refers Table 3 for more details.

Table 3
Cronbach's Alpha

	Cronbach's Alpha (α)	N of items
PE	.793	5
EE	.700	4
SI	.774	4
FC	.729	4
BI	.836	5
UB	.725	4

Correlations analysis
For correlation analysis, Table 4 shows there is a strong relationship between BI and UB because Pearson's r is 0.655. Pearson's r is close to 1. The Sig. (2-Tailed) value in

all variables are $p < 0.05$ because of this, we can conclude that there is a statistically significant correlation. For more details, can refers table below.

Table 4
Pearson correlation coefficient

		PE	EE	SI	FC	BI	UB
PE	Pearson Correlation	1	.499	.364	.104	.379	.437
	Sig. (2-tailed)		.000	.000	.304	.000	.000
	N	100	100	100	100	100	100
EE	Pearson Correlation		1	.556	.282	.510	.578
	Sig. (2-tailed)			.000	.005	.000	.000
	N		100	100	100	100	100
SI	Pearson Correlation			1	.434	.541	.587
	Sig. (2-tailed)				.000	.000	.000
	N			100	100	100	100
FC	Pearson Correlation				1	.306	.409
	Sig. (2-tailed)					.002	.000
	N				100	100	100
BI	Pearson Correlation					1	.655
	Sig. (2-tailed)						.000
	N					100	100
UB	Pearson Correlation						1
	Sig. (2-tailed)						
	N						100

Table 5 shows the percentage of correlation determination that all correlation contributed. This study pointed BI has the highest influence on the UB by 42.9%. Refers Table 5 for more details.

Table 5
Correlation of determination

Correlation	Correlation of determination (%)
PE → BI	14.4
EE → BI	26
SI → BI	29.3
FC → UB	16.7
BI → UB	42.9

DISCUSSION

The focus of this study to exploring the relationship between all variables using UTAUT model and to know the level of acceptance use of green materials for sustainable construction among students. Venkatesh et al. (2003) suggested the UTAUT model that the three variables - PE, EE, and SI directly influence BI, which subsequently influences UB. The theory also suggested the direct influence of FC on UB. The result forms this study suggests there is a weak relationship between PE and BI. This is because some students maybe did not like to read the current news or trend about the sustainable material for green building. In another hand, the respondents are

more female (90%) than male (10%) that also maybe affect the result. Next, EE and SI have a strong relationship between BI refers to table 4. In this case, reusable or recyclable materials that can be easily dissembled at the end of their useful life. By influence the consumers, social have many paybacks of green building such as improve occupant healthiness, well-being and increase the overall value of life (Western North Carolina Green Building Council, n.d). FC has a weak relationship between UB and lastly, BI has a strong relationship between UB. Since all variables in correlation coefficient Pearson's r is positive, we can conclude that when the value of PE, EE, and SI high, BI to use green materials also high. If the value FC and BI high, UB of green materials also high and vice versa. To conclude, all the variables propose in hypotheses 1 – 5 are accepted.

CONCLUSION

To conclude, among UTAUT variables, behavioral intention gives a large influence to use behavior at 42.9%. Sustainability is the blend of numerous decisions that contain components identified with social, ecological, use, quality, and construction strategies. These components must be considered with the goal that you can accomplish sustainability, which meets these day desires and can constantly offer for a day after today's needs. It's incredible for one material or method to be perfectly feasible, in any case, it's possible to be as sustainable as anyone might imagine. The supportability of construction materials no more extended easiest considers the materials itself, yet also other technique together with the sustainable approach and the correct capacity. Finally, everything about materials, even the brown ones, can help with making the building more significant reasonable on the off chance that they might be utilized carefully for the correct reason and in the suitable components. Inside a similar way, sustainability or green materials, if utilized for the wrong purposes, can prevent to maintain the building from becoming a sustainable fulfillment.

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