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Factors Influence the Adoption of Load-Bearing Masonry System: A Study on Malaysia Housing Developer Firms

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Abstract: This study aims to investigate the factor influencing theadoption of Load-Bearing Masonry (LBM) system among Malaysia housing developer firms. The research model has proposed the perception of the organization such as the relative advantage influence the LBM system adoption. Additionally proposed the organizational readiness and external supports influence on the organization's perception. The random sampling technique was applied to identify the number of respondents and a total of 100 useable questionnaires was returned for further analysis using the SEM-PLS. The findings shown the relative advantage appears as the factor for the adoption of LBM system. Meanwhile, the organizational readiness and external supports effect to the relative advantage. Generally, the findings provided support on the importance of recommended influence factors on the LBM system adoption.

Key words: Housing developer, Load Bearing Masonry System (LBM), relative advantage, organizational readiness, external supports

INTRODUCTION

It is highly acknowledged that in order for a company to become sustainable and competitive locally and globally, it needs to improve its ways in doing business. With the adoption of innovations such as the recent technologies in the construction industry, the firms would have the potential to survive in the highly competitive global business (Tatum, 1986).

The technology of Load Bearing Masonry (LBM) system brings several advantages to the construction industry such as speeding up the construction work, its economic benefits and its ability to reduce the works on the construction site. According to Majid about 10-20% of the total cost of the will be reduced as the formwork does not require for the concreting process.

Despite these advantages and it's widely used in European and the United States this system unfortunately did not reach the desired level of implementation in Malaysia (Ramli *et al*., 2014). The study of Abdullah highlighted the awareness regarding this technology but at the same time its implementation relatively uncommon. In these circumstances the factors that drive the technology adoption among the industry players in the construction industry need deeper understanding.

There are only a few studies regarding the LBM system adoption. According to Adedeji (2008) the adoption of the load bearing masonry namely as an interlocking brick system was influenced by cost and time. Nonetheless, in additional to these conducted studies there is still a void for research regarding the LBM system adoption. Hence, the aim of this study was to reveal the factors that drive the adoption of the LBM system among the developer firms as a decision maker for construction projects.

In particular, this study has focused on the characteristics of the adopted behavior. According to Rogers the adoption technology is driven by its aspects such as the relative advantage. For in deep understanding of the organizational readiness and the external supports were included in this study as a potential influence the perception of relative advantage. According to Hartmann, it's important to examine the factors that drive the perception of the technology adoption.

Innovation diffusion theory: The Innovation Diffusion Theory (IDT) is widely used in technology adoption and proven successful in predicting and explaining the behavior intention across a variety of fields. In a study by Rogers in the field of technology diffusion have proposed that the potential adopter's perceptions of an innovation influencing by five attributes namely relative advantage, compatibility complexity, observability and trialability.

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Framework of the study and hypothesis: Based on the IDT, this study has proposed that the relative advantage is influencing the adoption of the LBM system among the developer firms. The relative advantage is an important factor that influences the adoption of technology. According Henseler *et al*. (2014) the relative advantage is the most Roger's innovation attributes to the technology innovation (Fig. 1).

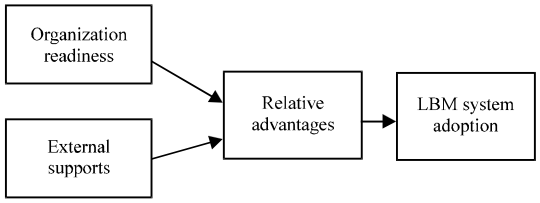

Fig. 1: Framewok of the study

Relative advantage: Relative advantage refers to the degree to which an innovation is perceived as being better than previous methods. For this study, relative advantage is defined as LBM system is perceived as being better than the conventional construction methods. Studies have consistently proven a positive relationship between the relative advantage and the adoption (Agarwal and Prasad, 1997; Ramayah *et al*., 2013). The organizational would adopt the LBM system according to the technological benefits it would give the company. The more the organization perceives the technology to be better than the traditional method of getting work done the more likely they would adopt that technology. Thus as proposed by Abdullah the relative advantage influences the adoption of the LBM system. Therefore, the hypothesis is:

- H_1: The relative advantage has a positive effect on the organizational adoption of the LBM system

Organizational readiness: Organizational readiness is the availability of the resources in the organization. Organizational readiness such as technological and financial factors remain significantly important influencing the adoption of technologies (Alam, 2009; Ramdani *et al*., 2009; Grandon and Pearson, 2004). Whereas El-Gohary (2012) has postulated that perception is influenced by the internal support of the organizational itself like theorganization's readiness. The more resources an organization has, the more likely it would have a positive perception of the technology. Therefore, this study also hypothesis;

- H_2: Organizational readiness has a positive effect on the relative advantage

External supports: External supports have an important role in the determination of technology adoption. External supports reflect the availability of the thirdly supports for implementing a technology in the organizational (Premkumar and Roberts, 1999). Abbasi in their study showed the significant relationship of the external factors through perception. It is important that external supports influence the perception of the organization to increase the likelihood of the technology adoption. Thus, the study hypothesis:

- H_3: External supports have a positive effect on therelative advantage

MATERIALS AND METHODS

The list of respondents was retrieved from the Real Estate and Housing Developer's Association Malaysia (REHDA). Data were randomly collected. Out of 405 questionnaires that were sent through postage and only a 100 were completed and returned. The result indicated a response rate of about 24%. The questionnaires were answered by employees of all levels in the developer companies, following a similar study by Ibrahim *et al*. (2013) that considered the upper and the lower employees in answering the questionnaires. Executive and managerial level employees play an important role in the activities of the company and usually involved in the working processes and are also involved in the decision making processes, thus, making them appropriate representatives of their companies in answering the questionnaires.

The relative advantage was measured by five items that were adapted from Moore and Benbasat (1991) organization readiness was measured by 6 items that were adapted from Hadaya and Pellerrin (2010) and external factors were measured by seventeen items that were adapted from Chua *et al*. (1999), Premkumar and Roberts (1999). Whereas, the LBM system adoption was measured by eight items that were taken from Davis (1989). A five grade-Likert scale has been used to measure the items.

Analysis: Table 1 shows the demographics of the 100 respondents. The surveyed developer companie's comprised the private companies of 94 and 6% GLC companies. The results indicated that the majority of companies are >20 years, experiences with a percentage of 42% followed by 11-20 years with 32% and companies

Table 1: Result of respondents

Categories	Percentage
Type of company	
Private firm	94
GLC	6
Employees	
<30 employees	48
31-75 employees	19
76-120 employees	16
>120	17
Company experiences (years)	
<10	26
11-20	32
>20	42
Job positions	
Managerial level	24
Professional level	19
Senior executive level	57
Year of position	
<10	59
10-15	14
16-20	21
>20	6
Location	
Northern region	19
Center region	47
Eastern region	27
Southern region	7

with <10 years experiences comprised 26%. A majority of the companies have <30 employees with the percentage 48%, 19% of the companies have between 31-75 employees. Meanwhile, 17% of the companies have >120 employees and 16% of the companies have between 76-120 employees. These results indicate that most of the respondents are from small companies.

A large percentage of 57% comprised the positions of senior executives, 24% at the managerial level and 19% at the professional level such as architects and engineers. Employees with <10 years of experience comprised with 58%, employees with 16-20 years of experience comprised 21%. Meanwhile, employees with 10-15 year of experience comprised 14% and employees with >20 years experiences comprised with 6%. Most of the companies located in the center region with the majority of 47%, companies in the eastern region comprised 27%, companies in the Northern region comprised 19% and companies in the Southern region with a percentage of 7%.

From the survey, the majority of the respondents not implemented the LBM system with a percentage of 80% and only 20% of respondents implemented this system in their projects.

RESULTS AND DISCUSSION

The Partial Least Square (PLS) approach on the SmartPLS 3.0 Software was applied to analyze the data collected. A component-based structural modelling such as the PLS is rapidly becoming an alternative method for data analysis in areas like construction management. PLS based structural modelling was chosen because it's predictive nature (Hair *et al*., 2012) of the construct rather than fit the model. Furthermore, PLS-SEM based is on executing the variance explains of the model proposed (Hair *et al*., 2010).

Table 2: Convergent validity

Category	AVE	Composite reliability	R^2	Cronbach's alpha
Adoption	0.500	0.831	0.200	0.756
External support	0.505	0.832	-	0.749
Organization readiness	0.504	0.858	-	0.810
Relative advantage	0.647	0.900	0.734	0.861

Table 3: Discriminant validity

Category	Adoption	External supports	Organization readiness	Relative advantage
Adoption	0.707			
External supports	0.535	0.711		
Organization readiness	0.358	0.598	0.709	
Relative advantage	0.446	0.677	0.790	0.810

A study by Anderson and Gerbing (1998) suggested the two-step approach for the PLS analysis, whereby the measurement model was the first estimate and then the structure model. The measurement model contains the relationships among the latent constructs and the items. It is important to establish the construct validity of the measurement model before testing the hypothesis. Construct validity was demonstrated for the convergent validity and discriminant (Hair *et al*., 2010). Table 2 shows the composite reliability and Average Extracted (AVE) as represented the convergent validity of the model.

The composite reliability for the reflective construct has exceeded the cut-off point of 0.70 and the loading exceeded 0.5 as recommended by Hair *et al*. (2012) and AVE for each construct were over the recommended value of 0.50 as suggested by Fornell and Larcker. The convergent validity was established.

Besides the convergent validity, the discriminant validity was tested for the reflective construct. The discriminant validity is the degree of measurement of different constructs are dissimilar from other and calculated by comparing the correlation between the constructs with the square root of the AVE. Based on Table 3, the indicating discriminant validity had been achieved.

The structure model was measured after the establishment of the measurement model. The structural model presented the hypothesized relationship between the exogenous variables (organizational readiness and

Table 4: Loading and cross loading

Category	Adoption	External supports	Organization readiness	Relative advantage
CONT3	0.128574	0.569732	0.317530	0.429988
CONT4	0.216608	0.557638	0.341324	0.286259
DECISION4	0.732282	0.416950	0.383757	0.365863
DECISION5	0.672628	0.409860	0.020651	0.198059
DECISION6	0.808636	0.400628	0.370859	0.418972
DECISION7	0.752984	0.399227	0.224919	0.305053
DECISION8	0.541340	0.269717	0.090389	0.200821
GOV1	0.296885	0.726844	0.496385	0.558649
GOV3	0.630514	0.854036	0.433348	0.539823
GOV4	0.535961	0.794878	0.504678	0.522094
OR1	0.023756	0.191464	0.664342	0.367291
OR2	0.078510	0.332291	0.708637	0.458631
OR3	0.258553	0.213475	0.678776	0.496891
OR4	0.436188	0.584271	0.655646	0.698242
OR5	0.138557	0.454430	0.718790	0.543833
OR6	0.392846	0.576390	0.820885	0.772498
RA1	0.337960	0.618096	0.670029	0.793120
RA2	0.408657	0.588083	0.772532	0.829416
RA3	0.347159	0.553500	0.737148	0.881717
RA4	0.439373	0.465231	0.638955	0.843444
RA5	0.240316	0.501020	0.447660	0.657120

Table 5: Results of hypothesis

Category	B-values	t-values	Result
ES->RA	0.2860	4.889	Significant
OR->RA	0.6542	13.289	Significant
RA->ADOPT	0.4469	5.539	Significant

H_1: RA>ADOPT; H_2: OR>RA: H_3: ES>RA

external supports) and endogenous variable (relative advantage and adoption). From the analysis, the explanatory power was obtained and indicated the R^2 for the relative advantage to be at 0.734 and the R^2 for the LBM system adoption to be at 0.20. It was shown that the 73% of the variance in relative advantage was explained by the organizational readiness and external support while 20% of the LBM system adoption was explained by the relative advantage (Table 4). Results from the Table 5 support the H_1 hypothesis. The positive relationship between the relative advantage and LBM adoption and with the t-value (t-value 5.539, $p<0.001$***).

H_2 was also supported by the positive relationship between the organizational readiness on the relative advantage perception (t-value 13.289, $p<0.001$***). The H_3 hypothesis supported by the external supports positive effect on the relative advantage perception (t-value 4.889, $p<0.001$***).

The findings prove that the relative advantage H_1 is a good predictor of the LBM system adoption. This study is consistent with the studies of Agarwal and Prasad (1997), Ramayah *et al*. (2013). The results show that the developers were willing to adopt the LBM system in their projects because of the benefits of the technology. A technology such a LBM system encourages the efficiency and the performance of the project as compared to the conventional methods. The results indicated the organizational readiness H_2 has a positive relationship on relative advantage. This finding was lined with the previous work by El-Gohary (2012). The more resources present in the organization such as finances, technologies and knowledgeable employees, the more they influence the relative advantage perception. Organizational readiness showed a higher value of significance and it informed that the developers regarding its importance in driving their perception of the technology.

H_3 hypothesis also had a positive effect on the relative advantage. A higher positive effect of external supports to the relative advantage's perceptions influences the company to adopt the technology. External support such as the government and the contractors are important in the implementation of the technology. Organizational believe adequate support from the government to encourage the adoption of the LBM system would bring benefit to their companies.

CONCLUSION

In conclusion, this study provides empirical findings for the adoption of the LBM system among the developer firms in Malaysia. The relative advantage characteristic as proposed in IDT is significant to this study. Furthermore, it is an effort to understand the important factors of the LBM system adoption. The results indicated that the organizational readiness and external supports influence the relative advantage. Thus, the developer organizations are important to improve their internal resources and receiving support from the externals in the implementation of the LBM system. Besides, a collaboration between external body such as the Construction Industry Development Board (CIDB) to enhance their knowledge and getting valuable information regarding the LBM system. Otherwise, the policy makers or any other parties who desire to incorporate the adoption of the LMB system among the housing developer firms should consider the factors such as a perceived relative advantage, organizational readiness and external supports. Presently, this study only focuses on the three constructs in driving the adoption of technology among the developer firms. To extend of this study, future research should cover other factors such as ease of use, knowledge and other characteristics of diffusion innovation.

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