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Measurement Model Assessment of Intervention Strategies for Littering Behavior Changes using Partial Least Square: in Context of Malaysian Flat Residents

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Abstract

This research was conducted for assessment of the measurement model by using Structural Equation Modeling Partial Least Square. In implementing the measurement model testing in this study, the variable exogenous and endogenous variables that intervention strategies are represented by the variables x and behavioral changes that are represented as variable y. Test validity and reliability is implemented through Structural Equation Modeling (SEM) analysis using Smart PLS 2.0. A total of 1200 questionnaires were distributed and only 849 forms returned and used for this analysis. In this paper, findings and discussion will only describe the results of an analysis of the measurement model linking indicators (manifest variables) to construct. Assessment of the validity and reliability of the measurement model is assessed through four following analysis of internal consistency reliability, indicator reliability, convergent validity and discriminant validity. The end result of over four analysis found that the measurement model in this study is valid and can be used for further analysis of the formation of structural models.

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1. Introduction

First critical efforts in the field of behavior analysis to find solutions to environmental problems is to start with the problem of littering. Littering is described as rubbish dumping in the wrong place, resources are no longer useful, is not beneficial for the environment, dangerous , detrimental to the health and cause disease (eg. needles and toxic waste being dumped in the wrong place) [12]. There are many harmful effects of littering behavior which affect the environment, health and safety hazard and cost a lot for the country to cover the cost of waste collection scattered. They can also damage ecosystems living environment such as animals and plants [9]. In Malaysia , the problem of litter removal has invited a variety of adverse impacts on public health, including disease spread by rat urine due to a breach of a clean environment. According to Urban Wellbeing Minister of Housing and Local Government Minister Datuk Abdul Rahman Dahlan (2013) in [5] , until June 1, 2013 , a total of 18 deaths were recorded for 1,768 cases of diabetes rats . According to him, a report released by the Ministry of Health show that the number of cases increased from 2,268 cases with 55 deaths in 2011 to 3,665 cases with 48 deaths in 2012. According to the Chairman of the National Institute of Occupational Safety and Health (NIOSH) in [1], Tan Sri Lee Lam Thye in The Star newspaper dated October 15, 2013 , an increase of rat urine disease or leptospirosis is caused by dirty environment and waste disposal is done incorrectly. Food scraps are thrown in the drain will provide food for rats and mice resulted in a population increase. According to Tan Sri Lee Lam Thye again , an increase in the breeding population of mice can be solved or alleviated by creating a clean environment with waste disposal is done in a way that betul. As per Report of the Seventh Malaysia Plan , the total allocation to the Ministry for cleanup expenses for the year From 1996 to 2000 , including the organization of environmental sanitation campaign by the Local Authority allocated RM 743,000 while for sanitation projects RM15 million has been allocated to address environmental problems in Malaysia [11]. Thus, according to [8] to solve the littering problem, emphasis and attention should be committed in changing the behavior of individuals and public attitude towards the problem. Changes in behavior are important as this kind of changes is more effective for continuing basis in long term. The study did not focus on behavior change which will only affect the temporary and will revert to its previous state when a strategy is not implemented yet.

2. The Need For Intervention Strategies To Change Littering Behaviour

The onset of this issue, a study of littering behaviour and a new method developed to address this problem [14]. Therefore, it should start by identifying and then focusing on techniques for bringing effective behavioural change. In the context of this article is a case study for the occupants of flats , appropriate behavioural interventions are identified and designed to provide community behavioural change in large clusters , with the aim to benefit everyone in the community to reduce littering [13]. Nevertheless, this study is intended only to test the validity and reliability of data indicators (manifest variables) that are connected to construct structural models for analysis.

3. Research Methodology

A total of 1200 questionnaires were distributed to the study and only 849 returned forms to be used for this analysis. The selection of respondents was based on convenience sampling flat residents (convenience sampling) or Non-Probability Samples. Sampling technique is most widely used in behavioral science research . The rationale for the selection of convenience sampling among residents of low-cost flats are because of the convenience factor, time saving, cost constraints and lack of cooperation of the population [4]. Moreover, the rationale for the selection of convenience sampling was due to the amount of the actual figures for the population in the flat is not known accurately. In this study, only three of the municipal councils who participated in this study, namely Kuala Lumpur, Shah Alam and Petaling Jaya. The selection of these three municipal councils because the city has the highest total number of low-cost flats in Malaysian if compared to the other cities. Therefore, the selection of the sample of the population in the cities would reflect the population situation in Malaysian flat residents who are not involved in the study.

4. Partial Least Square Analysis

For Structural equation analysis using the Partial Least Square Smart PLS 2.0 for the evaluation of the measurement model, the identification of indicators and constructs should be done first. In this study, the intervention strategy represented a symbol x representing the exogenous variables (independent variables), while changes in littering behavior labeled as a symbol y represents the endogenous variable (dependent variable). There are eleven independent variables identified through empirical research conducted while only one dependent variable which will be linked to the independent variable for this analysis. Independent and dependent variable in this study is known as the constructs. Item indicators or manifest variables used for exogenous variables (x) in this study is the implementation activities of intervention strategies indicators used items for endogenous variables (y) is the determination of the behavioral change determinant . There are 75 item indicators used for both constructs.

5. Validity and Reliability Testing for Measurement Model

Assessment of the validity and reliability of the measurement model is assessed through the following analysis of internal consistency reliability, indicator reliability, convergent validity and discriminant validity. The analysis and description of the measurement model are shown as per sub section below;

5.1. Internal Consistency Reliability

Internal Consistency Reliability of the measurement model study using the composite reliability (CR) for each construct. The testing validity of the constructs is measured by the criteria of reliability of block composite indicator that measures the construct [6]. According to [7] the composite reliability of the measurement model is acceptable when it reaches 0.70 or above and average variance extracted (average variance extracted) than 0.50 also considered acceptable. Table 5.1below shows the composite reliability (CR) for each construct of this study exceeded the value recommended by [7] of more than 0.70 (> 0.70) which is in the range of 0.77 to 0.96. This means, the constructs have met the stability and consistency of the indicators show that each item in each one constructs correlated well [16].

Table 5.1: Composite Reliability Value Output (CR)

CONSTRUCT	CONSTRUCT LABEL	COMPOSITE RELIABILITY (CR)
LAW ENFORCEMENT	ENFOR	**0.838**
REWARD	GAN	**0.845**
INCENTIVE	INSEN	**0.841**
CAMPAIGN	KEM	**0.840**
BEHAVIOURAL CHANGES	LBR	**0.961**
MODELING	MODEL	**0.799**
SOCIAL NORM	NORM	**0.902**
ENVIRONMENTAL EDUCATION	PEAS	**0.885**
COMMUNITY INVOLVEMENT	PK	**0.856**
PROMPT	PROM	**0.929**
PUNISHMENT	PUNISH	**0.777**
ENVIRONMENTAL DESIGN	RAS	**0.829**

5.2Indicator Reliability

Indicator Reliability is determined by analysis of the scores loading. According to [3], the measurement model achieved satisfactory reliability indicator when loading score for indicator items have value at least 0.7 and significant at least at the level of 0.05. Even so, according to [17], loading an acceptable score is 0.5 on and the items loading score <0.5 should be removed from the model. In this study, the results of calculations performed by the PLS algorithm found that items with a loading indicator has a score of less than 0.62should be removed from the model (< 0.62 deleted). The end of each loading scores for items indicators in this study is in the lower range until the 0.669 high of 0.956. Figure 5.2 shows the measurement model signifies the loading end of the indicators for each construct after a selection is made to select the best indicator. Table 5.2 shows the final score for each item loading for indicators will be used for the actual analysis.

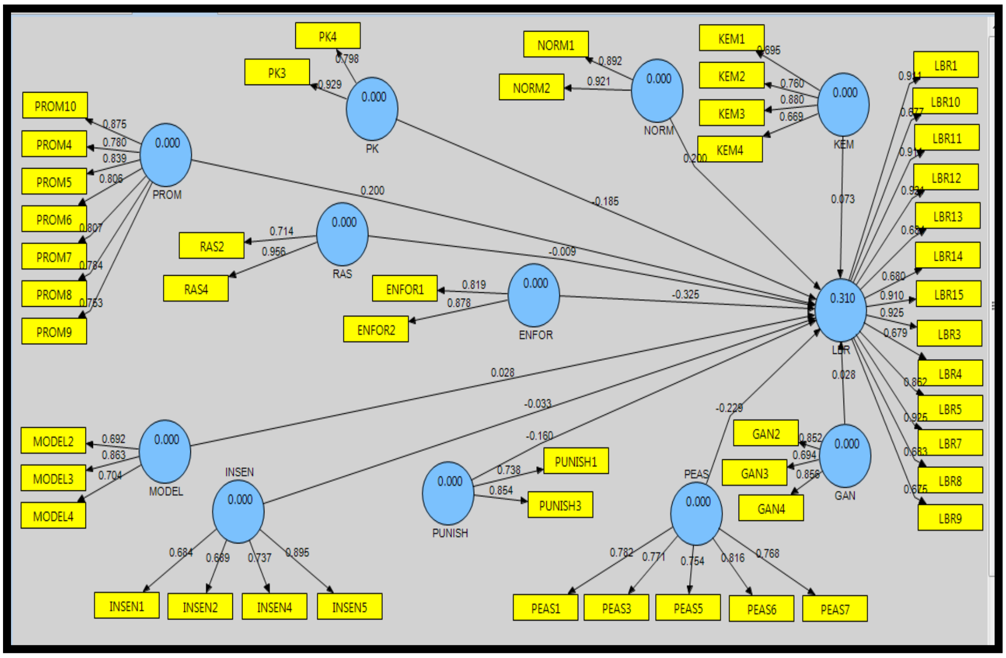

Fig. 5.2: Final score loading for each indicator item.

Table 5.2: Score Loading Output

Construct	Item	Label Item	Loading
LAW ENFORCEMENT	Strengthen existing law	ENFOR1	**0.819**
	Increase elevated surveillance of CCTV	ENFOR2	**0.878**
REWARD	Tangible reward	GAN2	**0.852**
	Intangible reward (appreciation & compliments)	GAN3	**0.694**
	Litter marked item (cash reward for bottle collection)	GAN4	**0.856**
INCENTIVE	Incentive in a form of material	INSEN1	**0.684**
	Incentive in a form of appreciation	INSEN2	**0.689**
	Bottle deposit law	INSEN4	**0.737**
	Organizing environmental sustainable programs	INSEN5	**0.895**
CAMPAIGN	Identifying of right target group for campaign delivering	KEM1	**0.695**
	Public service announcement (PSA)	KEM2	**0.760**
	Utilization of medium varieties	KEM3	**0.880**
	Celebrities as intermediary to present at venue	KEM4	**0.669**
LITTERING	Increase of bin usage	LBR1	**0.911**

BEHAVIOUR CHANGES			
	Decrease of total litter disposal for certain location	LBR3	**0.925**
	Increase of respond towards cleanliness and maintenance surrounding	LBR4	**0.679**
	Increase of responsibility	LBR5	**0.862**
	Existing community willingness to cooperate with local authorities.	LBR7	**0.925**
	Increase of awareness	LBR8	**0.683**
	Existance of a more stable attitude	LBR9	**0.675**
	Decrease of littering rate	LBR10	**0.677**
	Increase of cleanliness	LBR11	**0.911**
	Increase of community support in pro environmental activities	LBR12	**0.921**
	Increase of respond towards recycling facility usage	LBR13	**0.684**
	Increase in resource recovery	LBR14	**0.680**
	Cost saving including for cleaning cost	LBR15	**0.910**
MODELING	Influence of celebrity in role-modelling	MODEL2	**0.692**
	Parents modelling	MODEL3	**0.863**
	Peers programs	MODEL4	**0.704**
NORMS INFLUENCE	Cleanup of existing litter	NORM1	**0.892**
	Written of persuasive messages	NORM2	**0.921**
EDUCATION	Child education	PEAS1	**0.782**
	Community awareness program	PEAS3	**0.771**
	Community education program	PEAS5	**0.754**
	Use of promotional materials	PEAS6	**0.816**
	Education programs for youth communities	PEAS7	**0.768**
COMMUNITY INVOLVEMENT	Appoint of community leader	PK3	**0.929**
	Good communication delivery	PK4	**0.798**
PROMPT	Use of positive & polite message	PROM4	**0.780**
	Use of simple & comprehensible message	PROM5	**0.839**
	Approach Prompt	PROM6	**0.806**
	Avoidance Prompt	PROM7	**0.807**
	Locate signage of messages that can be easily seen	PROM9	**0.753**
	Use of anti litter prompt in promotional materials	PROM10	**0.875**
PUNISHMENT	Shame and Embarassment methods	PUNISH1	**0.738**
	Impose high rate of fines	PUNISH3	**0.854**

ENVIRONMENTAL DESIGN	Attractively designed waste bin	RAS2	**0.714**
	Provide additional facilities of recycled bin next to waste bin	RAS4	**0.956**

5.3 Convergent Validity

Performed to determine the convergent validity of the indicators of the suitability of each item in each construct is built [15]. In this study, an assessment of the convergent validity of the measurement model is done by evaluating the average variance of the average variance extracted (AVE). According to [10],convergent validity is considered adequate when the constructs have an average variance (AVE) exceeds 0.5 and above (> 0.5). Table 5.3 shows the results of the analysis of all constructs have AVE values between 0.571 until 0.822, exceeding the proposed AVE. Table 5.3 below shows the reliability of convergence for each construct.

Table 5.3: AVE Value Output

CONSTRUCT	CONSTRUCT LABEL	AVERAGE VARIANCE EXTRACTED (AVE)
LAW ENFORCEMENT	ENFOR	**0.721**
REWARD	GAN	**0.647**
INCENTIVE	INSEN	**0.572**
CAMPAIGN	KEM	**0.571**
BEHAVIOURAL CHANGES	LBR	**0.659**
MODELING	MODEL	**0.573**
SOCIAL NORM	NORM	**0.822**
ENVIRONMENTAL EDUCATION	PEAS	**0.606**
COMMUNTY INVOLVEMENT	PK	**0.750**
PROMPT	PROM	**0.651**
PUNISHMENT	PUNISH	**0.637**
ENVIRONMENTAL DESIGN	RAS	**0.712**

5.4. Discriminant Validity

In this study, discriminant validity of the measurement model is done through two evaluation process, through criteria Fornell and Larcker [2] and cross loading. Discriminant validity was formed as indicator variables in the other constructs. Measurement model is said to have discriminant validity when:

- The square root of AVE than the correlation between the variables and,
- Loading of the indicator construct scores was higher than the other constructs [3]

5.4.1 FornelldanLarcker (1981)

According to Fornell and Larcker view [2], if the square root of the average variance (AVE) is extracted exceeds the correlation between the constructs with other constructs in the model, the measurement model is said to have good discriminant validity [6]. Therefore, to determine the valuation of the discriminant validity of the measurement model according to Fornell and Larcker, criteria for the evaluation of the first, the AVE for each construct generated using the algorithm SmartPLS function. After that, the square root of each AVE value calculation is done manually. Based on Table 5.4.1 below, found the square root of AVE for each construct in bold (bold) is greater than the total value of which is on the extreme horizontal and vertical column down. Values in bold represent the square root of the AVE and the values that are not in bold represent the inter-correlation between the constructs. In the table below, the square root of the AVE is found recorded higher values of the diagonal blocks in the vertical and horizontal block diagonal of the correlation between the constructs with other constructs. Thus, the discriminant validity Fornell and Larcker criteria have been met.

Table 5.4.1: Fornell and Larcker Output

	ENFOR	GAN	INSEN	KEM	LBR	MODEL	NORM	PEAS	PK	PROM	PUNISH	RAS
ENFOR	**0.849**											
GAN	0.223	**0.804**										
INSEN	0.220	0.387	**0.756**									
KEM	0.214	0.280	0.290	**0.755**								
LBR	-0.424	-0.163	-0.217	-0.133	**0.812**							
MODEL	0.262	0.411	0.079	0.350	-0.127	**0.757**						
NORM	0.126	0.319	-0.122	0.238	0.134	0.192	**0.907**					
PEAS	0.463	0.492	0.163	0.458	-0.233	0.375	0.591	**0.779**				
PK	0.318	0.673	0.439	0.392	-0.276	0.452	0.336	0.660	**0.866**			
PROM	0.138	0.229	-0.085	0.242	0.148	0.265	0.700	0.505	0.290	**0.807**		
PUNISH	0.056	0.055	-0.077	0.383	-0.144	0.149	-0.010	0.003	0.031	0.034	**0.798**	
RAS	-0.049	0.128	-0.136	0.135	0.156	0.127	0.438	0.210	0.154	0.659	0.093	**0.844**

Note: Diagonal (the bolded figure) represents the average difference (average variance) and represents the squared AVE.

5.4.2 Cross Loading

Secondly, the determination of the discriminant validity of the measurement model is also done by performing an assessment on the loading of each indicator for each correlation between the constructs. To get the cross loading, the function of the PLS algorithm is used. Table 5.4.2 shows the cross loading between construct and item indicators. This table shows the scores for each block loading which is higher than the other blocks that are in the horizontal and vertical blocks of the same. In conclusion, the cross-loading of the schedule has good discriminant validity as the correlation indicator is greater than the correlation indicator-construct with other constructs. Therefore, the whole table 5.4.2 below shows the second assessment of the discriminant validity of the measurement model is valid and sufficient in meeting the discriminant validity.

Table 5.4.2: The Cross Loading Output

	ENFOR	GAN	INSEN	KEM	LBR	MODEL	NORM	PEAS	PK	PROM	PUNISH	RAS
ENFOR1	**0.819**	0.283	0.004	0.259	-0.326	0.245	0.306	0.562	0.366	0.313	0.034	0.087
ENFOR2	**0.878**	0.112	0.340	0.118	-0.391	0.205	-0.058	0.253	0.192	-0.046	0.059	-0.149
GAN2	0.189	**0.852**	0.369	0.215	-0.139	0.324	0.269	0.451	0.683	0.172	-0.072	0.005
GAN3	0.083	**0.694**	0.210	0.085	-0.073	0.268	0.159	0.190	0.355	0.074	0.070	0.027
GAN4	0.225	**0.856**	0.324	0.311	-0.159	0.383	0.305	0.463	0.533	0.256	0.136	0.229
INSEN1	0.196	0.191	**0.684**	0.219	-0.127	0.206	-0.066	0.138	0.344	-0.005	0.057	0.009
INSEN2	0.170	0.410	**0.689**	0.239	-0.115	0.052	0.010	0.245	0.431	0.086	-0.278	0.038
INSEN4	0.169	0.355	**0.737**	0.187	-0.115	0.250	-0.130	0.022	0.248	-0.112	0.007	-0.190
INSEN5	0.161	0.285	**0.895**	0.243	-0.243	-0.098	-0.144	0.117	0.345	-0.148	-0.051	-0.195
KEM1	0.201	0.600	0.365	**0.695**	-0.079	0.442	0.319	0.561	0.570	0.300	0.184	0.150
KEM2	0.096	0.078	0.297	**0.760**	-0.088	0.252	0.143	0.212	0.304	0.173	0.279	0.145
KEM3	0.206	0.096	0.107	**0.880**	-0.141	0.207	0.157	0.360	0.172	0.156	0.385	0.078
KEM4	0.093	0.264	0.278	**0.669**	-0.016	0.225	0.083	0.233	0.289	0.083	0.311	-0.065
LBR1	-0.354	-0.111	-0.190	-0.084	**0.911**	-0.108	0.203	-0.143	-0.187	0.216	-0.173	0.153
LBR10	-0.211	-0.091	-0.098	-0.027	**0.677**	0.010	-0.024	-0.067	-0.157	-0.004	-0.087	0.092
LBR11	-0.350	-0.114	-0.178	-0.099	**0.911**	-0.113	0.189	-0.151	-0.185	0.207	-0.176	0.153
LBR12	-0.353	-0.138	-0.188	-0.117	**0.921**	-0.128	0.212	-0.127	-0.186	0.247	-0.231	0.181
LBR13	-0.422	-0.202	-0.180	-0.204	**0.684**	-0.139	-0.078	-0.418	-0.392	-0.097	0.054	0.059
LBR14	-0.208	-0.081	-0.088	-0.005	**0.680**	0.015	-0.016	-0.064	-0.152	0.006	-0.083	0.100
LBR15	-0.349	-0.121	-0.170	-0.097	**0.910**	-0.098	0.192	-0.152	-0.187	0.213	-0.178	0.150
LBR3	-0.360	-0.134	-0.205	-0.102	**0.925**	-0.131	0.225	-0.119	-0.186	0.249	-0.229	0.178
LBR4	-0.427	-0.210	-0.209	-0.186	**0.679**	-0.135	-0.072	-0.415	-0.400	-0.094	0.064	0.053
LBR5	-0.334	-0.068	-0.171	-0.076	**0.862**	-0.080	0.167	-0.132	-0.134	0.178	-0.129	0.144
LBR7	-0.360	-0.134	-0.204	-0.101	**0.925**	-0.130	0.225	-0.120	-0.186	0.251	-0.229	0.178
LBR8	-0.418	-0.211	-0.211	-0.184	**0.683**	-0.136	-0.074	-0.412	-0.403	-0.089	0.068	0.047
LBR9	-0.197	-0.072	-0.108	-0.012	**0.675**	-0.001	-0.018	-0.060	-0.155	0.003	-0.064	0.104
MODEL2	0.049	0.258	0.128	0.135	-0.084	**0.692**	-0.053	0.109	0.254	0.067	0.102	-0.035
MODEL3	0.300	0.331	0.164	0.360	-0.118	**0.863**	0.118	0.349	0.423	0.137	0.129	0.070
MODEL4	0.214	0.351	-0.160	0.274	-0.081	**0.704**	0.397	0.382	0.330	0.441	0.105	0.275
NORM1	0.107	0.211	-0.033	0.256	0.112	0.097	**0.892**	0.535	0.307	0.640	-0.004	0.420
NORM2	0.121	0.358	-0.178	0.182	0.130	0.240	**0.921**	0.539	0.303	0.631	-0.014	0.378
PEAS1	0.178	0.265	-0.117	0.388	-0.053	0.291	0.653	**0.782**	0.395	0.459	0.094	0.226
PEAS3	0.359	0.309	-0.018	0.314	-0.189	0.199	0.558	**0.771**	0.467	0.416	-0.035	0.221
PEAS5	0.359	0.257	0.263	0.593	-0.133	0.183	0.455	**0.754**	0.525	0.450	0.079	0.304
PEAS6	0.301	0.487	0.216	0.389	-0.202	0.397	0.423	**0.816**	0.598	0.358	-0.043	0.136
PEAS7	0.463	0.458	0.149	0.213	-0.217	0.343	0.368	**0.768**	0.502	0.358	0.006	0.037
PK3	0.348	0.647	0.351	0.393	-0.284	0.506	0.354	0.670	**0.929**	0.269	0.075	0.154
PK4	0.170	0.502	0.442	0.265	-0.175	0.220	0.200	0.434	**0.798**	0.231	-0.050	0.106
PROM10	0.034	0.184	-0.042	0.092	0.179	0.212	0.527	0.351	0.227	**0.875**	0.020	0.540
PROM4	0.012	0.152	-0.011	0.255	0.123	0.171	0.511	0.396	0.209	**0.780**	-0.033	0.487
PROM5	0.158	0.222	0.042	0.255	0.036	0.134	0.660	0.454	0.261	**0.839**	-0.045	0.592
PROM6	0.110	0.344	-0.006	0.292	0.041	0.332	0.604	0.462	0.310	**0.806**	0.107	0.606
PROM7	0.215	0.086	-0.226	0.231	0.139	0.222	0.628	0.403	0.186	**0.807**	0.097	0.565
PROM8	0.264	0.322	0.014	0.294	0.058	0.260	0.584	0.541	0.354	**0.784**	0.075	0.578
PROM9	0.165	0.301	-0.116	0.078	0.034	0.253	0.658	0.529	0.283	**0.753**	-0.090	0.422
PUNISH1	0.027	0.070	-0.046	0.214	-0.099	0.146	0.032	-0.041	0.072	0.120	**0.738**	0.244
PUNISH3	0.059	0.024	-0.075	0.381	-0.129	0.100	-0.038	0.036	-0.011	-0.044	**0.854**	-0.056
RAS2	0.016	0.211	-0.105	0.059	0.070	0.205	0.294	0.147	0.174	0.625	0.103	**0.714**
RAS4	-0.068	0.073	-0.127	0.144	0.167	0.074	0.426	0.202	0.121	0.566	0.073	**0.956**

6. Conclusion

This paper has given the discussion and decision on test validity and reliability of measurement model of the study data collected on residents flats in Malaysia. Issues of this study are also discussed to provide an overview of the purpose of the study is done and the identification of indicators and constructs item. Testing validity and reliability of the analysis done by four analysis of internal consistency reliability, indicator reliability, convergent validity and discriminant validity. End of the results of the tests show the reliability and validity of the measurement model is satisfactory. Test results on the validity and reliability found that indicators for measurement model in this study is valid and can be used for further analysis of the structural models.

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