CONFIRMATORY FACTORAL VALIDITY OF PUBLIC HOUSING PERFORMANCE EVALUATION CONSTRUCTS

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Abstract
The aim of this study is to identify the housing features based on their tangible, intangible and component characteristics using occupants' experience and confirm the factorial validity of the building features with a view to develop a valid and reliable measurement model that can be used effectively in public housing performance evaluation. The study was based on survey of public housing occupants' experience carried out in Gombe metropolis, Gombe State, Nigeria. Two constructs of tangible and intangible building experience were developed as independent variables, with building components experience construct as dependent variable and validated using AMOS software Version 21. The study confirmed the factoral validity of the constructs, hence provided a better understanding of the housing features and components. The validated constructs in this study are useful for public housing performance evaluation, housing market analysis and public housing policies to improve public housing performance and achieve sustainability.

Key words: Occupants' experience, confirmatory factor analysis, housing performance evaluation, tangible building features, intangible building features.

BACKGROUND OF THE STUDY

Eventhough there is no universally accepted definition of performance evaluation in housing, scholars attempt to provide a working definition of the concept. Hronec (1993) in Amaratunga & Baldry (2002, p. 207) defined performance evaluation as "a quantification of how well the activities within a process or the outputs of a process to achieve a specified goal". Housing performance evaluation is a necessary exercise (Fernández-Solís *et al.,* 2011 and Wheeler *et al.,* 2011) to achieve sustainability in public housing policies (Ozturk *et al.,* 2012). Amaratunga & Baldry (2002) suggested that if the housing developers, whether government or private institution can be able to measure the performance outcomes of their developments and facilities they will be convinced to pay more attention to the areas of their weaknesses. Some of the weaknesses were cited by Husin *et al.* (2011), as the major areas that people complain about in public housing; which are the physical features that relate to the building performance, such as the finishing of the houses, the material used, the design and size of houses, among others.

Three scopes were identified in the study; these are area, concept and respondents scopes. The area scope indicated that there are different forms of housing development in Nigeria in general and Gombe in particular, these are private and public houses. The private houses comprises of two classes, which are private informal houses and organised private sector houses. There are also two classes of public houses, comprising institutionalised and public popular houses. The private informal houses were developed by individuals, usually on land acquired through market purchase or grant by the government. The houses were mostly owner occupier or for rentals. The organised private sector houses were developed by private liability companies either using bank loans or public-private partnership. The institutionalised houses were developed by government agencies or private corporate bodies which were mainly for staff use. Then there are public popular houses developed by government agencies or public liability companies on behalf of government but sold to private individuals on owner occupier bases (Ishiyaku & Ighalo, 2012). This study examines the last group, because they are the public houses developed for civic use. Literature indicated that two concepts were mostly used interchangeably in building/housing performance evaluation. These concepts are occupants' satisfaction with features and occupants' experience on the performance of the features (Jiboye, 2012). As the detail of their differences was presented by Kasim *et al,* (2014), this paper validates the constructs in the building performance evaluation based on occupants' experience, thereby limiting the scope of the study. The third is respondents' scope, which the study limited to the occupants. Occupants here refer to the people using the houses.

LITERATURE REVIEW

The process of evaluating building in a prearranged and systematic way after it has been in use over a period of time was termed post occupancy evaluation (Shen, Shen & Sun, 2012), popularly abbreviated to POE. The term POE was said to have originated from occupancy permission given to certify that a property is fit for occupation (Riley, Kokkarinen & Pitt, 2010). The popular housing evaluation plat forms are Royal Institution of British Architects (RIBA), Post Occupancy Review of Building and Their Engineering (PROBE), Building Use Studies (BUS) and Commission for Architecture and the Built Environment (CABE). Collections of the occupants' view of buildings were introduced by the Royal Institution of British Architects (RIBA) and were incorporated in the RIBA First handbook in 1965 (Baird, Gray, Isaacs, Kernohan, & McIndoe, 1996). Building a POE was incorporated in the RIBA plan of work a part M, which encourages the collection of feedback on mostly government buildings. To further improve the efficiency and acceptance of POE, a team of multidisciplinary group comprising researchers, publishers, practitioners and experts was formed and named Post Occupancy Review of Building and Their Engineering (PROBE) in the 90s. The study aimed to collect data on different POE studies carried out between that periods of time and published is for the public, to help interested professionals to utilise them (Riley et al., 2010). Building Use Studies (BUS) is a method of evaluation developed in UK by BUS Ltd. It is a questionnaire type of assessment with 12 topics of assessment consisting of physical, conditions in the environment and personal control over the physical conditions (Cohen et al., 2001). The methodology provided world standard measurement applicability. Cohen et al. (2001) cited observed that the BUS questionnaire uses "small core set of key performance indicators". Commission for Architecture and the Built Environment (CABE) was the government's advisor on architecture, urban design and public space in UK. CABE has design reviewed over 3,000 since 1999 in England. They Provides design review service, develop housing standards and Provides professional advice on planning at Lower rates. Their aim was to improve the quality of public buildings and deliver better urban and housing design. They were also engaged Develop educational programmes on built environment, provide advice to schools. They advise both government and general public on green open space and community engagements in open space management.

However, there are relevant housing evaluation standards which are popularly used in POE. The Building Use Studies (BUS) occupant survey developed in UK by BUS Ltd is one of them. It is a questionnaire type of assessment with 12 topics of assessment consisting of physical, conditions in the environment and personal control over the physical conditions (Cohen et al., 2001). Soft landing is another method developed by Architect Mark Way in UK to extend the scope of service so that feedback method can be incorporated in housing delivery projects. It involves putting the designers and builders together throughout the development process. PROBE method which refers to Post Occupancy Review of Building and their Engineering (later changed to Environment) was a joint venture project between the UK government, a publisher and researchers team (BUS, 2011). The PROBE was developed to simplify the BUS methodology in to simple, reliable, timed and cost effective building evaluation questionnaire (BUS, 2011) which was adapted in this study. The Construction Industry Council Design Quality Indicator (DQI) is an evaluation method developed by university of Sussex to evaluate feedback from anybody affected by the building under evaluation (Riley, et al., 2010). It was designed to measure the quality of design in a building. The method was designed from previous works on building quality such as PROBE and Building Research Establishment Environmental Assessment Method (BREEAM). There is Building Quality Assessment (BQA) which is building performance evaluation method mostly used in Austria and New Zealand. It contained nine (9) quality categories which comprises of presentation, space functionality, access and circulation, amenities, business services, working environment, health and safety, structural considerations and building operation (Best, Langston & De Valence, 2003). Standard of House Performance Appraisal (SHPA) method was introduced by ministry of construction in mainland China to encourage sustainable development of housing industry (Husin, et al., 2012). The method was developed based on Housing Performance Indication Standards in Japan, with five (5) performance indicators which are applicability, environment, economy, safety and security and durability (Yau, 2006). Meanwhile, there are several other performance evaluation methods in use around the globe which were not mentioned here because they focus on the "greenness" or energy efficiency of buildings, or environmental evaluation, hence limited in scope and application.

The popular feedbacks collected for the housing performance evaluation are occupants' experience, and satisfaction as mentioned. The experience was defined by Hurlburt and Schwitzgebel (2007) in Kasim *et al.* (2014, p. 3) as "anything that emerges, coalesces, become a phenomenon or is experienced out of the inner and outer stimuli that simultaneously impinge on people". Hence, experience seems to have a particular content and significant form, for in each experience there is seems to be a specific reference to reality (Kasim *et al.,* 2014). Reality itself belongs only to the whole; no item of experience is real in isolation. Therefore, what distinguishes one form of experience to another is the degree of failure to achieve a complete and absolute assertion of reality. In an attempt to highlight types of experience John Locke (1690-1975) divided experience as those that arise from sensation and those that arise from reflection. James Mill (1829-1967) in the other hand classified experience based on their respective sensory organs of sight, hearing, touch, taste and smell (Hurlburt & Schwitzgebel 2007). Based on this understanding of experience, this study adopted the use of occupant's experience as closer to reality in housing performance evaluation than occupant's satisfaction.

Theories of performance

In-depth knowledge of performance theories and models is very vital to the validation of the measurement models. Hence, a review of theoretical models of performance was carried out to highlight their relevance in housing performance evaluation. The theories that have cut across performance, satisfaction and experience boundaries and in some cases have had significant influences in all of them were reviewed. These comprises of Expectations-Disconfirmation theory, Perceived performance theory, Norms in concept of performance, Multiple process theory, Equity theory, Complexity theory and the theory of Word-of-mouth (Tesser & Rosen, 1975; Erevelles & Leavitt, 1992; Woodruff, Cadotte & Jenkins, 1983; Sirgy, 1984; Wang & Lim, 2012). The Expectations-Disconfirmation theory implies using pre-consumption expectation on the product in relation to post consumption experiences. If the performance is above expectation then positive disconfirmation occurs, which leads to satisfaction, while if the product performance is below the consumer expectation, then negative disconfirmation occurs and leads to dissatisfaction. If both are the same, simple confirmation occurs (Hom, 2000). A study by Churchill & Suprenant (1982) in (Erevelles & Leavitt, 1992) pointed that addition of Perceived performance (theory) is necessary in the model of Expectation-Disconfirmation theory. This is because there is difference in satisfaction judgement between durable and nondurable products. Hence, they suggested an extension to the previous model by incorporating direct effects of perceived performance in the model. The Norms theory suggested that there are various bases of comparism to achieve satisfied performance in addition to expectation (Erevelles & Leavitt, 1992). Woodruff, Cadotte & Jenkins (1983) suggested the use of experience-based norms instead of expectation-disconfirmation argument. In a study by Sirgy (1984), ideal performance was proposed as the comparison standard to use. Hence, the model opined that beside expectation, other standards are used by customers to achieve performance and satisfaction decision.

The Multiple process theory viewed that there is no single theory or model that can explain human decision in entirety (Erevelles & Leavitt, 1992). A study by Tse & Wilton (1988) supported this notion with empirical results indicating the need for multiple comparism process and need for complex interactions between variables to achieve satisfied performance. Equity theory was based on equity theory paradigm in Adams (1963). Oliver & Desargo (1988) was cited in Erevelles & Leavitt (1992) to have found out that equity was the fourth (4th) most important factor in determining satisfaction after factors like disconfirmation, performance and an independent expectation. Complexity theory was cited as relevant here because performance by itself is very complex field, with many different studies adopting radically different ontological and epistemological approaches (both extreme positivists and passive socialist values). Therefore, to establish the true relations between the complexity classes, there is a need to look in to every detail at computation, because there is complex linkage of elements that behave in line with external factors (Wang & Lim, 2012). The theory of word-of-mouth suggested that consumers tends to tell more about dissatisfied experience than a satisfied one (Technical Assistance Research Program, 1981). In another view, Tesser & Rosen (1975) opined that consumers tend not to speak of bad news. This stressed the need for caution in conducting and interpreting housing performance evaluation results. In summary, the theories mentioned above indicated that Prior knowledge of the occupants influences their experience with the buildings. The theories also confirmed that Building performance is different from other goods performance because of its durability. Even though some theories suggested that experience and not perception explain performance, they further showed that Performance evaluation is complex as it requires several judgements. The theories also indicated that the performance of some features such as plumbing and electrical facilities depended on external factors like water and electricity supplies which are out of the building itself. Conclusively, the theories reviewed suggested that performance evaluation is a complex exercise, involving multidimensional constructs as confirmed in this study.

HOUSING PERFORMANCE CONSTRUCTS

A house comprises of two broad classifications of features as discussed in Kasim, Ishiyaku, Harir & Mohammed (2015). These are building components (such as rooms, kitchens and toilets) and building features (such as ceiling, plumbing facilities and ventilation). Going by studies of Santos (2002), Green & Ryan (2005), Allee (2008) and Alsaqre (2011), the building features can be subdivided into tangible (such as rooms, lighting facilities) and intangible features (such as privacy, ventilation). Therefore, there are housing components as well as tangible and intangible building features (Kasim et al., 2013 and Ishiyaku, et al., 2014). Hence, Performance evaluation whether for residential, educational, commercial or an office building can be carried out based on users/occupants' satisfaction (Ibem et al., 2013), experience (Brown et al., 2010), perception (Cozens et al., 2001) etc.
The building performance constructs in building performance evaluation can be viewed from dual measurement scopes. First, the building performance construct is a product of both tangible and intangible factors' performance. Different names were given to the features that make up the tangible and intangible factors in literature. The tangible factors in Gann, Sautar & Whyte (2003) were called physical factors in Amole (2009). These comprises of features such as floor, ceiling, doors and windows, etc. The intangible factors in Gann, Sautar & Whyte (2003) were also called social factors in Amole (2009). These comprises of features like design, lighting, ventilation and privacy as illustrated in Figure 1.

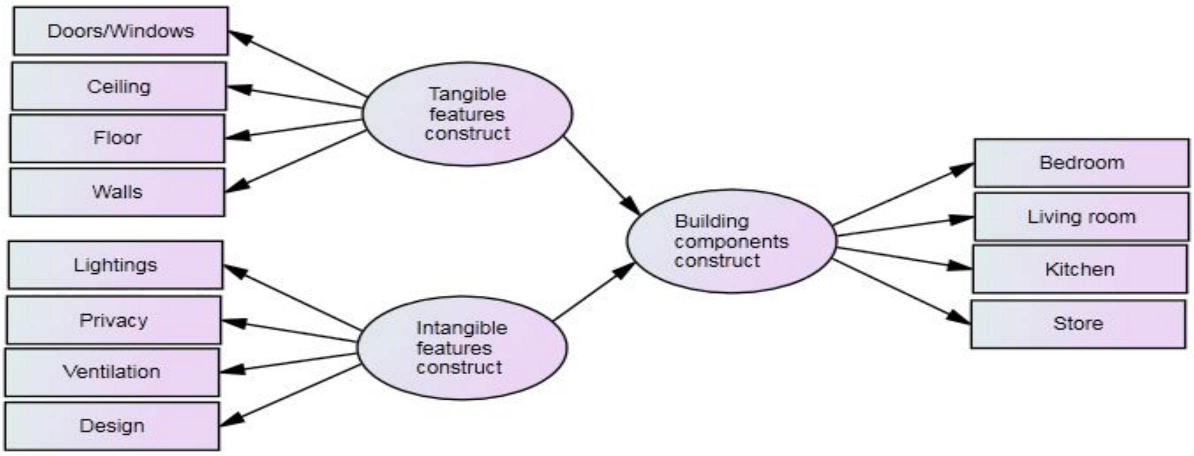

Figure 1: Theoretical model of housing components

However, the second dimension is what constitutes the building construct itself; those are the building components. The building components were sometimes cited as building features, while in real term, they are products of building features. The best way to understanding this is by subjecting the building features to residential building performance evaluation. To measure residential building performance, components like bedroom, living room, kitchen, bath and toilets, dining area and garage has to be measured as components of the building (Figure 1). Hence, they are products of features and service facilities such as walls, floor, ceiling, electrical fittings (tangible factors) and ventilation, lighting (natural and artificial), privacy and design (intangible factors). Therefore, measurement models or constructs such as tangible building experience and intangible building experience can be identified as independent latent constructs for dependent latent construct of building components' experience. In the same vein, tangible building satisfaction and intangible building satisfaction can be identified as independent latent constructs for dependent latent construct of building components satisfaction. The likes of these constructs in satisfaction evaluation study by Doll, Xia & Torkzadeh (1994) was proved to be a single second-order construct. Meanwhile, Performance evaluation of each of those latent constructs required the establishment of their factorability. Therefore, the aim of this paper is to identify the building components, tangible and intangible building features and confirm the factorial validity of their constructs for use in housing performance evaluation studies, policies practice.

METHODS AND MATERIALS

A Survey research strategy was adopted to collect data using the questionnaire and walkthrough observation. The BUS Methodology Questionnaire was adapted and used on a license agreement with survey code number 1328 from BUS Methodology, UK. Four (4) housing estates were identified as the houses developed by government agencies for civic use (public house) in Gombe metropolis

Nigeria. The questionnaire was pretested and pilot survey was conducted prior to the field survey. The pre-test was carried out through discussing the questionnaire with colleagues (Fowler, 2008) to improve the questionnaire before the pilot survey. The houses were prototype and comprises of two and three bedroom flats. A total of 100 questionnaires were administered as recommended in Zikmund et al. (2010) and Awang (2014). The results of the pilot study indicated positive feedback towards the structure and presentation of the questionnaire. To improve the face validity of the questionnaire it was refined as suggested in the pilot results. The walkthrough observation method involves carrying out a walk-through inspection of the public housing estates in the study area to assess their present conditions. The findings from the walkthrough observation revealed that the Bedrooms, Living rooms, Toilets/baths, Store, Kitchen and Dining were in good state of maintenance and aesthetic condition, with adequate sizes in relation to the occupants possessions. The circulation spaces look smaller in relation to the size of the houses. The house Design was very simple, with good Internal and External aesthetic values. The isolated location of the housing estate has given them unique privacy and adequate ventilation. Some of the houses were fenced by a wall, to improve their Privacy. The simplicity of the design has given the buildings good natural and artificial lighting. The quality of the materials used in services such as plumbing and electrical facilities were good, though there was neither electrical light nor water supply at the time of the visit. It was further discovered that there was no provision of Safety, Disable and Energy Saving facilities in the housing estates, except the ones provided by the occupants.

A sample size of approximated 300 housing units were chosen as recommended by Bartlett et al., (2001) against the population of about 1000 houses for the field survey. The systematic sample method was employed to determine the housing units to administer the questionnaires. A total of 246 (82%) questionnaires were retrieved and 34 (14%) were discarded due to incomplete responds, missing data, univariate and multivariate outliers, thereby, 212 (86%) responds were used for the final analysis. The high percentage response was achieved due to the involvement of both the management and junior staff of Gombe State Investment and Property Development Company Ltd (GSIPDC) in the questionnaire administration processes.

The Statistical Package for Social Science (SPSS) version 21 was used in the preliminary analyses, while AMOS software version 21 was used for the Confirmatory Factors Analysis (CFA). The data were screened to ensure univariate and multivariate normality as required (Child, 2006). This was carried out to identify and remove univariate and multivariate outliers (Field, 2009 in Yong & Pearce, 2013). After the data screening, the profile of the respondents was computed using frequency and percentages. The descriptive analysis was also carried out, to assess the normality of the data using mean, standard deviation, skewness and kurtosis of the categorical items. The reliability, exploratory and confirmatory factor analyses were then carried out to ascertain the reliability and validity of using the factors in measurement models for public housing performance evaluation.

Exploratory Factor Analysis (EFA)

EFA is necessary in housing performance evaluation to identify the variables that influence the factors and also determine the variables that "go together" (DeCoster, 1998 in Yong & Pearce, 2013, p. 80). It was used to identify the underlying data pattern in each construct because there is inadequacy of research in the area (Gerbing & Anderson, 1988 in Harrison & Rainer, 1996). However, this generated the components used to develop the second order construct as recommended in Sweeney, Soutar & Johnson (1996). As the building experience was identified to comprise of building components, tangible and intangible factors, which cannot be measured directly, the EFA was used to determine the number of common features that accounted for the correlations and identified the possible groupings into components and used in the measurement models (McDonald, 1985 in Yong & Pearce, 2013). The aim of EFA in this study was not to reduce items to factors, but to extract items that influence responses on the observed variables as in Williams *et al.* (2010). The observed variables refer to linear combinations of the underlying and unique factors (Suhr 2005). Eventhough EFA is important in housing performance studies, its subjectivity and pragmatism (Tabachnick and Fidell, 2013) make it necessary to use multiple criteria simultaneously in extraction methods before deciding which factors to drop (Williams *et al.,* 2010).

There are different views in the literature on how to carry out EFA in behavioural and humanities studies. There are three most commonly reported extraction methods in factor analysis, which are Principal Components Analysis (PCA), Principal Axis Factoring (PAF) and Maximum Likelihood (ML). PCA involves correlating variables with the purpose of reducing the numbers of variables and explaining the same amount of variance with fewer variables (Suhr 2005; Williams *et al.,* 2010). Therefore, Principal Components Analysis is a data reduction technique and the issues of whether it is truly a factor analysis technique have been raised (Costello & Osborne, 2005: Yong &

Pearce, 2013). A review by Williams *et al.,* (2010) indicated that most authors carry out factor extraction using Principal Component Analysis (PCA). However, Scholars like Bentler & Kano, (1990); Floyd & Widaman, (1995) and MacCallum & Tucker, (1991) in Costello & Jason (2005) caution against the use of Principal Component Analysis (PCA) and favoured factor analysis method, though scholars like Schoenmann (1990) and Steiger (1990) in Costello & Jason (2005) were in affirmation. Costello & Jason (2005) argued that PCA is pattern reduction method and not factor extraction method; hence, they favoured factor extraction using PAF. Yong & Pearce (2013) concluded that PCA produces components, whereas PAF produces factors.

In the same vein, scholars argued that ML produces parameter estimates that are the most likely to have produced the observed correlations, if the sample is from a multivariate normal population (Fabrigar *et al.,* 1999 in Costello & Jason, 2005). Tabachnick & Fidell (2013) pointed that ML attempts to analyse the maximum likelihood of sampling the observed correlation matrix, which is more appropriate for behavioural and humanity studies. Therefore, as this study was based on established factors of building components, tangible and intangible features, the aim of the extraction is to identify possible components and variables with higher loadings for further analysis. Hence, the PCA, PAF and ML were all carried out, to compare their output and extract the most appropriate variables and components for Confirmatory Factor Analysis (CFA). The extract was based on Kaiser's criteria, which is the SPSS default retention method of eigenvalues greater than 1.0. Eventhough it was cited by Costello & Jason (2005) as "among the least accurate methods", other methods like screeplots were observed to strengthen the weakness.

Rotation techniques were used to ensure high item loading on one factor and smaller item loadings on the other factors (Williams *et al.,* 2010). The two major rotation techniques are orthogonal rotation and oblique rotation (Yong & Pearce, 2013). The orthogonal rotation is where the factors are rotated 90° from each other, which assume that the factors are uncorrelated (DeCoster, 1998; Rummel, 1970 in Yong & Pearce, 2013). This assumption is less realistic in social science or behavioural studies like this one, as in most case, factors are correlated to some level (Costello & Osborne, 2005). The widely reported orthogonal techniques are Quartimax and Varimax rotation. Quartimax is used where the aim is to minimize the factors needed to explain each variable (Gorsuch, 1983 in Yong & Pearce, 2013). In the other hand, Varimax tends to minimize the items loadings irrespective of the factor. The Oblique rotation is when the factors are rotated 360° from each other, and the factors are assumed to be correlated (Yong & Pearce, 2013). It produces a pattern matrix and correlation matrix results, which present both items loadings and correlations between them. The most cited oblique rotation techniques are Direct Oblimin and Promax. The Direct Oblimin rotates the axis such that the vertices can have any angle and allows factors to be correlated. Promax required raising the items loadings to a power of four which the results normally show greater correlations among the variables and achieves a simple structure (Gorsuch, 1983 in Yong & Pearce, 2013). As the occupants' experience variables cannot perform independently of each other, the Oblique rotation method was adopted. This is because, the correlation ability of Oblique options such as direct Oblimin and Promax provide more accurate results in human behavioural studies (Costello & Jason, 2005: Williams *et al.,* 2010). The Direct oblimin was used as Fabrigar et al. (1999) in Costello & Jason (2005) cited that both oblique methods produce the same results and the default delta (0) & Kappa (4) were maintained as there is no scholarly justification for changing them (Costello & Jason, 2005). As cited above, multiple EFA iterations were carried out and the coefficient values were suppressed at 0.10, 0.40, 0.50 and 0.60 to ensure that the good factor structure (item loadings above 0.3) was selected (Costello & Jason, 2005).

The Confirmatory Factor Analysis (CFA)

The Confirmatory Factor Analysis (CFA) was carried out to confirm the underlying structure of the factors based on their factor loadings, validity and reliability indices. Average Variance Extracted (AVE) was used to measure Convergent validity for all the final measurement models. To ensure the validity of the constructs, Awang (2014) cited that the AVE should be ≥0.5. The discriminant validity was determined using Modification Indices (MI). This is by ensuring that the models are free from redundant items. In the constructs where redundant variables were identified, free parameter estimates were used to solve the redundancy issues. It was further ensured that the correlations between exogenous constructs are less than 0.85 (Awang, 2014).

There is no general consensus on how many fitness indices can be reported or which of the fitness indexes can be used within the three major model fit categories of Absolute fit, Incremental fit, and Parsimonious fit. Eight (8) fitness indices were popularly cited in literature within the three categories. These are chi-square (Chisq), Root Mean Square Error of Approximation (RMSEA) and Goodness-of-Fit Index (GFI) in the Absolute fit category. In the Incremental fit category, Adjusted

Goodness-of-Fit Index (AGFI), Comparative Fit Index (CFI), Tucker-Lewis Index (TLI) and Normed Fit Index (NFI) were reported. Chi-square (x^2 /df) is the fitness index used to measure Parsimonious fit (Awang, 2014). Anderson & Gerbing (1988) opined that a researcher can report one or more of these indices, while Kline (1998) suggested a minimum of four indices, at least one from each category. All the three categories of fitness indices were presented and discussed in this study. Eventhough Chisq was identified as a conventional measure of construct overall absolute fitness (Bollen, 1989), it was criticized for being sensitive to sample size above 200 (Hair et al., 1995). Therefore, as the sample size used in this study is more than 200, chi-square was presented but not discussed; RMSEA and GFI proposed by Jöreskog & Sörbom (1981) were used to measure the absolute fit index. However, AGFI, CFI, TLI and NFI were also used to measure the incremental fit of the measurement models, which shows the proportion which the model fit compared to null model and Chi-square (x^2 /df) was used to measure the parsimonious fit index of the measurement models. The acceptable levels for fit indexes are, RMSEA < 0.08 (Awang, 2014); GFI ≥ 0.80 (Forza & Filippini, 1998, Shevlin & Miles, 1998); AGFI ≥ 0.80 (Forza & Filippini, 1998); CFI > 0.90 (Byrne, 1995 and Hair et al., 2010); TLI > 0.90 (Vandenberg & Scarpello, 1994); NFI ≥ 0.80 (Forza & Filippini (1998) and Chi square/ df < 5.0 (Marsh & Hocevar, 1985).

RESULTS

Profiles of respondents

The demographic profiles of the sampled housing occupants assessed, with 212 numbers of cases presented after the data screening. The gender distribution indicated that about 85% of the respondents were males and 15% were females. The data showed that more than 90% of the respondents were married and aged between 30 years to 60 years. Eventhough more than 73% of the respondents were civil servants, about 42% reported that they mostly stay at home and about 54% stay in the evenings and during weekends. This probably indicated a significant number of retired civil servants in the housing estates. The data further indicated that about 67% of the occupants are low income earners (less than N100, 000), while about 33% are high income (more than N100, 000).

Descriptive statistics results

The data collected were screened and questionnaires with missing data less than 10% were imputed using variable means, while those with more than 10% missing data were dropped as recommended by (Coakes, 2006). The categorical data were assessed to determine normality of distribution as recommended for factor analysis (Hair et al., 1995; Tabachnick & Fidell, 2001). Skewness and kurtosis was used which required that the values should be between +-2 (George & Mallery, 2010). The results in Table 1 showed that all the values were within the range recommended.

Table 1: Descriptive and normality test of Building Experience Constructs

	Item Code	Item	Mean	Std. Deviation	Skewness	Kurtosis
Tangible Building Experience Construct (TBEC)	TBE1	Condition of wall	3.95	1.381	.181	.251
	TBE2	Condition of fence	4.29	1.847	.104	-.932
	TBE3	Condition of burglary proof	3.86	1.331	.250	.660
	TBE4	Condition of nets on window	4.61	1.612	.119	-.778
	TBE5	Condition of doors and windows	4.29	1.638	.063	-.622
	TBE6	Condition of ceiling	4.12	1.451	.084	-.123
	TBE7	Condition of floor	3.99	1.418	-.104	-.100
	TBE8	Condition of plumbing facilities	4.04	1.350	.191	.150
	TBE9	Condition of cooling facilities	4.31	1.556	.194	-.505
	TBE10	Condition of heating facilities	4.36	1.459	.005	-.247
	TBE11	Condition of electric facilities	4.10	1.341	.177	-.013
Intangible Building Experience Construct (IBEC)	IBE1	Condition of light generally	3.70	1.169	-.247	-.236
	IBE2	Condition of natural lighting	4.20	1.299	-.501	.560
	IBE3	Condition of artificial lighting	3.66	1.207	-.218	-.410
	IBE4	Condition of privacy	4.50	1.619	-.469	-.744
	IBE5	Condition of ventilation	4.65	1.349	-.734	.199
	IBE6	Condition of design	3.45	1.251	-.430	-.048
	IBE7	Condition of internal appearance	3.83	1.244	-.216	.248
	IBE8	Condition of external appearance	3.77	1.260	.292	.283
Building Experience Constructs (BEC)	BE1	Condition of bedroom	3.59	1.005	-.276	.843
	BE2	Condition of living room	3.59	1.005	-.276	.843
	BE3	Condition of toilets	3.82	1.249	-.024	.638
	BE4	Condition of Finishing	4.15	1.013	.006	1.462
	BE5	Condition of roof	4.37	1.039	-.258	-.137
	BE6	Condition of dining area	4.03	1.617	.144	-.472

BE7	Condition of kitchen	3.56	1.169	-.275	.269
BE8	Condition of store	3.75	1.287	-.193	-.105
BE9	Condition of garage	4.36	1.924	.037	-1.075

The reliability test
Reliability test was carried out using Cronbach alpha to measure the reliability of all the constructs as suggested by Henseler et al. (2009). Eventhough the recommended level is 0.7 (Pallant, 2011), the first iteration of data indicated that Tangible Building Experience Construct (TBEC) achieved 0.845, Intangible Building Experience Construct (IBEC) was 0.593 and Building Experience Construct (BEC) was 0.773. The Cronbach alpha if Item deleted column in item-total statistic table indicated no need for deleting any item in TBEC construct, but required deleting IBE6, IBE7 and IBE8 in IBEC construct. These changed the IBEC construct final Cronbach alpha to 0.764 (table 2). The Inter item correlation matrix results showed that there is a relationship between the variables with the correlation *r* above 0.30 as recommended by Hair et al. (1995) and Tabachnick & Fidell (2013), except in BE5. Hence, BE5 was deleted, which improved the Cronbach's Alpha in BEC construct to 0.80.

Exploratory Factor Analysis (EFA) results
EFA was carried out to examine the unidimensionality of the factors prior to the application of CFA. The results of the analysis in Table 3 show that the values for the Bartlett test of sphericity are large for all constructs and significant (p <.05), which means that the variables are related and therefore can be factorised. The results are 747.648 in TBEC construct, 727.474 in IBEC construct and 876.587 in BEC construct at last iteration. The Kaiser-Meyer-Olkin (KMO) measures of Sampling Adequacy are 0.850 in TBEC, 0.648 in IBEC and 0.781 in BEC constructs. These are more than 0.5 and significant at 0.001 as required in literature (Williams *et al.,* 2010). To ensure sampling adequacy, the anti-image correlation matrix was also analysed. The total variance explained by the constructs ranges from 51% to 73% which indicated good result.

Table 2: EFA results for all study constructs

Construct	Items	Item-Total Correlation	Kaiser-Meyer-Olkin (KMO)	Bartlett's Test Of Sphericity	Total Variance Explained	Cronbach's Alpha
TBEC	TBE1	.534	.850	747.648***	51.291%	.845
	TBE2	.440				
	TBE3	.352				
	TBE4	.424				
	TBE5	.611				
	TBE6	.621				
	TBE7	.638				
	TBE8	.615				
	TBE9	.543				
	TBE10	.534				
	TBE11	.467				
IBEC	IBE1	.681	.648	727.474***	73.324	.764
	IBE2	.466				
	IBE3	.623				
	IBE4	.381				
	IBE5	.477				
BEC	BE1	.605	.781	876.587***	63.946	.830
	BE2	.583				
	BE3	.566				
	BE4	.671				
	BE6	.402				
	BE7	.543				
	BE8	.555				
	BE9	.410				

*** $p < 0.001$

Reliability and Validity of the Measurement Models
The final measurement models were assessed in determining their reliability and validity after the EFA. It requires the examination of internal consistency reliability, indicator reliability, convergent validity and discriminant validity. Composite Reliability (CR) in Table 3 was used to indicate the reliability of the constructs and the recommended value of CR is 0.6 and above (Fornell & Larcker, 1981; Henseler et al., 2009 and Hair et. al., 2010), which TBEC, IBEC and BEC constructs achieved at 0.676, 0.760 and 0.621 respectively. Eventhough the accepted factor loadings of between 0.5 and 0.7 was suggested by the literature (Tabachnick & Fidell, 2001; Henseler et al., 2009 and Hair et. al., 2010), the recommended Individual item reliability is achieved if factor loadings values are ≥0.4, with

sample ≥200 (Hair et al., 2010). The Table 3 showed that all the manifest items had factor loading >0.4. The convergent validity was assessed using average variance extracted (AVE). It measures the degree to which a set of indicators represents one and the same underlying construct. The value of ≥0.5 was recommended (Hair et al., 2010), which Table 3 showed that TBEC, IBEC and BEC constructs achieved 0.929, 0.940 and 0.908 respectively.

Table 3: The reliability and validity of the study constructs

Construct	Items	Factor Loadings	Cronbach's Alpha	CR	AVE
TBEC	TBE4	.678	.793	.676	.929
	TBE5	.833			
	TBE6	.882			
	TBE7	.829			
	TBE9	.859			
	TBE10	.835			
IBEC	IBE1	.954	.764	.760	.940
	IBE2	.722			
	IBE3	.930			
	IBE4	.877			
	IBE5	.857			
BEC	BE2	.846	.761	.621	.908
	BE3	.786			
	BE4	.752			
	BE6	.793			
	BE7	.749			
	BE9	.800			

CFA for Measurement Models

The CFA was carried out and the results showed good fit in the models based on the established fit indices discussed above. The result for TBEC construct (Figure 2) indicated good fit in the first iteration with all factor loadings above 0.4. The Absolute fit indices of RMSEA and GFI showed acceptable levels of 0.72 and 0.977 respectively. The acceptable fit was also achieved in AGFI= 0.938, CFI=0.977, TLI= 0.958, NFI= 0.958 and ChiSq/df of 2.092. The correlation coefficient between the TBEC1 and TBEC2 components is 0.56.

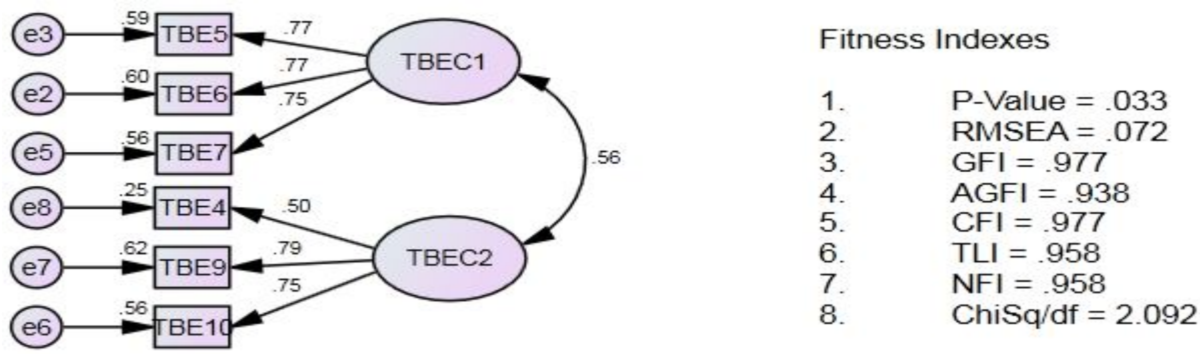

Figure 2: CFA for Tangible Building Experience Construct (TBEC) Measurement model

The CFA result in BEC construct indicated that all required measurements of fitness were achieved. The result in Figure 3 showed that all factor loadings are above 0.4 and the correlation coefficient between the components BEC1 and BEC2 is 0.66. The RMSEA and GFI indices are 0.065 and 0.977 respectively. The incremental fit indices showed good fits with AGFI at 0.939, CFI at 0.976, TLI at 0.955 and NFI at 0.951. The parsimonious fit also indicated good result with ChiSq/df at 1.892.

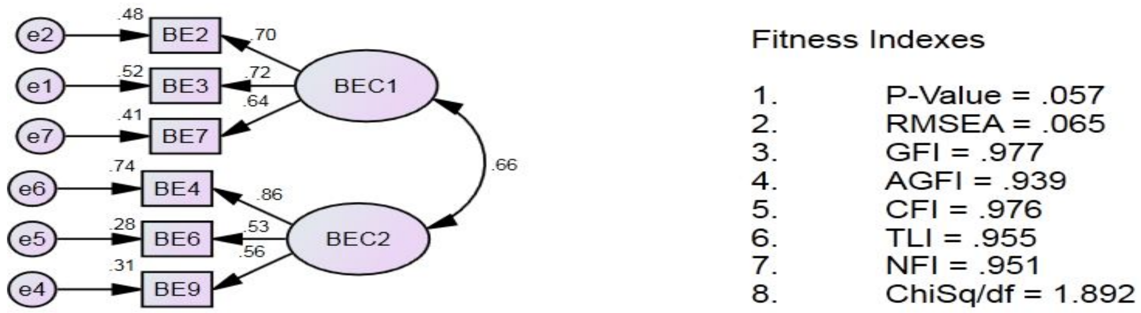

Figure 3: CFA for Building Experience Construct (BEC) Measurement model

The first CFA iteration for IBEC Construct indicated good factor loadings in all the variables, with factor loadings above 0.4 (Figure 4). All the fitness indices indicated good fit except the RMSEA with 0.082, which is above the recommended index of less than 0.080. The GFI is 0.978, AGFI is 0.933, CFI is 0.987, TLI is 0.974, and NFI is 0.978. Eventhough the ChiSq/df also indicated good fit at 2.412, there is a need for second iteration. This is because of the poor index in RMSEA and MI indicated that if the analysis is repeated by treating the covariance between e3 and e5 as a free parameter, its estimate will become smaller than it is in the present analysis.

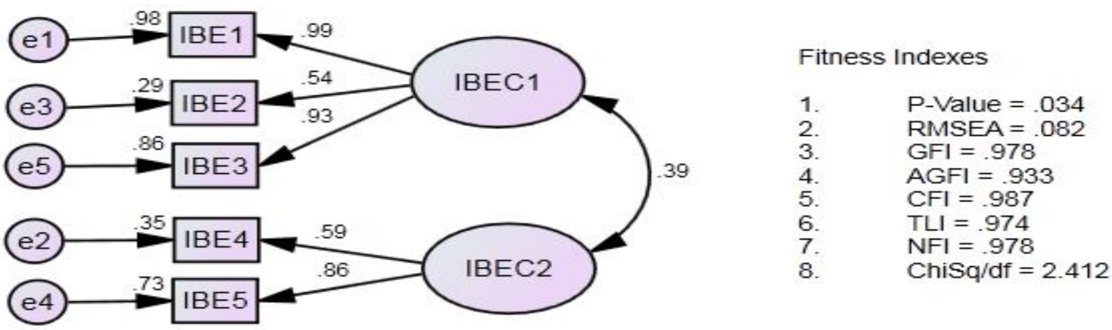

Figure 4: CFA for Intangible Building Experience Construct (IBEC) Measurement model

The second iteration was carried out by treating e3 and e5 as a free parameter (Figure 5). The results indicated that all factor loadings are above 0.4 and the correlation coefficient between components IBEC1 and IBEC2 is 0.40. The absolute fit indices indicated good fit in RMSEA (0.079) and GFI (0.983). The incremental fit results showed good fits with AGFI at 0.936, CFI at 0.990, TLI at 0.975, and NFI at 0.983. However, the parsimonious fit also indicated good fit with ChiSq/df at 2.323, which is less than five (<5) as required in literature above.

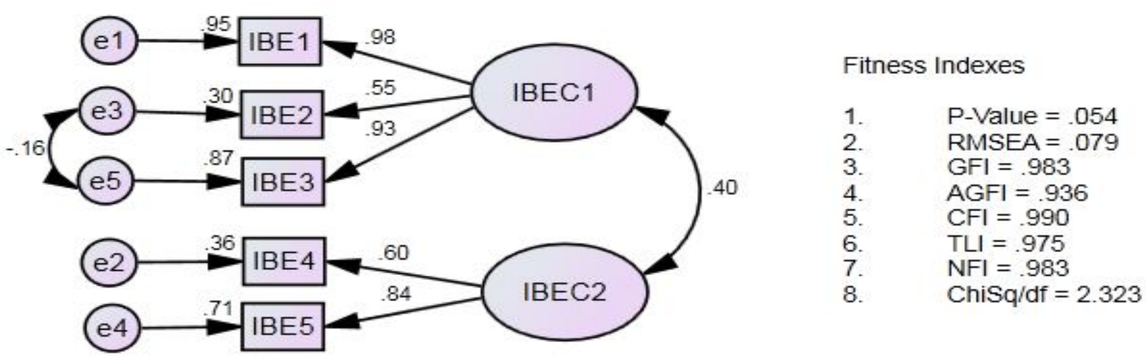

Figure 5: Second Iteration CFA for Intangible Building Experience Construct (IBEC) Measurement model

DISCUSSION

This study developed three housing performance constructs with acceptable reliability and validity based on public housing occupants' experience. The study indicated that building performance is a product of building components, tangible and intangible features experience. The extracted factors for the three constructs (BEC, TBEC and IBEC) revealed the important features that determine housing performance in the study area, which may differ in other studies. This agreed with the observation in Aigbavboa & Thwala (2013) that CFA for low income public housing performance is necessary, to ascertain the factorial validity of the features for use in housing performance studies, especially in developing countries. The general result revealed that building performance indicators satisfied the internal reliability and the construct validity criteria. The reliability coefficients of the entire constructs were above the recommended 0.7 (Table 2) and the models fitness indices were all above the minimum levels (Figures 1-4).

The analysis of EFA carried out for Tangible Building Experience Construct revealed that all the identified tangible building features are relevant and have an impact on the building performance. The CFA analysis has removed some feature not because they are insignificant in housing performance evaluation, but the responds were weak. These features are Condition of wall, Condition of fence, Condition of burglary proof and the Condition of plumbing facilities as recommended in MacKenzie, Podsakoff & Podsakoff (2011). The final results for Intangible Building features (IBEC) identified five most relevant features in housing performance evaluation. These features are Condition of light generally, Condition of natural lighting, Condition of artificial lighting, Condition of privacy and the Condition of ventilation in the houses. Other features like Condition of design, Condition of internal appearance and the Condition of external appearance appeared to have weak effects in the construct, hence were removed as suggested in MacKenzie, Podsakoff & Podsakoff (2011). This is possibly because most of the occupants have carried out significant improvements in the houses and couple with their income level, as cited by salleh *et al.,* (2011), they may have varying degree of experience in such features. The result of Building Experience Construct (BEC) which validated the building components as dependent variables revealed that six components, out of eight examined were retained. These are Condition of living room, Condition of toilets, Condition of Finishing, Condition of the dining area, Condition of kitchen and Condition of garage. Two components; Condition of the bedroom and Condition of roof, have weak effects in the construct and were removed as per discussed. This was summarised in Table 4. The table indicated that the Standardized coefficient of the accepted variables were ≥0.5. It further revealed that the variables have significance in their respective constructs.

Table 4: the summary of findings

Constructs	Item Code	Item	Standardized coefficient	P
TBEC	TBE4	Nets On Window	.502	***
	TBE5	Doors And Windows	.769	***
	TBE6	Ceiling	.771	***
	TBE7	Floor	.752	***
	TBE9	Cooling Facilities	.787	***
	TBE10	Heating Facilities	.749	***
IBEC	IBE1	Light Generally	.976	***
	IBE2	Natural Lighting	.553	***
	IBE3	Artificial Lighting	.927	***
	IBE4	Privacy	.601	***
	IBE5	Ventilation	.838	***
BEC	BE2	Living Room	.702	***
	BE3	Toilets	.718	***
	BE4	Finishing	.863	***
	BE6	Dining Area	.532	***
	BE7	Kitchen	.641	***
	BE9	Garage	.552	***

Therefore, the measurement models presented in this study focused on the validation of the building performance factors using components, tangible and intangible building experience constructs as latent constructs. Hence, those measurement models can be used to develop a causal effect model or structural equation model with the building components construct as the dependent variable. The model can demonstrate the effects of tangible and intangible building features performance on building components performance as dependent construct. However, the same constructs can be applied in housing environmental features performance evaluation. The constructs can be tangible environmental features such as drainage, road network, and intangible environmental features such as noise, sanitation and nuisance. This is because the bases of the evaluation, which are building and environmental features are the same. As cited by Amaratunga & Baldry (2002) and Jiboye (2012), occupants' satisfaction with the building or environment is a potential benefit that can arise as a result of having an appropriate building or environmental performance. This invariably means under normal circumstances, there is positive relationship between occupants' satisfaction and housing performance. Hence, the validation methodology used in this study can be applied in all housing performance evaluations, in which occupants', users' or owners' behavioural evaluation such as experience, satisfaction, expectation or perception is measured. The validation of tangible and intangible housing experience constructs is imperative with the increasing application of Structural Equation Modelling (SEM) in Post Occupancy Evaluation (POE) studies.

CONCLUSIONS

The results indicated the factorability of the occupants' experience with building components, tangible and intangible building features and provide a guide to a better understanding of the housing features and components, especially in developing countries, thereby provided significant insight into how public housing performance could be improved. The findings of this study are useful for public housing performance evaluation studies, organisational forecasting, housing market analysis and public housing policies to achieve sustainability. Therefore, this study provides a guide for policy design in respect of the building features performances that significantly influence housing performance for sustainable future public housing developments.

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