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The relationships between valuers’ support systems for capturing property sustainability in Nigeria and their knowledge perceptions

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Abstract

Purpose – The aspects of sustainability are often not considered explicitly in property valuation. The purpose of this paper is to investigate the structural relationships between valuers’ support for integration of industrial sustainability into property valuation process in Nigeria and their knowledge perceptions about the potential sustainability benefits.

Design/methodology/approach – The paper compares the results of the respondents’ evaluation of the models and indicators for modelling the study population. Data were obtained from 267 real estate firms from three core Nigerian cities. The conceptual framework was developed and pattern matrices for factor indicators were extracted for the predictions and hypothesis testing using the partial least squares – structural equation modelling.

Findings – Perceived lowering of risks and cost savings are the significant predictors of the valuers’ support system (BLR→SUP (t = 12.181); BCS→SUP (t = 2.078) > 1.196). The findings challenge the conceptual expectations as prospects of high building value, improved productivity gains and quality of life have no significant factor loadings. Moreover, potential improvement to the quality of life is not a significant mediator.

Research limitations/implications – Testing the knowledge-support systems in sustainability and property valuation could help bridge the knowledge gap in property sustainability studies.

Practical implications – This study presents evidence that can aid in decision making regarding public and private efforts to define sustainability knowledge requirements for the valuers and other stakeholders.

Originality/value – The current investigation finds that there is insufficient sustainability knowledge among the valuers. Thus, these analytical procedures can be used to predict sustainability scenarios at a global level.

Keywords Perceptions, Relationships, Property sustainability, Support systems, Sustainability benefits

1. Introduction

The theoretical basis for the integration of sustainability considerations into the property valuation process began in 1996 (Harrison and Seiler, 2011; Lorenz and Lützkendorf, 2011). Nonetheless, following the Vancouver Valuation Accord (2007) imposition of a social and professional responsibility on valuers to understand its implications to valuation and appraisals, it has become imperative for them to appreciate the benefits of sustainability in property investment, management and development and also acquire the knowledge and skills to report them in their valuations. Ibiyemi (2018) insisted that the valuers’ knowledge, skills and attitude in providing an integrated basis for industrial sustainability-related obsolescence (ISRO) factor could bring about a change in the behaviour of industries towards environmental, economic and social sustainability uptakes. Moreover, studies on climate change suggest that property sustainability improvements have implications for energy efficiency and greenhouse gases emissions. Evidently, the role of the valuer would be to seek ways of capturing sustainability in their assessments, reporting and decision making.
In the property sub-sector, manufacturing industries are confronted with the requirement for sustainable production due to energy and natural resource depletion, devastating global environmental deterioration and human beings pursuing higher life quality. Ibiyemi et al. (2015) acceded that the jaded support for sustainability initiatives, such as green development and regulated productive capacities of industries, may have led to excessive pollution and systematic depletion of natural resources at a huge cost to society. There is an urgent need for pro-sustainability behaviour from valuers and industry owners.

The work proceeds with the concept that the effectiveness of the knowledge-based support system for capturing industrial sustainability in the valuation process would be a function of their understanding the potential benefits realisable from industries adopting sustainability initiatives. In support, Lorenz (2006) settled that success in achieving more sustainable development (SD) in property and construction would depend on progress in integrating sustainability issues into the property valuation theory and practice. The success may not be actualised in the industrial real estate sector unless valuers support its inclusion into property valuation, not as a responsible alternative, but based on sound knowledge about the benefits it portends for lowering risks, productivity gains, cost savings and quality of life. The study intends to promote a new understanding that leverages on engendering support for industrial sustainability initiatives through knowledge linkages. It does this by testing the causal relationships concerning knowledge of industrial sustainability paybacks and valuers’ support system. The testing of structural relationships is scant in the sustainability literature.

2. Literature review and hypotheses

Environmental aspects of property sustainability

From the environmental viewpoint, sustainability focuses on the stability of biological and physical systems regarding ecological integrity, carrying capacity and biodiversity (Munasinghe and Shearer, 1995; Alvarez, 2011). The viability of subsystems that are critical to the global stability of the overall ecosystem needs proper interpretation. Reconciling these various concepts and operationalising them is a major challenge, since all dimensions must have an equal attention and they are mutually inclusive (Alvarez, 2011). The environmental aspects of property sustainability are classified as building specific and are essentially the green features. The aspects concern the reduction of land and resource use, hazardous substances, emissions and the closing of material flows to minimise impacts (Lorenz, 2011). Moreover, Cheng and Venkataraman (2013) classified the environmental aspects into energy and water-related, material components and wastes, indoor environmental quality (IEQ) and sustainable site management. Energy and water-related issues focus on strategies for renewable energy usage, optimised energy performance, monitoring and emission reduction. The efficiency of water consumption is enhanced by recycling, metering and storm water management. Material wastes require collection, storage, disposal and recycling. IEQ leverages on acoustic performance, noise levels, ventilation, control of indoor air pollutants and post-occupancy surveys. Site erosion, conservation, landscaping and signage are keys for sustainable site management. The environmental aspects reduce risks through changes in energy and water prices that promote efficiency features. Lützkendorf and Lorenz (2007) insisted on compliance with environmental protection policies and the use of environment-friendly building products and materials, but noted that the dearth of environmental data accounts for the rarity of empirical results.

Industrial sustainability and potential benefits

Industrial sustainability envisaged cost savings in materials purchasing, licensing fees, disposal, and costs; increased protection of the environment; generated income through the sale of wastes or by-products; enhanced corporate image; improved relations with other
manufacturers and organisations and other market advantages (Addae-Dapaah et al., 2009; Alvarez 2011). The studies by Tibbs (1992), Tonelli et al. (2013) and Herrmann et al. (2015) recognised the following environmental sustainability indicators related to industries: pollution control devices, regulation compliances, effluent treatments, recycling and removal, use of ozone depleting substances, condition of air conditioning plants, refrigerants and the presence of plants that remove air pollutants; others are the waste disposal technologies, indoor air quality, ventilation, natural lighting and acoustics, noise abatement, durability, adaptability and flexibility, compliance with fire, escalators and other safety regulations, lifts and escalators.

Industrial sustainability benefits are categorised as economic, social and environmental. Wasiluk (2007) and Madew (2006) posited that sustainability uptake increases property value by lowering risks and costs, boosting gains in productivity, scaling down construction costs and drawing-in financial incentives. Wasiluk (2007) implied that commercial buildings with uptakes have a competitive advantage over traditional commercial buildings because of their ability to command economic rents, high capital values and attract higher profile tenants. Mallawaarachchi and De Silva (2013) reaffirmed that green building renders a healthier working environment, and an improved indoor air quality. Both of these factors help to reduce the health and safety risks to occupants from sick building syndrome and Legionnaire’s disease. Fisk (2002) contended that sustainable or green buildings could improve heating, ventilation and air conditioning systems, which can curtail the spread of contaminants and pathogens as well as cut back respiratory illnesses by 9–20 per cent. Green buildings and sustainability offer a lower degree of environmental risk by functioning to minimise the environmental footprints of the real estate industry on the surroundings. The rational use of natural resources and appropriate management of the building stock could contribute to saving scarce resources, reduce energy consumption and improve environmental quality (Roper and Beard, 2006). The logical deduction from the concept of sustainability would be its ability to play an important role in guiding environmental policy to derive quantitative measures for carbon emissions, and other sustainability indices where the application of cost-benefit analysis becomes challenging (Ekins, 2000; Madew, 2006).

Knowledge-support systems in sustainability

Gloet (2006) developed a framework linking knowledge management (KM) and human resources management (HRM) and then applied it to the development of leadership and management capacities to support sustainability. The findings of the study provide a means to promote sustainability through effective KM and HRM linkages. Gloet evoked possibilities by which organisations can build up leadership and management capabilities to support sustainability across business, environmental and social justice contexts. Exploring how the management of sustainability in organisations can be backed up by business intelligence (BI) systems, Petrini and Pozzeboh (2009) indicated that BI has an important role to play in helping organisations implement, support and monitor sustainability practices. The study utilises the grounded theory to propose a conceptual model that attempts to support the process of integration of socio-environmental indicators into organisational schemes for sustainability. Barrios and Trejo (2003) and Glantz (2001) formulated a framework for understanding the effectiveness of systems that link knowledge to action for sustainability by exploring the implications of that framework for research and practice. The works present that science, technology and knowledge can make essential contributions to sustainability across a wide range of places and problems. These studies show that it is unlikely that the transition to sustainability could be quick enough to prevent significant degradation of human life and the earth system unless those knowledge contributions increase vividly. Cash et al. (2003) advised the creation of bridges across spatial scales so that the location-specific demands and knowledge vital to sustainability can be linked with the relevant national- and international-level research and development. Individual campaigns in research, innovation, monitoring
and assessment can also contribute to sustainability. Nonetheless, Evangelista and Durst (2015) stressed that the full utility of such independent contributions depends on developing integrated knowledge systems. A lesson already learned in the agriculture, defence and health sectors can be used elsewhere.

Knowledge requirements for property valuers

It became apparent that after 2007, additional investigation was required to know how valuers considered sustainability credentials in the valuation process. In particular, when literature reveals that valuers’ knowledge of sustainability could be a potential source of results bias (Warren-Myers, 2016). Surveys in 2011 and 2015 obtain knowledge rating from valuers including a series of test questions about key property market-based sustainability concepts such as the Green Building Rating Tools (GBRTs), building codes and indicators of sustainability. Knowledge levels changed marginally between 2011 and 2015, but professional knowledge about GBRTs improved in 2015. Warren-Myers (2016) insisted that the knowledge levels of these sustainability concepts and tools could correlate with how valuers assess the sustainability metrics of buildings in the valuation process. Michl et al. (2016) and RICS (2017) prescribed that valuers should continuously seek to enhance their knowledge of sustainability in the following areas:

- the assessment of values having regard to energy efficiency, greenhouse gas emissions and other property sustainability indicators obtained through market analysis or non-market sources;
- the assessment of the extent to which properties currently meet sustainability requirements and arriving at an informed view on the likely impacts on market or non-market values;
- documentation of relationships between sustainability features and attributes, potential benefits, risks and property values;
- inclusion of sustainability into property valuation theory;
- knowledge integration about GBRTs for assessment;
- improved heuristic qualities and the identification of sustainability indicators; and
- valuation variables such as risks, yields, rental growth, vacancy rates and operational expenses requisite to sustainability, including anticipated retrofitting costs.

In Nigeria, Babawale and Oyalowo (2011) appraised the perception of sustainability in real estate valuation in Nigeria. The study sets the social, economic and environmental features as observed variables for sustainability. It presents evidence that there is a rising awareness of the need to incorporate sustainability into the real estate valuation theory. Respondents tended to define real estate sustainability regarding its social, rather than economic or environmental features. The work suggests that Nigerian valuers would need to improve on their present knowledge of sustainability to effectively account for the sustainability dimensions in property valuations. Investors, property occupiers, the government and valuers were recognised as the principal drivers of the sustainability.

Conceptual framework

Knowledge integrates, applies and extends insights to the study of sustainability systems and programmes for linkages to SD actions. Linking knowledge for action requires the understanding of open channels for communication between stakeholders. Cash et al. (2002) emphasised that mutual understanding is often hindered by jargon language and lack of persuasive argument. Nonetheless, National Research Council (1999) advocated that
sustained transition to sustainability is structured through scholarly research, practical experimentation and comparative learning. This view was supported by Cash et al. (2003). In series of case studies, the relevance of KM and information systems in sustainability has been demonstrated. Cash et al. (2003) revealed that large systems of research information, innovations and applications evolve to correct past shortcomings in the sustainability systems. For instance, Guston (1999) stated that organisation structures can support or block the construction of credible and legitimate information for a range of decision makers. Also, forecasting systems from KM strive to produce timely information, allowing the identification of those system features that promote effective use of predictive information (Cash, 2000). Even so, Alcock (2001) reiterated that it is KM that explains how sustainability characteristics influence political, economic and natural systems outcomes. Active, iterative and inclusive communication between experts, decision makers and the community proves crucial to systems that mobilise knowledge in the world of action.

The conceptual model hypothesises that the valuers’ knowledge of the potential sustainability benefits summarised in the study of Addae-Dapaah et al. (2009) could build up a support system for integration into the industrial real estate evaluation theory and practice. The benefits include high building value (HBV), cost savings (CS), lower risks (LR), productivity gains (PG) and impact minimisation (IM). Figure 1 illustrates the conceptual framework. Valuers’ support system could then be validated if they agree to have, and use the green industrial rating tools, agree to pay premium for green features, agree to recommend green features to others; accept industrial valuation reflecting sustainability, the appropriateness of the valuation approach, and that it could induce industry investors to comply with local sustainability requirements.

This concept was also part of the postulations of Gloet (2006) and Petrini and Pozzeboh (2009), who developed support systems based on knowledge and BI. The following six hypotheses were tested as indicative of the objectives shown by the regression arrows in Figure 2:

**H1.** Prospects of high building value (BHBV) influence support for integration (SUP).

**H2.** Cost savings (BCS) predict SUP, that is, SUP is influenced by BCS.

**H3.** Prospects of lowering risks (BLS) are related to SUP.

**H4.** Productivity gains (BPG) influence SUP.

**H5.** SUP depends on the expectation of improved quality of life (BQL), that is, BQL predicts SUP.

**H6.** Expectation of improved quality of life acts as a mediator between BLR and SUP.

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**Figure 1.**
Conceptual framework for appreciation of benefits and support for industrial sustainability valuation

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**Source:** Adapted from Addae-Dapaah et al. (2009)
3. Methods
The research adopted the survey approach. The survey research offered the scope for a large representative sampling of real estate valuers from where reliable information can be extracted about perceived benefits of industrial sustainability and their support for integration into real estate valuation. Interviews and observations have limited scope in this scheme. The secondary information was gathered from related literature sources. A randomly selected pilot sample size of 46 valuers was first taken from the survey population across three cities (Lagos, Abuja and Port Harcourt) for the purpose of reliability testing, and the questionnaire was adjusted accordingly to reflect the outcome of the face and content validity tests. These cities are representative of the Nigerian real estate valuers clusters (Falade, 2005; Ibiyemi and Tella, 2013). Over 70 per cent of registered firms have either their principal offices or branch offices in at least one of the three cities covered by the study. The distribution of offices comprises 52 per cent in Lagos, 13 per cent in Port Harcourt and 7 per cent in Abuja (Babawale and Oyalowo, 2011). Moreover, there are 28 per cent in other areas. The pre-reliability-tested closed-ended questionnaire has 34 items, including items s4, s5 and s7 that were added as new concepts. Information of 267 randomly selected real estate valuers distributed as follows: Lagos (102), Port Harcourt (76) and Abuja (89) was retrieved. This represents a response rate of 41 per cent. The 2009 Register of valuers was used as the sampling frame. The sample size for factor analysis used for data reduction could be at least five times as many observations as there are variables to be analysed, with the acceptable range up to a ten-to-one ratio (Hair et al., 1998).

Selection of the variables used in the study
In total, 36 knowledge-based industrial sustainability benefits and support variables were identified in the current literature and classified by parameters for measuring the constructs selected from the studies of Madew (2006), Addae-Dapaah et al. (2009), Babawale and Oyalowo (2011) and Ibiyemi et al. (2015). Two items were removed after a face validity test reveals that those two items of the scale were not related to the domain of valuers’ support for integration. A reliability test was run on the 34 variables factor by factor and eight items were dropped. The items dropped are as follows: siting and structure design efficiency a1, secure grants and subsides b4, reduced societal costs of landfill creation b5, fewer complaints about comfort and related problems c5, user having more control over the environment d6, minimise site impact f5, pay a premium for green features s2 and ISRO factor would induce firms to comply with metrics and invest in further initiative s6. Robust statistically significant internal consistencies at > 0.7 were established for the remaining 26 variables distributed within each of the six factors. Cronbach α coefficients reported are as follows: BHBV = 0.717; BCS = 0.953; BLR = 0.858; BPG = 0.765; BQL = 0.761; and SUP = 0.819. The 26 variables which exhibited
statistically significant internal consistencies (Cronbach $\alpha > 0.7$) were used in the study (see Table AI). The constructs are: BHBV—higher building value; BCS—cost savings; BLR—lower risks; BPG—productivity gains; BQL—quality of life; and SUP—support for industrial sustainability integration. SUP is an endogenous or dependent variable and BQL is the mediating variable. Table AI depicts the distribution of the constructs and their indicators.

The questionnaire comprises three sections.

Section 1 concerned the demographic and professional data of the respondents. In Section 2, the questionnaire sought to ascertain the respondents’ knowledge about potential benefits and support for integrating sustainability into industrial real estate valuation, given that ISRO could induce industries to invest in sustainability initiatives that can assure all the benefits that the respondents considered to be of importance. This section has 21 items. A five-point Likert scale (1 = not important, 2 = not so important, 3 = moderately important, 4 = important, 5 = very important) was applied. Section 3 has five items. The responses were scored on a five-point Likert scales (1 = strongly disagree, 2 = disagree, 3 = undecided, 4 = agree, 5 = strongly agree). These scales are considered appropriate having been used in similar studies by Addae-Dapaah, et al. (2009) and Babawale and Oyalowo (2011). Table AI also shows the frequency distribution of the constructs and the indicators.

Methods of analyses: the data analysis has been structured into three parts. The first part has the descriptive analysis of respondents’ characteristics based on the reliability-tested questionnaire responses. The exploration of factors has been done with EFA in the second part. The third part tests $H1$–$H6$ using the partial least squares–SEM.

4. Results and data analysis
The results, made out in three parts, are reported as follows.

First part: descriptive statistics
The frequency distribution of responses for the reliability-tested items is presented as Table AI. Missing values were replaced with median values and outliers checked. A total of 80.9 per cent of the respondents are real estate valuers having full registration status with registration board of valuers, 15.3 per cent are in the final stages of full registration, while 3.7 per cent did not indicate their status; 86.1 per cent hold either Ph.D. or MSc degrees; 4.9 per cent with first degrees; 33.7 per cent are heads of firms, managers and staff partners, 46 per cent are university and polytechnic lecturers, while 9 per cent work for governments and private organisations; 54.6 per cent are above 50 years old, and 91.4 per cent have over ten years’ experience, while just 8.6 per cent have ten years’ experience. It indicates that these respondents are core professionals, having deep experience to deliver quality responses. Of the 267 respondents, 19 per cent were based in Ikeja axis, 21 per cent in Lagos Island, 16 per cent operated within Victoria Island-Lekki area and 10 per cent were based in Surulere axis. These are the core cluster operation areas for Appraisers in Lagos, Nigeria. A total of 13 per cent are based in other parts of Lagos Metropolis. Of the remaining 34 per cent, 9 per cent practice in Port Harcourt and 25 per cent in Abuja. The distribution of sampling and responses are representative for statistical analyses and inferences. Respondents were asked to rate the extent to which they consider the 21 reliability-tested variables in factors 1–5 are contributors to potential industrial sustainability support for integration. They were also asked to indicate their support for green industrial features and sustainability based on responses to the five items in factor 6.

Second part: exploratory structure and reliability of factor loadings
The fitness of the data was at first confirmed through the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy, which yielded a score greater than 0.6 ($KMO = 0.698$) (Kaiser, 1970). Bartlett test of sphericity is significant at $p \leq 0.05$ ($p = 0.001$) (Bartlett, 1954).
The indication is that factor analysis appropriate (Ho, 2006; Field, 2009; Pallant, 2011; Howitt and Crammer 2011). Eight components reported eigenvalues $\geq 1$, explaining a total of 71.06 per cent of the variance. PCA pattern matrix indicates three factors. Factor loadings from oblimin rotation relocated items a2–a4, f1–f3 to SUP and d1–d5 to BLR. BCS remains stable (Table I). The two highest ranking factors, each of which accounts for more than 10 per cent of the variance, are support (s1, s3–s5, s7, a2–a4, f1–f3) accounts for 17.19 per cent and BLR (c1–c3, d1, d2, c4, d3–d5, f4) accounts for 16.20 per cent. BCS (b1–b3, b6) account for 9.57 per cent. Item loadings above 0.4 on the components indicate strong loadings (Pallant, 2011; Howitt and Crammer, 2011). The indication is that the support from real estate valuers and knowledge about anticipated lower risks from operationalising sustainability initiatives are the determinant factors for integrating industrial sustainability into property valuation in Nigeria. The support variables (s) for integration and the benefit variables for lowering risks (c) are dominant in components, 1 and 2, respectively. The SUP, BLR and BCS factor loadings are shown as evidence for adopting three factors for the analysis. SUP has 11 items, BLR has 10 items and BCS has 4 items (Table I).

The support factor accounts for 17.19 per cent, which is greater than 10 per cent of the variance statistically attests to the respondents’ strong support for incorporating industrial

<table>
<thead>
<tr>
<th>Components</th>
<th>1</th>
<th>2</th>
<th>3</th>
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</thead>
<tbody>
<tr>
<td>Factor 1—support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s5. Industrial valuation to reflect sustainability</td>
<td>0.794</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s3. Recommend green features to others</td>
<td>0.739</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s7. Support the cost/ISRO approach where no market exists</td>
<td>0.639</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f1. Sustainability provides future generation needs</td>
<td>0.626</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s1. Invest in Green industrial building rating tools</td>
<td>0.584</td>
<td></td>
<td></td>
</tr>
<tr>
<td>s4. Relationship between sustainability and industrial building obsolescence</td>
<td>0.568</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f2. Less pollution</td>
<td>0.525</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a2. Faster tenants lease up</td>
<td>0.489</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a4. Better market distinction</td>
<td>0.489</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f3. Fight global warming</td>
<td>0.448</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a3. Recommend green features to others</td>
<td>0.342</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>17.19%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 2—benefit: lower risks</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>d4. Improved indoor quality for staff welfare</td>
<td>0.698</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c1. Reduced wastewater pollution and degradation</td>
<td>0.660</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c3. Reduced liability risks</td>
<td>0.658</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d2. Higher morale</td>
<td>0.625</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c2. Lower risk of unsustainable resource use</td>
<td>0.605</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d5. User satisfaction</td>
<td>0.599</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d3. Improve employee productivity</td>
<td>0.595</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c4. Reduced health and safety risks</td>
<td>0.515</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f4. Minimise wastes</td>
<td>0.461</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d1. Boost creativity</td>
<td>0.400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variance</td>
<td>16.20%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Factor 3—benefit: cost savings</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b3. Lower services maintenance costs</td>
<td>0.867</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b1. Water conservation</td>
<td>0.855</td>
<td></td>
<td></td>
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<tr>
<td>b2. Energy efficiency</td>
<td>0.816</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b6. Less claims on medical costs</td>
<td>0.812</td>
<td></td>
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</tr>
<tr>
<td>Variance</td>
<td>9.57%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table I.** Pattern matrices for factor loadings

**Notes:** Extraction method: principal component analysis; rotation method: oblimin with Kaiser normalisation
sustainability into valuation (0.794) by using the cost approach where no market exists (0.639). Also, it supports sustainability initiatives for providing future generation needs (0.626), ensuring pollution reduction (0.525), and would indeed recommend green features to those who are not valuers (0.739). Regarding perceived benefits, lower risks of exposure to pollution are 16.20 per cent of the variance. The benefit factor, BLR, has reduced waste pollution and degradation (0.660) and lower risks of unsustainable practices (0.605) as the most influential. Cost savings also account for close to 10 per cent (9.57 per cent) for inclusion. The underlying implication of both factors 2 and 3 is that the respondents seem to be aware that industrial sustainability issues are not merely a responsible alternative, but could provide significant exposure to risk-lowering outcomes and save costs.

**Third part: predictions and hypothesis testing**

The factor analysis indicates factor loadings for three factors: SUP, BLR and BCS. BHBV, BPG and BQL are poorly loaded < 0.40. The factors could not be included in the test because they could not predict SUP. Hence, no mediation effect could be reported. The relationship between the three constructs of the reflective model was estimated (Figure 3).

The factor loadings ranged from 0.576 to 0.935 (> 0.5). The regression weight on BCS→SUP is weak (< 0.5) and strong for BLR→SUP (0.653 > 0.5). BLR, BCS = 0.462 SUP: the coefficients of determination ($R^2$) of 0.462 are fair. (0.19–0.33, weak; 0.34–0.66, fair; > 0.67, strong (Henseler et al., 2009)). A total of 41.6 per cent of SUP is explained by BLR and BCS. The results of the confirmatory tests are shown in Table II.

![Path diagram](image)

**Figure 3.** Path diagram specifying relationships between constructs

<table>
<thead>
<tr>
<th></th>
<th>AVE</th>
<th>Composite reliability</th>
<th>$R^2$</th>
<th>Cronbach’s $\alpha$</th>
<th>Communality</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCS</td>
<td>0.7644</td>
<td>0.9285</td>
<td>0</td>
<td>0.9006</td>
<td>0.7644</td>
</tr>
<tr>
<td>BLR</td>
<td>0.6059</td>
<td>0.7446</td>
<td>0</td>
<td>0.4062</td>
<td>0.6059</td>
</tr>
<tr>
<td>SUP</td>
<td>0.4798</td>
<td>0.8456</td>
<td>0.4615</td>
<td>0.7933</td>
<td>0.4798</td>
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</table>

**Notes:** Quality criteria of model adjustments—SEM specification—rates of average variance extracted (AVE), compound reliability, $R$ and Cronbach’s $\alpha$ of constructs—overview

**Table II.** Quality criteria of model adjustments
Reference value: AVE > 0.5; CR > 0.7, Cronbach α > 0.7; communality > 0.40. Convergent validity is achieved (AVE > 0.5 across constructs) and composite reliability is achieved at > 0.7. Internal consistency is not proven for BLR (0.4062 < 0.7). Communality is achieved across all constructs (> 0.4). Latent variable correlations viewed from outer loadings are < 0.9. Discriminant validity is thus achieved showing that all constructs are independent.

A total of 5,000 bootstrap modules were run for the test of significance to obtain the t-values. The regression line is significant if \( t \geq 1.196 = p > 0.05 (> 1,000) \) (Ringle et al. 2010). Figure 4 indicates the significance of the prediction lines.

As shown in Figure 4, the adjusted research model has two significant paths: BLR→SUP (t = 12.181) and BCS→SUP (t = 2.078) > 1.196. Inference can be drawn that BLR and BCS are significant predictors of valuers’ support for the integration of industrial sustainability into real estate valuation. The Smart-PLS blindfolding module (Stone–Geisser Indicator \( Q^2 \)) evaluates the predictive relevance, that is, how well the model predicts the data \( (Q^2 = 0.1818 > 0) \) (Perfect model, \( Q^2 = 1 \)). Cohen’s Effect Size Indicator \( f^2 \) estimates how useful each construct is to the derived model \((\leq 0.02\), small; 0.15, medium; \( \geq 0.35\), large) (Hair et al., 2013). The values of \( Q^2 \) (0.1818) and \( f^2 \) (0.5866, 0.0242, 0.2991) indicate that the model is correct, and the three constructs are important for the general adjustment of the model.

**Evaluation of the hypotheses**

The model’s general quality was considered by indicator goodness-of-fit through the geometric mean of mean \( R^2 \) and mean AVE (Tenenhaus et al., 2005). The result was given as 0.418. It shows that the model is a well-adjusted model. Rates over 0.36 were good and acceptable in the case of applied social sciences (Wetzels et al., 2009). Table III evaluates the hypotheses.

With the quality of the model’s adjustments confirmed, the inferences on the path coefficients and their rates could be confirmed. Since the model was adjusted, rates were employed to evaluate the research hypotheses, as shown in Table III. \( H2 \) and \( H3 \) are the supported hypotheses. \( H1 \) and \( H4–H6 \) could not be proven for the population of valuers.

**5. Discussion and implications**

The hypotheses have been tested, and findings have indicated that the relationships of BLR and BCS to SUP are significant. The path \( \beta \)s shown on BLR → SUP (12.181) and BCS → SUP (2.078) have explanatory power. The relationship of BLR and SUP has demonstrated a
strong influence on SUP. The variance of 41.6 per cent explained in SUP by BLR and BCS is fair. Unknown factors explain 58.4 per cent of the variance in SUP. BLR has a stronger influence than BCS. Although the influence of BCS on SUP is also significant, the relationship is comparatively less powerful. The theoretical postulations of Addae-Dapaah et al. (2009) about relationships are supported in part because only BLR and BCS influence the support factor in the research model. Moreover, there is a deviation from the model that BHBV, BPG, and BQL would also be significant predictors of SUP.

BHBV, BPG and BQL were less considered as probable benefit nodes for industrial sustainability by the valuers. The logical explanation would be either that valuers do not seem to have sufficient knowledge about industrial sustainability benefits being a vehicle for a higher premium, and building values, productivity gains and enhanced quality of life or that the KM among them is ineffectual. The outcome is unexpected at this time when innovations for SD are gaining higher grounds at the local and global levels. Sustainability support systems based on knowledge as developed by Gloet (2006) and Petrini and Pozzeboh (2009) are also not fully supported. With knowledge insufficiency about BQL, it could not have a mediation effect. The three factors not considered in the conceptual model could lend credence to a submission that the valuers’ perception was a responsible alternative rather than knowledge based.

The outcome challenges the conceptual models of Gloet (2006) and Petrini and Pozzeboh (2009) that sustainability in organisations can be backed up by knowledge and intelligence. Nevertheless, there is theoretical indication that valuers’ specific understanding of economic and risks reduction advocacy can help achieve industrial sustainability. Since BLR is more important than BCS as dominant factors, there is evidence that SUP could improve significantly with more proof of risk lowering available to the valuers. However, in support of the models of Glantz (2001), Gloet (2006) and Petrini and Pozzeboh (2009), BHBV, BPG and BQL are associated with SUP. The theoretical implication is that valuers’ knowledge about sustainability is to be advanced in concert with the defined sustainability knowledge requirements. In practical terms, they need to be aware that the inducement of industry investors to sustainability uptakes can be achieved through concrete support for the implementation of assessment-based industrial sustainability initiatives and the use of valuation as a tool. On the policy front, valuers better align efforts on a global level regarding the orientation of decision-making processes to canvass for the establishment of a Sustainability Rating Council, as there is evidence in this study to suggest its urgent need.

### 6. Limitations

This study identified and investigated factors inducing SUP as an endogenous variable. There could be more than the two exogenous factors (BLR and BCS) and mediating variables that can be important for the general adjustment of the model, but currently obscure to the researcher in literature. Second, we might assert that the sampling is probabilistic, but can make no claim about possible errors of random sampling. We reckon that the data was handled properly. Even so, it was neither possible to control inappropriate response in spite of

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Pathway</th>
<th>t-value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>BHBV → SUP</td>
<td>–</td>
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<tr>
<td>H2</td>
<td>BCS → SUP</td>
<td>2.078</td>
<td>Supported</td>
</tr>
<tr>
<td>H3</td>
<td>BLR → SUP</td>
<td>12.181</td>
<td>Supported</td>
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<tr>
<td>H4</td>
<td>BPG → SUP</td>
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<tr>
<td>H5</td>
<td>BQL → SUP</td>
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<td>Factor loading not significant</td>
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<tr>
<td>H6</td>
<td>BQL mediates between BLR and SUP</td>
<td>–</td>
<td>No mediation effect</td>
</tr>
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</table>

Table III. Evaluation of hypotheses
the pilot tests nor the non-responses. Sampling was deemed representative if taken from the three major cities of Abuja, Port Harcourt and Lagos. Although theory supports this, it is hard to know the extent to which the findings are generalisable.

7. Conclusion and future work
The existing model of KM for sustainability and perceived benefits can be characterised as a rational model as it assumes that the sufficiency and neutrality of objective expert knowledge are sequential in nature and that its planning methods have universal applicability requiring minimal situational adaptations. However, it is apparent that sustainability policy decision making is decidedly interactive and qualitative. The work contributes towards the broadening of the investigation field on the evaluation of activities and variable relationships in industrial sustainability for inclusion into property valuation for which cognate knowledge of the valuer is indispensable. In particular, it submits that the perception of valuers regarding sustainability integration into the valuation process is constrained by the inadequate consideration of productivity gains and the prospects of enhanced quality of life which are pivotal to the valuers’ social responsibility. Also, the characteristics of the valuers’ population depicted by the path modelling provide a strong baseline for the future study of that population. Future research could focus on the perspectives of the industry investors, which might also be compared and contrasted with the valuers’ perspectives.

References
Cash, D.W., Clark, W., Alcock, F., Dickson, N., Eckley, N. and Jäger, J. (2002), Salience, Credibility, Legitimacy and Boundaries, John F. Kennedy School of Govt., Harvard University, Cambridge, MA.


National Research Council (1999), Our Common Journey, National Academy Press, Washington, DC.


## Appendix

**Valuers’ support systems**

<table>
<thead>
<tr>
<th>Latent variables (factors)</th>
<th>Items (observed variables)</th>
<th>(Likert scales)</th>
<th>Frequencies</th>
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<th>Total</th>
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<td>High building value (BHBV)</td>
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<td>Quality of life (BQL)</td>
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<td>Support (SUP)</td>
<td>Invest in Green industrial building rating tools—s1</td>
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<td>Recommend green features to others—s3</td>
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<td>Relationship between sustainability and industrial building obsolescence—s4</td>
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<td>Would support the cost/ESRO approach where no market exists—s7</td>
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</table>

**Table AI.** Study variables and frequency distribution of respondents

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