

## Interactive Effects of Institutional, Economic, Social and Environmental Barriers on Sustainable Housing in a Developing Country

Michael Atafo Adabre<sup>1</sup> ; Albert P.C. Chan<sup>2</sup>; Amos Darko<sup>3</sup>

### Abstract

This study investigates the causal relationships among ‘institutional’, ‘economic’, ‘social’ and ‘environmental’ sustainability barriers in addition to assessing their effects on sustainable housing. A questionnaire survey was conducted with professionals in the regulated sector of the Ghanaian housing market. Data collected were analyzed using the partial least squares structural equation modeling (PLS-SEM). Results revealed the following significant paths among the barriers: ‘institutional barriers’ to ‘economic barriers’ path is supported at a significance level of  $p < .05$  at a t-value of 2.125; ‘institutional barriers’ to ‘social barriers’ path is also supported at a significance level of  $p < .05$  at a t-value of 2.132 and likewise ‘institutional barriers’ to ‘environmental barriers’ path of  $p < .01$  at a t-value of 3.740. Between the barriers and sustainable housing, both ‘institutional barriers’ and ‘environmental barriers’ have significant impacts on sustainable housing at t-values of 3.673 and 1.790 supported at  $p < .01$  and  $p < .10$ , respectively. Three underlying barriers, viz: ‘bureaucratic delays’, ‘policy instability’ and ‘weak enforcement of development control on land’ accounted for all the significant paths of the ‘institutional barriers’. Among them ‘policy instability’ has the highest

---

<sup>1</sup> Co-author’s address : Dr. Michael Atafo Adabre, Building and Real Estate Department, Hong Kong Polytechnic University, Hong Kong. [Tel:+85266450743](tel:+85266450743)  
E-mail address: [17902405r@connect.polyu.hk](mailto:17902405r@connect.polyu.hk)

<sup>2</sup> Co-author’s address: Prof. Albert P.C. Chan, Building and Real Estate Department, Hong Kong Polytechnic University, Hong Kong. E-mail address: [albert.chan@polyu.edu.hk](mailto:albert.chan@polyu.edu.hk)

<sup>3</sup> Corresponding author’s address: Dr. Amos Darko, Building and Real Estate Department, Hong Kong Polytechnic University, Hong Kong.. E-mail address: [amos1.darko@polyu.edu.hk](mailto:amos1.darko@polyu.edu.hk)







Various techniques have been employed for analyzing barriers. Analytical techniques have evolved with succeeding techniques building on the weakness of preceding ones (Kim et al., 2009; Guan et al., 2020; Adabre et al., 2021b). Among different analytical techniques such as traditional multiple regression (TMR) analysis (Roufechaei et al., 2014), artificial neural network (ANN) (Kim et al., 2009), interpretive structural model (ISM) (Guan et al., 2020), fuzzy-DEMATEL (Addae et al., 2019), structural equation modelling (SEM) is considered as one of the most appropriate techniques for assessing interactive effects among groups of variables. For instance, following a comparative assessment of different techniques (i.e. TMR, ANN and SEM), Kim et al. (2009) asserted that interactive networks produced by structural equation model proffer enhanced outcomes on causal relationships among project barriers and goals. Therefore, the partial least squares structural equation modelling (PLS-SEM) is deployed in this study to develop a network of interactive effects among groups of barriers on one hand and to assess impacts of the groups of barriers on goals of sustainable housing. Findings on the network would enable policymakers and practitioners to re-evaluate barriers to sustainable housing supply, and they could serve as decision support network for improving housing provision from the formal sector of the housing market in Ghana and in other sub-Saharan African countries.

## **2.1 Sustainable Housing Criteria and Barriers: A Literature Review**

As part of the United Nations Sustainable Development Goals, various critical success criteria (CSC) have been specified for gauging sustainable housing development. CSC are the set of standards through which judgement can be made (Ahadzie et al., 2011). They could be qualitative or quantitative criteria and are, therefore, measured subjectively or objectively, respectively (Mulliner et al., 2008; Adinyira et al., 2014). Chan and Adabre (2019) categorized CSC for sustainable housing into six groups, with the following key underlying criteria, viz:



government incentives’, ‘higher costs’, ‘inadequate professional knowledge and expertise’, ‘lack of financing schemes’ and ‘inadequate policies for sustainable development’. Providing a checklist of barriers, as evidenced in prior studies, is fundamental to managing barriers. In addition to this basic benefit, lists of project barriers have been decomposed into smaller groups via classification techniques to ensure more manageable barriers.

One technique of barrier classification is clustering by nature (Marle et al., 2013). That is, the checklist of barriers could be a priori classified (included in the methodology or empirically classified) or a posteriori classified based on the nature of the barrier (Marle et al., 2013). For instance, regarding a priori classified barriers, Darko et al. (2018) deployed factor analysis for clustering barriers into ‘government-related’, ‘human-related’, ‘knowledge and information-related’, ‘market-related’ and ‘cost and risk-related’ barriers. Similarly, through confirmatory factor analysis, Adabre and Chan (2021) grouped sustainable housing barriers into three categories: ‘cost-related barriers’, ‘incentive-related barriers’ and ‘retrofitting-related barriers’. On the other hand, using a posteriori clustering of barriers, Owusu et al. (2019) made a clear distinction between economic barriers and institutional barriers. Yet, broadening on these two distinctions, study by Adabre et al. (2020) grouped the barriers based on their potential impacts on the four sustainability goals. Thus, in Adabre et al. (2020), barriers from extant literature were clustered into ‘institutional sustainability barriers’; ‘economic sustainability barriers’; ‘environmental sustainability barriers’ and ‘social sustainability barriers’. Notwithstanding the two different forms of clustering barriers by nature – a priori and posteriori –, their essence is to facilitate identification of stakeholders or entities that have the requisite skills and expertise for mitigating clustered barriers. Yet, both forms of clustering barriers do not account for prioritization of the clustered barriers (Marle et al., 2013; Adabre et al., 2021b).





barriers albeit without empirical investigation on causation between the barriers. Besides, attributed to limitations in most techniques such as decision making trial and evaluation laboratory (DEMATEL) (Sivakumar et al., 2018); fuzzy DEMATEL (Addae et al., 2019); interpretive structural modelling (Guan et al., 2020); fuzzy weighted interpretive structural modelling (Tavakolan and Etemadnia, 2017), regression and artificial neural network (Kim et al., 2009), developing a statistically validated network of the impact of barriers on sustainable housing is also a knowledge gap regarding the analytical techniques. For instance, test of statistical significance among causal relationships cannot be achieved with the ISM and fuzzy-DEMATEL. Although such test is possible in regression analysis, this technique is only suitable for one dependent variable with at least two independent variables (Astrachan et al., 2014; Adabre et al., 2021b). Therefore, this study seeks to bridge the identified knowledge gaps by making empirical and methodological contributions through the PLS-SEM technique.

The categorization of underlying barriers into the four sustainability pillars – economic, social, environmental and institutional (refer to Table 1) – is based on prior studies (Hosseini & Kaneko, 2012; Adabre et al., 2020; Jing & Wang, 2020). According to Hosseini & Kaneko (2012), economic sustainability factors include macroeconomic variables (i.e. inflation, interest rate, consumer prices). Institutional sustainability barriers involve factors that influence governments' effectiveness, regulatory quality, control of corruption, political stability, rule of law. Environmental sustainability barriers lead to depletion of natural resources (i.e. land depletion, net forest depletion, energy depletion) while social sustainability barriers negatively affect social inclusion, equality, empowerment and social phenomena (i.e. lifestyle and cultural forms) (Jing & Wang, 2020).

**Table 1: SHC and Barriers to Sustainable Housing**

Category	Code	Underlying Variables	References
<b>Sustainable Housing Criteria (SHC)</b>			
	SHC1	Timely completion of project	<p>Adabre &amp; Chan (2018); Chan &amp; Adabre (2019)  Adinyira et al. (2014); Ahadzie et al. (2011)  Mulliner et al. (2008); Osei-Kyei &amp; Chan (2017)  Cruz et al. (2019)</p>
	SHC2	Construction cost performance	
	SHC3	Quality performance	
	SHC4	Safety performance (crime prevention)	
	SHC5	Environmental-friendly (Eco-friendly)	
	SHC6	Ease of maintenance of housing facility	
	SHC7	Energy efficient housing	
	SHC8	Affordable price of facility	
	SHC9	Affordable rent of facility	
	SHC10	Commuting cost of household to facility	
	SHC11	Technology transfer/innovation	
<b>The Four Main Categories of Barriers to Sustainable Housing</b>			
Economic Barriers	ESB1	Inadequate public funding	Owusu et al. (2019); Adabre et al. (2020)
	ESB2	Excessive cost of serviced land	Keivani and Werna (2001); Owusu et al. (2019)
	ESB3	Excessive cost of sustainable building materials/technologies	Amoatey et al. (2015); Darko et al. (2018); Owusu et al. (2019)
	ESB4	High approval cost due to high taxes and fees on developers	Owusu et al. (2019)
	ESB5	Inadequate incentives for private investors	Darko et al., (2018); Eduful & Hooper (2019)
	ESB6	High interest rates	Arku et al. (2012); Amoatey et al. (2015)
	ESB7	High inflation rates	Amoatey et al. (2015); Owusu et al. (2019)
	ESB8	Tight credit conditions	Amoatey et al. (2015); Owusu et al. (2019)
Social Barriers	SSB1	Income inequality	Arku et al. (2012); Dong (2018); Eduful & Hooper (2019)
	SSB2	Social exclusion and segregation	Eduful & Hooper (2019); Niembro et al. (2021)
	SSB3	Poor maintenance culture/inadequate retrofitting of existing housing	Agyefi-Mensah et al. (2015); Mete & Xue (2020)
	SSB4	High loan/mortgage default rates by clients	Ebekozien et al. (2019); Adabre et al. (2020)



## 2.2 Theoretical Model of Barriers and Sustainable Housing

A theoretical model was established for assessing the causal relationships among the institutional, economic, social and environmental barriers as well as evaluating their impacts on sustainable housing. Review of the extant literature suggests the following theoretical model (refer to Fig. 1) and hypotheses:

**Hypothesis 1:** ‘Institutional barriers’ significantly influence ‘economic barriers’. That is, if this statement is confirmed in the data analysis, then institutional barriers originate economic barriers to sustainable housing development in the regulated sector of the housing market (Owusu et al., 2019).

**Hypothesis 2:** ‘Institutional barriers’ significantly influence ‘social barriers’. Thus, institutional barriers cause social barriers (i.e. income inequality, social exclusion and segregation etc.) (Eduful and Hooper, 2019; Sulemana et al., 2019) in the regulated sector of the housing market, provided this hypothesis is valid.

**Hypothesis 3:** ‘Institutional barriers’ have a significant impact on ‘environmental barriers’. If this statement is verified, then ‘environmental barriers’ are caused by existing institutional challenges in the housing market (Cobbinah & Amoako, 2012).

**Hypothesis 4:** ‘Economic barriers’ have a significant impact on ‘social barriers’. Thus, on condition that this hypothesis is confirmed, there is a causality from ‘economic barriers’ to ‘social barriers’ (Hosseini & Kaneko, 2012); this implies that social barriers could be alleviated by mitigating economic barriers in the housing market (Sulemana et al., 2019).

**Hypothesis 5:** ‘Economic barriers’ have a significant impact on ‘environmental barriers’ (Hosseini & Kaneko, 2012). That is ‘economic barriers’ instigate ‘environmental barriers’ in the Ghanaian housing market, on condition that the hypothesis is valid.

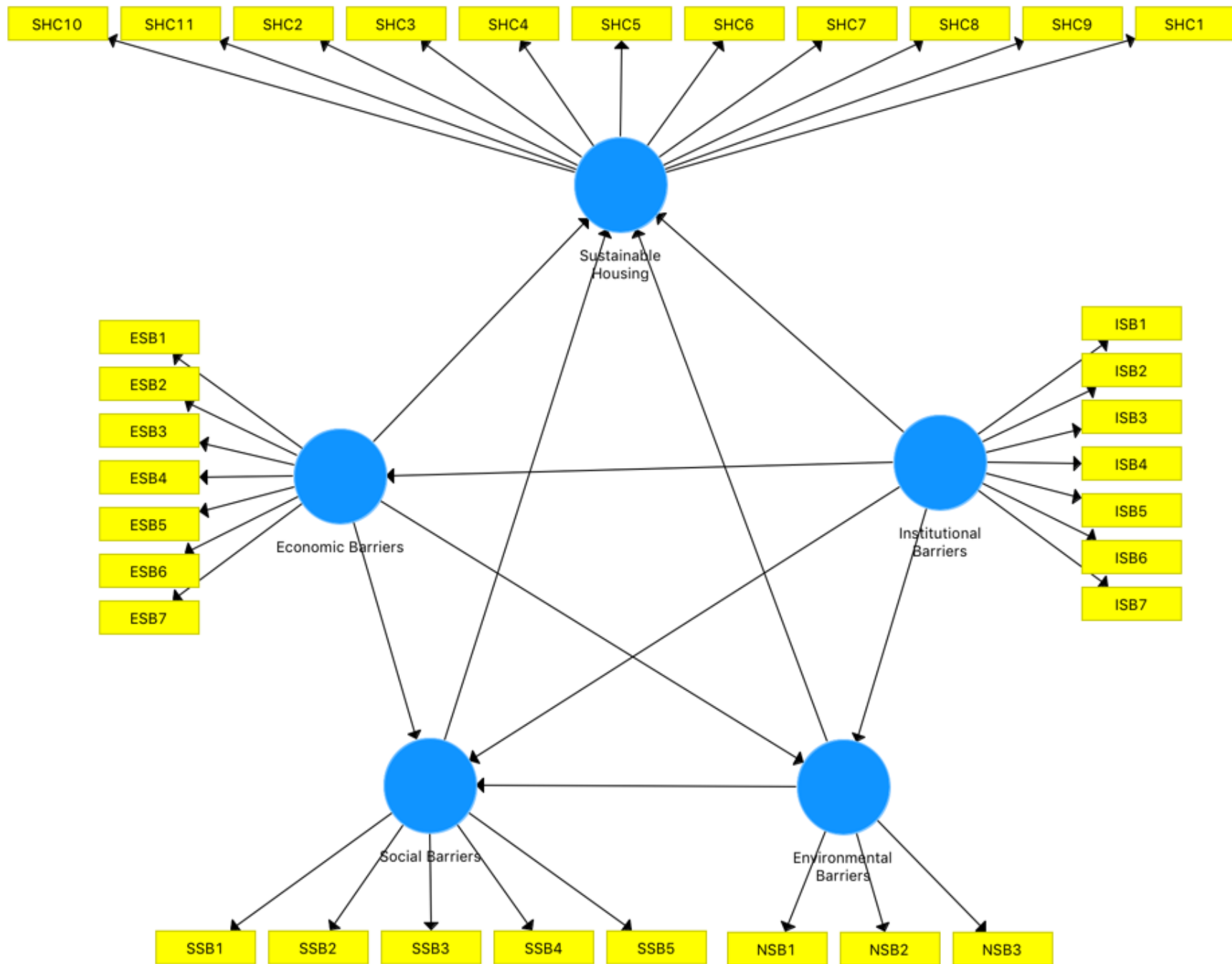
**Hypothesis 6:** ‘Environmental barriers’ have a significant impact on ‘social barriers’. It is hypothesized that problems related to conservation of natural resources such as land (environmental barriers) lead to social sustainability challenges such social exclusion and income inequality (Haidar & Bahammam, 2021). Besides, according to Zhang et al (2014), environmental barriers (regarding land use) can destabilize an ecosystem and instigate social barriers. Therefore, there is a significant effect of environmental barriers on social barriers, provided this claim is valid. Otherwise, ‘environmental barriers’ do not cause ‘social barriers’.

**Hypothesis 7:** ‘Institutional barriers’ significantly influence sustainable housing. If this hypothesis is validated, then sustainable housing is negatively affected by institutional barriers in the Ghanaian housing market (Owusu et al., 2019).

**Hypothesis 8:** ‘Economic barriers’ significantly influence sustainable housing. That is, sustainable housing is negatively affected by ‘economic barriers’ provided the hypothesis is confirmed. Otherwise, economic barriers do not have any significant impact on sustainable housing development in the Ghanaian housing market (Owusu et al., 2019).

**Hypothesis 9:** ‘Environmental barriers’ significantly influence ‘sustainable housing’. This could imply that sustainable housing development is directly and negatively affected by environmental barriers (Hosseini & Kaneko, 2012).

**Hypothesis 10:** ‘Social sustainability barriers’ significantly influence ‘sustainable housing’ in the Ghanaian housing market. If this statement is corroborated, there is a causality from social barriers to sustainable housing development .



**Fig. 1:** A Conceptual Model of the Interactive Effects Among Barriers and Sustainable Housing



### **3.3 Population and Sampling**

The population for this study includes members of the formal/regulated sector of the Ghanaian housing market. Some of these include: MWRWH; PWD; SHC; SSNIT; TDC; AESL; BRRI and GREDA. Due to inadequate list of the members of these institutions, probability sampling could not be deployed for data collection. However, non-probability sampling techniques such as purposive sampling and snowballing were utilised for collecting data. These established non-probability sampling techniques are suitable in situations where it is difficult to assess the representativeness of the sample vis-à-vis the population of the study (Adabre et al., 2021b). Yet, the problem of sample size biased could occur in using non-probability sampling techniques. Therefore, appropriate strategies were employed for the data collection from the different institutions to ensure that sampling bias was minimized as far as practicable. This was achieved by first identifying the institutions within the formal sector of the Ghanaian housing market through a comprehensive literature review and snowballing with professionals (Adabre et al., 2021b).

### **3.4 Data Collection**

To prevent sampling bias, the time for administering the questionnaire is important and was, therefore, taken into consideration. The questionnaire was administered at the Annual General Meeting (AGM) of the Ghana Institution of Surveyors (GhIS), which was held on 2<sup>nd</sup> March 2019 in Accra at the Ghana Institute of Management and Public Administration (GIMPA). At the AGM, most quantity surveyors, land surveyors and valuers of the regulated institutions were present since attending such meeting is a requirement on all professionals of the GhIS. The questionnaire was administered to members who worked in the formal sector of the Ghanaian housing market after briefly introducing them to the aim of the study. The participants at the AGM were mostly identified through snowballing. Other professionals who



do not belong to the GhIS did not attend the AGM. Therefore, the researchers visited the offices of the formal institutions such as PWD, SHC, SSNIT, TDC, MWRWH, AESL and BRRI. The questionnaires were administered to architects, engineers and planners. Concerning the developers, a brochure containing the email addresses and phone numbers of the developers was obtained from the head office of GREDA. Phone calls were made to members of GREDA to book appointment with them for either face-to-face questionnaire administration or questionnaire administration via email. The members of GREDA, who participated in the survey, were kindly requested to forward the questionnaire by email to other interested members who could provide the required data for achieving the study's aim. A total of 110 questionnaires were administered via email and face-to-face contacts, out of which 47 valid questionnaires were retrieved which corresponds with a 42.7% response rate.

### **3.5 Respondents' Profile**

Respondents' profile was descriptively analysed using the Statistical Package for Social Science (SPSS). Results showed that 47.9% of the respondents are employed in the public sector, 35.4% are employed in academic institutions and 16.7% were private developers. On professions of the respondents, most (55.3%) were quantity surveyors, followed by architects (19.2%), then construction managers (12.8%) and planners and engineers constituting 12.7%. On housing projects handled, most of the respondents (52.2%) stated that they have handled  $\geq$  two projects in Ghana, of which 55.1% are state or public housing projects. Concerning years of working experience of respondents, 63.9% have  $> 5$  years working experience. The respondents' profile shows that they are abreast of the Ghanaian housing market ([Adabre et al., 2021b](#)). Therefore, they could provide the required data for assessing the interactive effect among the economic, social, environmental and institutional sustainability barriers as well as evaluating their impact on sustainable housing.

### 3.6 Data Analysis Technique – PLS-SEM

Structural equation modelling (SEM) is deemed appropriate for this study because of the limitations in other statistical techniques as elaborated in extant literature (Kim et al., 2009; Eybpoosh et al., 2011; Astrachan et al., 2014; Ahmadabadi & Heravi, 2019). SEM is suitable for assessing potential interactive effects among the four constructs of barriers and for establishing a predictive model between the barrier categories and sustainable housing (Adabre et al., 2021b). Therefore, the stated hypotheses (hypotheses 1 to 10) could be tested with the use of SEM, either with the partial least square structural equation modeling (PLS-SEM) or covariance-based structural equation modeling (CB-SEM). The PLS-SEM is suitable for testing hypotheses with relatively small sample size of non-normally distributed data. In contrast, the CB-SEM is appropriate for testing existing theories with large sample size of data (i.e. > 200) that are normally distributed (Adabre et al., 2021b). Since this study aims to test hypotheses using relatively small sample of data that are not normally distributed, the PLS-SEM is more appropriate for data analysis (Astrachan et al., 2014).

Notwithstanding the PLS-SEM's relative low sensitivity to sample size compared to the CB-SEM's, adequate sample for statistical analysis was assured. This was achieved by meeting basic requirements for statistical analysis. First, the data must fulfill the central limit theorem requirement of a sample size of 30. Since a sample size of 47 valid responses were obtained, the data fulfilled the central limit theorem and are appropriate for statistical analyses. Besides, one of the requirements for employing the PLS-SEM is that the estimated sample size should be more than 10 times the maximum number of arrows pointing at a construct (Hair et al., 2012). From the conceptual model (refer to Fig. 1), there are four maximum number of arrows pointing at the sustainable housing construct. Therefore, the required sample size should be more than 10 times the maximum number of arrows pointing at the sustainable housing

construct (i.e.  $10 \times 4 = 40$ ). Since the sample size  $47 > 40$ , the data is deemed suitable for statistical analysis using the PLS-SEM. However, regards CB-SEM, it is a requirement that the sample size should be five times the number of indicators included in the original model (Astrachan et al., 2014).

In conducting the PLS-SEM, the measurement model was first estimated. This was achieved by establishing the relationships between the constructs (i.e. the barrier categories and sustainable housing) and their indicators. All constructs were reflectively measured by their indicators. This was followed by assessments of the measurement model through reliability and validity checks. Cronbach's alpha, composite reliability and rho-alpha were used for assessing reliability of the measurement model while convergent validity (via factor loading and average variance extracted) and discriminant validity (via Fornell & Lacker criterion, cross loadings and heterotrait-monotrait/HTMT) were used for assessing validity of the measurement model. The measurement model assessment was followed by specification of the structural model which establishes the potential relationships among the clustered barriers and sustainable housing. The structural model was checked for multicollinearity using the variance inflation factor (VIF). Afterwards, test of significance of the relationships (i.e. hypotheses) was conducted using bootstrapping analysis.

## **4. Results of Data Analysis**

### **4.1 Descriptive and Reliability Analysis**

The content validities of the data were first assessed using the Cronbach's alpha values obtained from the SPSS data analysis. Estimated Cronbach's alpha values of 0.878 and 0.882 were determined for the indicators of sustainable housing and the indicators of the various barrier categories, respectively. Since these estimated Cronbach's alpha values are  $> 0.700$  (i.e.

the recommended threshold for data validity), the results imply adequate validity of the data. Mean scores and standard deviations were estimated for the indicators of sustainable housing and the barriers. The underlying indicators of the constructs were ranked using their mean scores. For two indicators that have the same mean scores, their rankings were based on their standard deviations. In that case, the indicator with a lower standard deviation is ranked higher. Table 2 shows the mean scores and standard deviations of the indicators. '*Construction cost performance*', '*quality performance of housing projects*', '*timely completion of projects*', '*affordable price of facility*' and '*affordable rent of facility*' are the top five ranked criteria of the sustainable housing construct. Concerning the barriers, their mean scores (refer to Table 2) revealed that the top ranked underlying barriers include: '*high interest rates*'; '*excessive cost of sustainable building materials/technologies*'; '*excessive cost of serviced land*'; '*policy instability*' and '*tight credit conditions*'. Most of the top five highly ranked barriers are in the 'economic barriers' category (refer to Table 2).

**Table 2: Descriptive Statistics of the Underlying Variables/Indicators**

Constructs	Code	Observable Variables	Mean Score	Standard Deviation	Rank	Corrected Item-total correlation	Cronbach's Alpha if Item Deleted	Overall Cronbach's Alpha
<b>Sustainable Housing Criteria (SHC)</b>								
	SHC1	Timely completion of project	4.340	0.815	3	0.378	0.875	0.813
	SHC2	Construction cost performance	4.468	0.584	1	0.231	0.878	
	SHC3	Quality performance	4.343	0.644	2	0.496	0.872	
	SHC4	Safety performance (crime prevention)	4.085	0.803	7	0.654	0.867	
	SHC5	Environmental-friendly (Eco-friendly)	4.085	0.803	7	0.380	0.875	
	SHC6	Ease of maintenance of housing facility	4.283	0.851	5	0.566	0.869	
	SHC7	Energy efficient housing	3.915	0.880	9	0.547	0.870	
	SHC8	Affordable price of facility	4.298	0.749	4	0.393	0.875	
	SHC9	Affordable rent of facility	4.196	0.824	6	0.472	0.872	
	SHC10	Commuting cost of household to facility	3.787	0.999	10	0.582	0.869	
	SHC11	Technology transfer/innovation	3.468	0.856	11	0.621	0.868	
<b>Underlying Barriers to Sustainable Housing</b>								
<b>Economic Barriers</b>								
	ESB1	Inadequate public funding	4.404	0.742	8	0.436	0.861	0.882
	ESB2	Excessive cost of serviced land	4.467	0.710	3	0.386	0.837	
	ESB3	Excessive cost of sustainable building materials/technologies	4.467	0.544	2	0.395	0.838	
	ESB4	High approval cost due to high taxes and fees on developers	4.170	0.637	12	0.326	0.839	
	ESB5	Inadequate incentives for private investors	3.872	0.924	20	0.553	0.829	
	ESB6	High interest rates	4.761	0.427	1	0.443	0.837	
	ESB7	High inflation rates	4.404	0.712	7	0.414	0.836	
	ESB8	Tight credit conditions	4.404	0.680	6	0.397	0.837	
<b>Social Barriers</b>								
	SSB1	Income inequality	3.979	0.737	16	0.427	0.835	
	SSB2	Social exclusion and segregation	4.085	0.905	13	0.905	0.830	
	SSB3	Poor maintenance culture/inadequate retrofitting of existing housing	4.213	0.907	11	0.493	0.832	
	SSB4	High loan/mortgage default rates by clients	3.915	0.974	18	0.430	0.861	
	SSB5	Negative culture towards mortgage	3.894	0.890	19	0.354	0.863	
<b>Environmental Barriers</b>								



#### 4.2.1 Results of PLS-SEM: Measurement Model Estimation

The PLS-SEM analysis was conducted using Smart PLS version 3.27 for assessing the interactive effects among the categories of barriers and their effects on sustainable housing development. On establishing the measurement model, indicators' factor loadings which were below 0.50 were deleted, and the analysis was performed repeatedly until the retained indicators have loadings  $\geq 0.50$ . Table 3 shows the outcome of the valid and reliable measurement model (Hair et al., 2012). From Table 3, all the factor loadings and the average variance extracted (AVE) are above the required 0.50, which indicates data validity. Besides, the composite reliability (CR) and the rho alpha (Rho\_A) values are greater than the recommended 0.70, which imply satisfactory reliability of the measurement model (Hair et al., 2012).

**Table 3:** Measurement Model Results

	Items	Loadings	AVE	CR	Rho_A
Sustainable Housing	SHC10	0.520	0.516	0.837	0.811
	SHC3	0.624			
	SHC7	0.651			
	SHC8	0.848			
	SHC9	0.881			
Economic barriers	ESB1	0.741	0.627	0.870	0.811
	ESB2	0.743			
	ESB3	0.828			
	ESB7	0.850			
Social barriers	SSB2	0.656	0.571	0.841	0.810
	SSB4	0.800			
	SSB5	0.743			
	ESB5	0.813			
Environmental barriers	NSB1	0.865	0.571	0.796	0.744
	NSB2	0.597			
	NSB3	0.781			
Institutional barriers	ISB1	0.790	0.702	0.876	0.804
	ISB3	0.874			
	ISB4	0.848			

Items deleted: indicators' factor loadings < 0.5: SHC1;SHC2;SHC4;SHC5;SHC6;SHC11; ESB4;ESB5;ESB6; ESB8; SSB1;SSB3;ISB2;ISB5;ISB6;ISB7

#### 4.2.2 Discriminant Validity

Further assessments of the measurement model were conducted using the cross loadings of the variables, the Fornell and Lacker criterion and the heterotrait-monotrait (HTMT) ratio of correlation (refer to Tables 4, 5 & 6). Concerning cross-loadings, all indicators of the sustainable housing constructs and barriers had the highest loadings in the constructs they were hypothesized to measure (refer to Table 4). On the Fornell and Locker criterion, the condition is that each construct should have the highest correlation with itself. Such correlations are shown diagonally in Table 5. Regarding the HTMT ratio of correlations, the condition for assessment is that the correlations should be compared to an established threshold i.e. 0.90 (HTMT<sub>0.90</sub>) as proposed by [Teo et al. \(2008\)](#), and all the correlations should be lower than the established threshold. All correlations of the HTMT (refer to Table 6) are < 0.90, which further confirmed the adequacy of the measurement model regards discriminant validity.

**Table 4:** Indicators' Cross Loadings

Indicators /Variables	Sustainable Housing	Economic Barriers	Social Barriers	Environmental Barriers	Institutional Barriers
SHC10	<b>0.520</b>	0.079	0.016	-0.077	0.090
SHC3	<b>0.624</b>	0.347	0.291	0.197	0.409
SHC7	<b>0.651</b>	0.181	0.084	0.121	0.351
SHC8	<b>0.848</b>	0.141	-0.128	-0.105	0.230
SHC9	<b>0.881</b>	0.111	0.009	-0.154	0.334
ESB1	0.141	<b>0.741</b>	0.244	0.347	0.148
ESB2	0.216	<b>0.743</b>	0.092	0.162	0.214
ESB3	0.207	<b>0.828</b>	0.186	0.173	0.372
ESB7	0.186	<b>0.850</b>	0.317	0.139	0.240
SSB2	0.126	0.293	<b>0.656</b>	0.091	0.319
SSB4	-0.068	0.268	<b>0.800</b>	0.315	0.411
SSB5	0.118	0.159	<b>0.743</b>	0.218	0.311
ESB5	0.050	0.148	<b>0.813</b>	0.505	0.603
NSB1	-0.007	0.142	0.401	<b>0.865</b>	0.608
NSB2	-0.025	0.152	0.222	<b>0.597</b>	0.254
NSB3	-0.014	0.349	0.286	<b>0.781</b>	0.256
ISB1	0.372	0.241	0.404	0.356	<b>0.790</b>
ISB3	0.263	0.272	0.573	0.605	<b>0.874</b>
ISB4	0.416	0.272	0.460	0.386	<b>0.848</b>



**Table 5:** Fornell and Lacker Criterion

Construct / Categories	Sustainable housing	Economic barriers	Social barriers	Institutional barriers	Environmental barriers
Sustainable housing	<b>0.718</b>				
Economic barriers	0.235	<b>0.792</b>			
Social barriers	0.063	0.272	<b>0.756</b>		
Institutional barriers	0.410	0.313	0.579	<b>0.838</b>	
Environmental barriers	-0.017	0.260	0.420	0.548	<b>0.756</b>

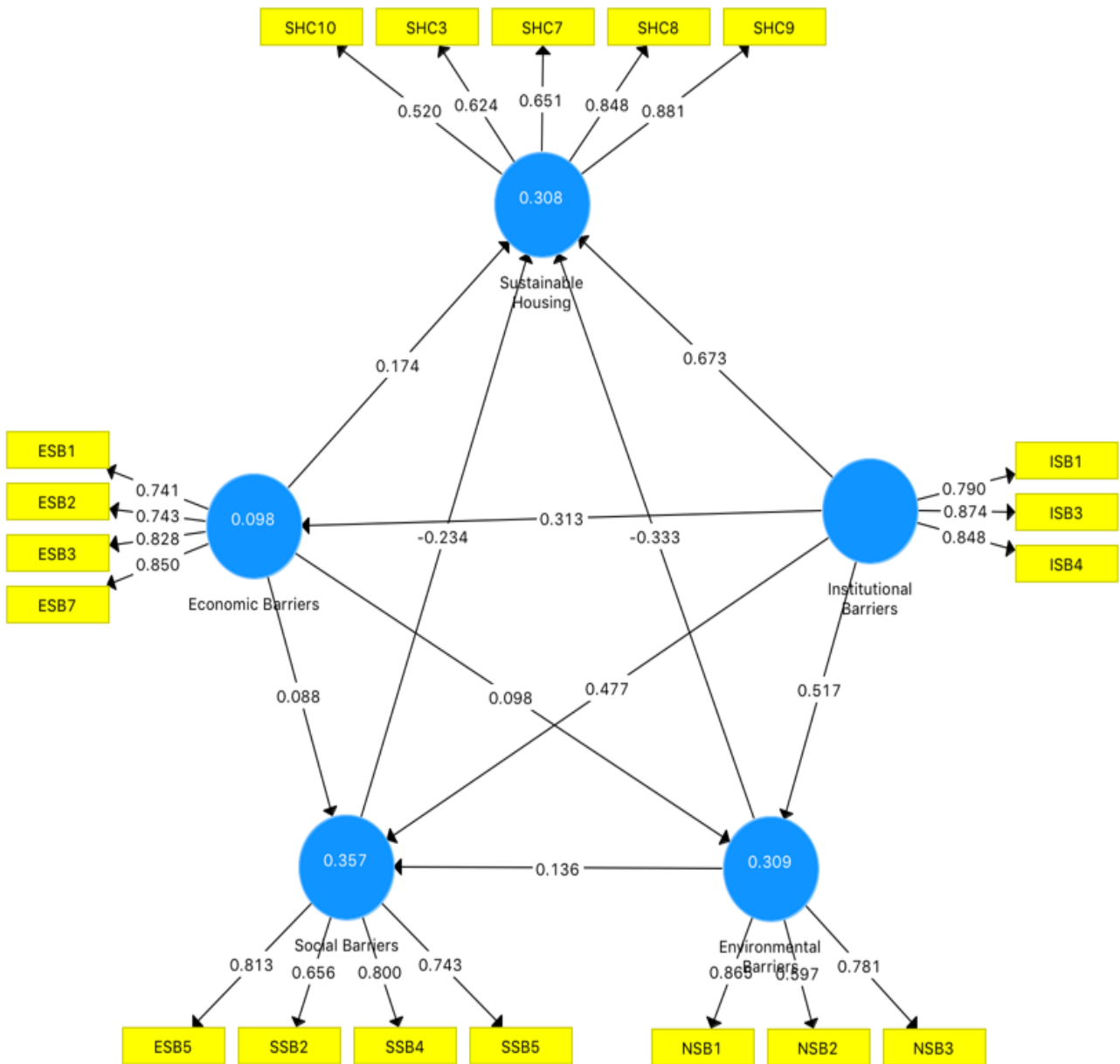
**Table 6:** Heterotrait-monotrait ratio of Correlation (HTMT)

Construct / Categories	Sustainable housing	Economic barriers	Social barriers	Institutional barriers	Environmental barriers
Sustainable housing					
Economic barriers	0.328				
Social barriers	0.269	0.365			
Institutional barriers	0.523	0.387	0.691		
Environmental barriers	0.284	0.395	0.507	0.667	

#### 4.2.3 Structural Model Estimation

The structural model was estimated by conducting path analyses to assess the impact of the constructs among themselves. That is, the structural model was developed to assess the interactive effects among the categories of barriers and their impacts on sustainable housing.

Result of the structural model is shown in Fig. 2.

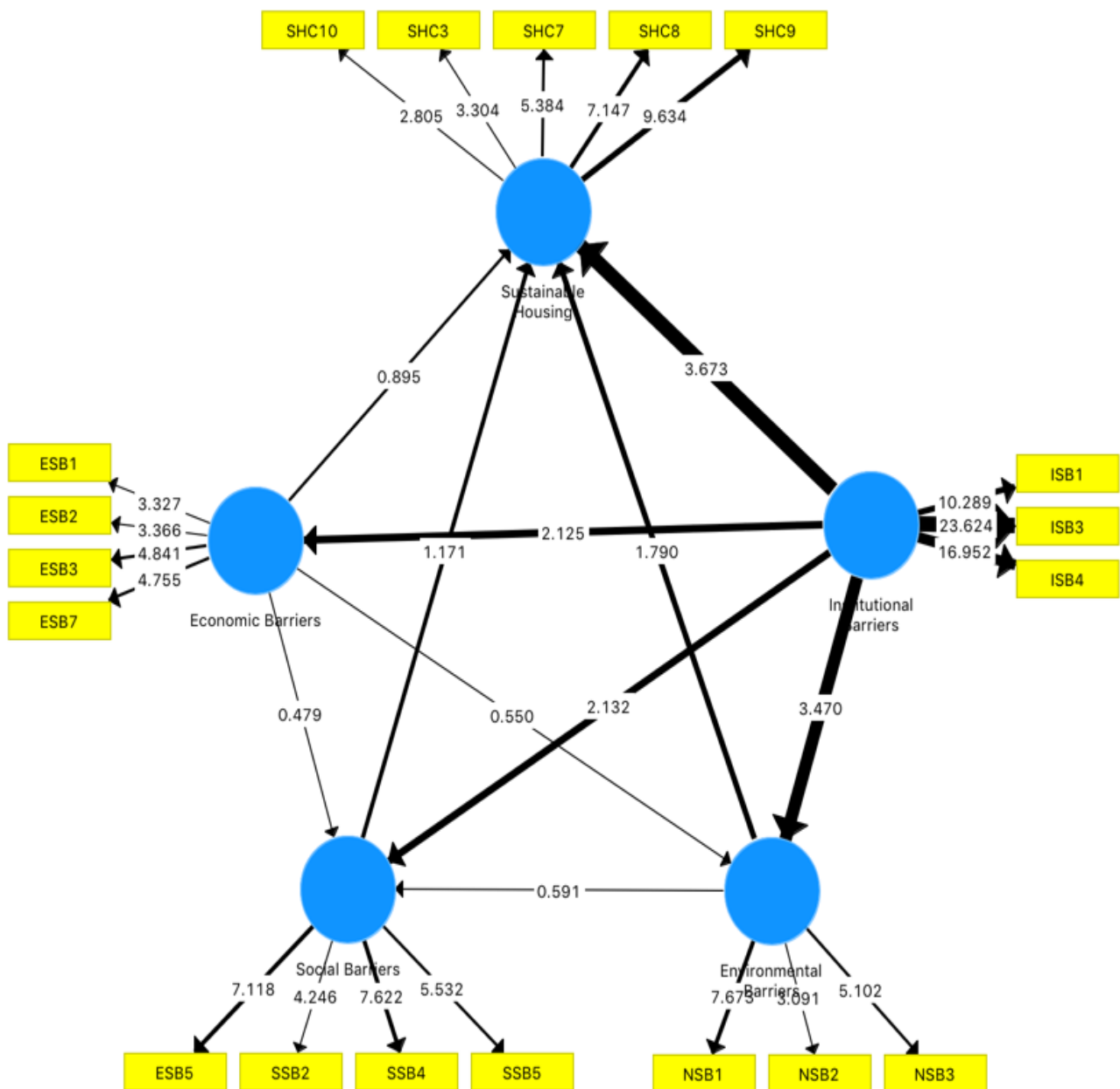


**Fig. 2:** Structural Model of the four Barrier Categories and Sustainable Housing Construct

#### 4.2.4 Structural Model Assessment

The structural model was estimated to determine the significance of the hypotheses. Prior to that, the model was tested for multicollinearity using the variance inflation factor (VIF). Minimum multicollinearity was obtained since all estimated values of VIF were  $< 5.00$ , which implies that there was no problem of multicollinearity. Furthermore, the structural model was assessed using the coefficient of determination ( $R^2$ ) to evaluate the total effect size and variance explained in the sustainable housing constructs by the four categories of barriers. It is recommended that  $R^2$  of the sustainable housing construct should be  $\geq 0.10$  (Gorai et al., 2015).

Tests of significance of the path / hypotheses were performed by first assessing the normality of the data. Results of the test showed estimated Mardia's multivariate skewness and kurtosis of 8.81 and 38.96 were greater than their respective cut-offs of  $\pm 1$  and  $\pm 20$  for data normality. Thus, the data were non-normally distributed, and the tests of significance of the paths were conducted using bootstrapping analysis (refer to Fig. 3). Bootstrapping analysis is suitable for measuring the direct impact of all the hypotheses (hypotheses 1 to 10) of non-normally distributed data.



**Fig. 3:** Results of Bootstrapping Analysis of the four Barrier Categories and Sustainable Housing Construct

#### 4.2.5 Validation of Hypotheses

The coefficients of the bootstrapping analysis (refer to Fig.3) are the t-values for assessing the significance of the paths. The significant paths for a two-tailed test are paths with t-values of 1.65 (for significance level =10%), t-values of 1.96 (for significance level = 5%) and t-values of 2.58 (for significance level = 1%) (Astrachan et al., 2014). Therefore, for the interactive effects among the barriers, the t-value of 2.125 for the ‘institutional barriers’ to ‘economic barriers’ path is supported at a significance level of  $p < .05$  ( $t_{0.05} > 1.96$ ). Similarly, the t-value of 2.132 for the ‘institutional barriers’ to ‘social barriers’ path is supported at a significance level of  $p < .05$  ( $t_{0.05} > 1.96$ ). With a t-value of 3.470, the ‘institutional barriers’ to ‘environmental barriers’ path is supported at a significance level of  $p < .01$  ( $t_{0.01} > 2.58$ ) (refer to Fig. 3). Concerning the relationships between the ‘barriers’ and ‘sustainable housing’, the ‘institutional barriers’ and ‘sustainable housing’ path is supported at a significance level of  $p < .01$  ( $t_{0.01} > 2.58$ ) since its t-value is 3.673. Besides, with an estimated t-value of 1.790, the ‘environmental barriers’ to ‘sustainable housing’ path is supported at a significance level of  $p < .10$  ( $t_{0.1} > 1.65$ ) (refer to Fig. 3). However, the ‘economic barriers’ to ‘sustainable housing’ path and the ‘social barriers’ to ‘sustainable housing’ path are not supported at any of the significance levels.

#### 4.2.6 Effect Sizes of the Structural Model

In addition to conducting test of significance, the structural model was further evaluated by estimating the effect sizes of some barrier constructs and the sustainable housing construct. Effect size ( $f^2$ ) measures how strongly one independent construct contributes to explaining a certain dependent construct in terms of  $R^2$  (Adabre & Chan, 2021, p.11). The effect sizes were calculated by assessing changes in the  $R^2$  to determine possible substantive interactive impacts among the barrier categories on one hand and between the barrier categories and sustainable

housing on the other hand. Results of the changes in  $R^2$  were then employed for calculating the  $f^2$  using the following equation, eqn. (1) as employed in [Adabre et al. \(2021b\)](#).

$$f^2 = (R^2_{\text{included}} - R^2_{\text{excluded}}) / (1 - R^2_{\text{included}}) \dots\dots\dots \text{eqn. (1)}$$

where  $R^2_{\text{included}}$  and  $R^2_{\text{excluded}}$  are the  $R^2$  values of the dependent construct when a selected independent construct is included or excluded from the model, respectively ([Adabre & Chan, 2021](#)). The changes in the  $R^2$  values are estimated by conducting the PLS path analysis twice: once with the independent construct included which yields  $R^2_{\text{included}}$  and the second time with the independent construct excluded which yields  $R^2_{\text{excluded}}$ . The effect size of a construct is small if  $0.02 \leq f^2 < 0.15$ ; medium if  $0.15 \leq f^2 < 0.35$  and large if  $f^2 \geq 0.35$  ([Cohen, 2013](#); [Adabre & Chan, 2021](#)). The estimated values of  $f^2$  for some of the paths are shown in Table 7. From Table 7, the effect size of ‘institutional barriers’ on ‘economic barriers’ is small ( $f^2 = 0.109$ ). Likewise, ‘environmental barriers’ have small effect size ( $f^2 = 0.085$ ) on ‘sustainable housing’. However, ‘institutional barriers’ have moderate effect sizes on ‘environmental barriers’ ( $f^2 = 0.297$ ), ‘social barriers’ ( $f^2 = 0.275$ ) and ‘sustainable housing’ ( $f^2 = 0.257$ ). Nonetheless, the effect sizes of the remaining paths (refer to Table 7) were negligible since their  $f^2$  were below the estimated range for small effect.

**Table 7: Hypotheses Testing**

Hypotheses	Relationships	Std Beta	Std Error	/t-value/	Decision	f <sup>2</sup>	P-Values	95%CILL	95%CIUL
H1	Institutional Barriers -> Economic Barriers	0.348	0.144	2.125**	Supported	0.109	0.030	0.092	0.550
H2	Institutional Barriers -> Social Barriers	0.483	0.219	2.132**	Supported	0.275	0.030	0.096	0.823
H3	Institutional Barriers -> Environmental Barriers	0.539	0.138	3.470***	Supported	0.297	0.000	0.326	0.736
H4	Economic Barriers -> Social Barriers	0.080	0.187	0.479	Not Supported	0.000	0.639	-0.236	0.420
H5	Economic Barriers -> Environmental Barriers	0.105	0.182	0.550	Not Supported	-0.001	0.588	-0.189	0.406
H6	Environmental Barriers -> Social Barriers	0.132	0.228	0.591	Not Supported	0.039	0.550	-0.279	0.493
H7	Institutional Barriers -> Sustainable Housing	0.659	0.194	3.673***	Supported	0.257	0.001	0.330	0.932
H8	Economic Barriers -> Sustainable Housing	0.161	0.191	0.895	Not Supported	0.030	0.362	-0.191	0.451
H9	Environmental Barriers -> Sustainable Housing	-0.328	0.198	1.790*	Supported	0.085	0.093	-0.630	0.006
H10	Social Barriers -> Sustainable Housing	-0.209	0.217	1.171	Not supported	0.036	0.283	-0.554	0.164

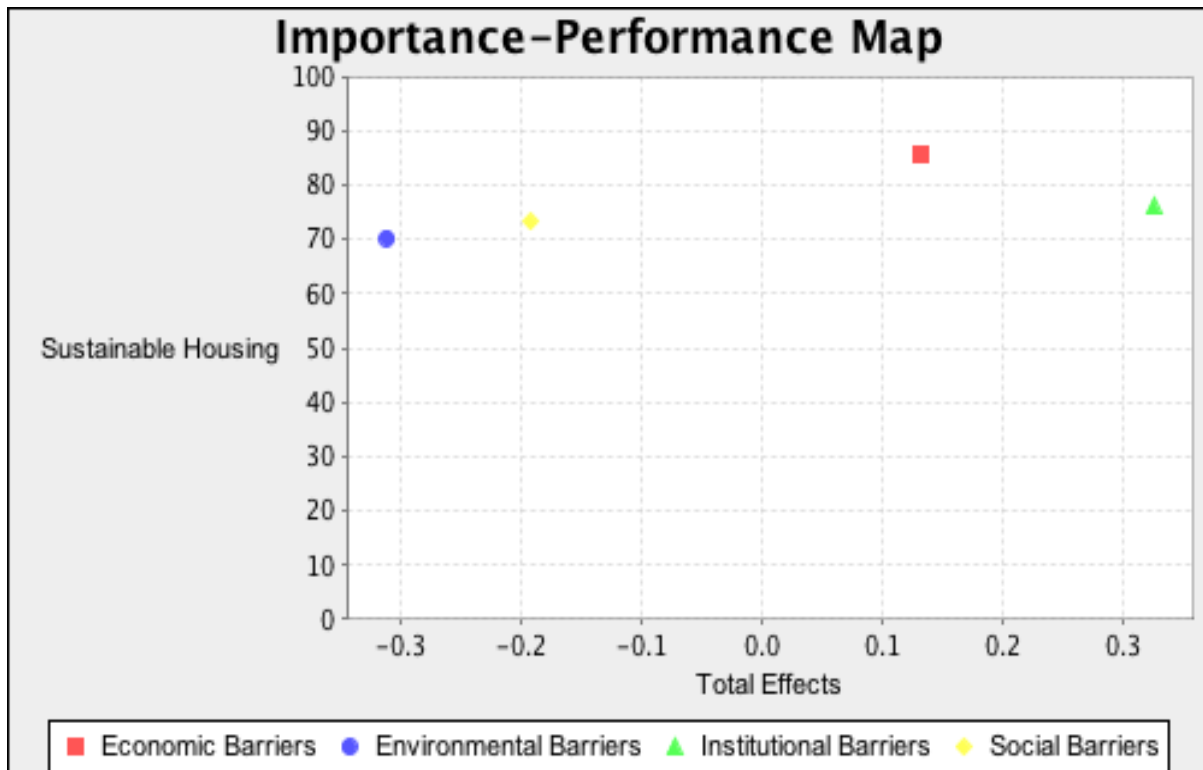
\*\*\*p < 0.01, \*\*p < 0.05, \*p < 0.10

R<sup>2</sup> (Sustainable housing = 0.308)

Effect sizes are according to [Cohen \(1988\)](#), f<sup>2</sup> values: 0.35 (large), 0.15 (medium), and 0.02 (small)

#### 4.2.7 Importance-Performance Analysis (IPMA)

Importance-performance analysis (IPMA) was conducted to measure the importance and performance of the barrier categories on the target construct – sustainable housing. The x-axis displayed as ‘Total Effects’ shows the standardized path coefficients or importance of the barrier constructs (refer to Fig. 4) while the values on the y-axis represent the average values (performances) of the barriers on the sustainable housing construct (Adabre et al., 2021b). For decision-making using the IPMA results, constructs that have the highest total effects, notwithstanding possible low performance scores, are the target constructs. Thus, from Fig. 4, the ‘institutional barriers’ have the highest total effect (0.325) and performance of 76.048%, which implies that strategies or interventions on mitigating the institutional barriers could have substantive impact on sustainable housing development. This finding buttresses the results of the bootstrapping analysis in which the ‘institutional barriers’ category was identified as the causal barrier that has multiplier effects on the remaining barriers and sustainable housing. Therefore, the ‘institutional barriers’ require more attention of policymakers and practitioners. In addition, the IPMA results showed that the next target group of barriers that are exigent are the ‘economic barriers’ which have effect size of 0.132 and performance of 85.762%. Although the ‘economic barriers’ were identified as effects that originate from the institutional barriers (refer to Fig. 3), the IPMA results imply that effective strategies on controlling ‘economic barriers’ could enhance sustainable development in housing. Thus, for significant improvement on sustainable housing, institutional strategies should be more focused on eliminating economic barriers.



**Fig. 4:** Importance-Performance Analysis (IPMA)

## 5. Discussion of Results

### 5.1 ‘Institutional Barriers’ to ‘Economic Barriers’ Path

At an estimated t-value of 2.125, the ‘institutional barriers’ have a significant impact on ‘economic barriers’, which is supported at a significance level of  $p < .05$  ( $t_{0.05} > 1.96$ ). Indicators or underlying barriers of the ‘economic barriers’ category, that are highly loaded include: ‘*ESB1-inadequate public funding*’; ‘*ESB2- excessive cost of serviced land*’; ‘*ESB3-excessive cost of sustainable building materials/technologies*’ and ‘*ESB7-high inflation rate*’. These underlying barriers could influence one another. For instance, the barrier ‘*ESB7- high inflation rate*’ could lead to ‘*ESB2- excessive cost of serviced land*’ and ‘*ESB3-excessive cost of sustainable building materials/technologies*’. Besides, inadequate public funding scheme such as subsidies on sustainable building materials and technologies could be a contributory factor to high cost of sustainable building materials. Similarly, [Adabre and Chan \(2021\)](#) concluded that the effects of ‘*high cost of sustainable building materials*’ and ‘*high cost of*



*serviced land*' in the Ghanaian housing market are attributed to inadequate financial incentives for developers or investors.

The significant path from 'institutional barriers' to 'economic barriers' implies that the underlying 'economic barriers' are caused by the underlying 'institutional barriers'. For example, policy instability regarding macroeconomic instability is the main cause of fluctuations in inflation rates in the Ghanaian housing market. '*Fluctuations in inflation rates*' lead to increase speculations on land which could cause excessive cost of serviced in land in cities and towns. Furthermore, the effects of '*fluctuations in inflation rates*' on cost of sustainable building materials and technology are compounded by bureaucracy on land administration regarding land registration, validation and permit for land development. Delays in acquiring permit for land development could be attributed to the inadequate financial and human resource at the planning departments (Siiba et al., 2018), which leads to weak enforcement of planning control on land development. Therefore, to control the underlying economic barriers, there should be effective strategies on mitigating the underlying institutional barriers, namely, '*ISB1- difficult land registration procedures*'; '*ISB3-policy instability*'; '*ISB4-weak enforcement of planning control on property development*'. Specifically, expedited land administration and permit on land development by the Land Commission and Land and Spatial Planning Authority, respectively, could prevent developers from incurring extra cost on building materials and technologies attributed to increasing inflation rate. Additionally, draconian measures on macroeconomic variables such as interest rate and inflation rate at the institutional level are essential for successful economic development and economic sustainability.



income earners for maximum profit margin and for ensuring high-take rate of housing facilities in order to amortize loans or to break-even at high interest rates of short-term loans.

The significant path from ‘institutional barriers’ to ‘social barriers’ implies that some underlying institutional barriers could originate some underlying social barriers. For instance, the underlying social barrier ‘*social exclusion or segregation*’ could be caused by institutional challenges such as ‘*ISB1 - difficult land registration procedures*’ and ‘*ISB4 - weak enforcement of planning control on property development on land*’. [Ehwi et al. \(2019\)](#) revealed that gated community development, which is a main source of social exclusion or segregation in urban areas, continues apace due to land administration challenges. These challenges include bureaucracy in land registration, validation and permit on land development. Similarly, [Kasanga and Kotey \(2001\)](#) and [Gambra \(2002\)](#) concluded that the land registration process is highly bureaucratic. The time for perfect land transfer could be between 6 months and 10 years. Besides, the process is fraught with corrupt practices carried out by the Land Commission’s officials, which could render land title registration costly ([Ehwi and Asante, 2016](#)). The main effect of the land administration challenges is that they derive gated community development in urban areas since people consider gated communities as a panacea to these challenges. High cost of residential facilities in the gated communities leads to social segregation between high-income earners and low-income earners ([Zheng et al., 2017](#)), since gated communities are priced beyond the reach of most Ghanaians ([Soyeh et al., 2020](#)); they are mostly affordable to high-income earners, namely, expatriate, returnee migrants and employees of Ghanaian based foreign companies.

The underlying social barriers could be controlled through the state’s interventions on incentives to developers. For example, through effective land supply/allocation to developers,

the state or government could ensure inclusionary housing supply to middle and low-income earners in unaffordable urban areas (Eduful and Hooper, 2019). This could serve as a strategy to control social exclusions and segregation. Additionally, expedited land administration on registration, validation and permit approval on land development is essential for mitigating social exclusion ascribed to gated community development. This could be achieved through institutional development. Effective anti-corrupt practices in land title registration could prevent the deliberate delays perpetrated by the employees of the Land Commission. This could also reduce the associated cost of land registration due to rent-seeking practices (Ehwi and Asante, 2016). Moreover, delays on permit approval concerning development on land are caused by inadequate human resources and financial resources at the Land and Spatial Planning Authority. Therefore, ensuring that the planning authorities are adequately provided with financial and human resources will enable them to expedite regulatory procedures on land development. Besides, adequate financial resources for remunerations could alleviate the rent seeking practices and other corrupt practices by planning officials (Fuseini and Kemp 2015).

### **5.3 ‘Institutional Barriers’ to ‘Environmental Barriers’ Path**

The ‘institutional barriers’ to ‘environmental barriers’ path had an estimated t-value of 3.740 which is supported at a significance level of  $p < .01$  ( $t_{0.01} > 2.58$ ). Highly loaded underlying indicators of the ‘environmental barriers’ category include: *‘NSB1-inadequate access to land within cities/towns’*; *‘NSB2- peripheralization of housing projects/facilities’* and *‘NSB3-low-rise housing development’*. High association among the underlying environmental barriers is evinced in their high loadings. This implies that the underlying barriers could influence one another. For instance, *‘low-rise development of residential facilities’* could lead to faster depletion of land resources. This could influence *‘inadequate access to land within cities/towns’* which could instigate *‘peripheralization of housing projects/facilities’*.





## 5.5 General Discussion and Policy Recommendations

From the network analysis, the institutional barriers have multiplier effects as they originate the other barriers, namely, economic, social and environmental barriers. Besides, they have a higher impact on sustainable housing development as compared to the impact of the environmental barriers. Similarly, [Liu et al. \(2016\)](#) concluded that instability of government and policies (law changes) could instigate economic barriers regards resource prices, foreign exchange rate and interest rate. On barriers to sustainable old residential neighborhood renewal, for example, [Zhu et al. \(2020\)](#) also found that immature law and regulations are the most important barriers that cause other barriers. The multiplier effects of institutional barriers as found in this study and in prior studies ([Liu et al., 2016](#); [Zhu et al., 2020](#); [Panayides et al., 2015](#); [Keivani and Werna, 2001](#)) indicate that controlling the institutional barriers could be a panacea for the remaining economic, social and environmental barriers in sustainable housing development. Three underlying institutional barriers require the most attention, namely, '*ISB1- difficult land registration procedures*'; '*ISB3- policy instability*' and '*ISB4- weak enforcement of planning control on land development*'. Among these three, '*ISB3- policy instability*' has the highest loading which suggests that it is the biggest barrier to sustainable housing in the formal sector. Therefore, effective and sustained policies are salient measures for controlling institutional barriers ([Panayides et al., 2015](#)). Additionally, government's support (i.e. public funding incentives or housing financing strategies) to stakeholders of the formal sector in addition to effective and stable policies on public-private partnership could assuage economic, social and environmental barriers to sustainable housing development ([Keivani and Werna, 2001](#)). Through public-private partnership, the state could provide suitable land and tax incentives while private firms could finance construction of housing facilities. Upon completion, some of the facilities could be sold at the prevailing market price while the rest could be offered at affordable prices to low- and middle-income earners. This could be an





of 3.673 of the ‘institutional barriers’ to ‘sustainable housing’ path was supported at a significance level of  $p < .01$  ( $t_{0.01} > 2.58$ ). Though relatively low, a t-value of 1.790 supported at a significance level of  $p < .10$  ( $t_{0.1} > 1.65$ ) was estimated for the ‘environmental barriers’ to ‘sustainable housing’ path. Thus, both the ‘institutional barriers’ and ‘environmental barriers’ have significant impacts on ‘sustainable housing’. These barriers significantly influence the following sustainable housing criteria (SHC): ‘quality performance of housing facility’ (SHC3); ‘energy efficiency of housing facility’(SHC7); ‘affordable price of facility’(SHC8); ‘affordable rent of facility’(SHC9) and ‘commuting cost of household to facility’(SHC10).

Among the barriers, the study’s findings imply that ‘institutional barriers’ are causal barriers while the ‘economic barriers’, ‘social barriers’ and ‘environmental barriers’ are the multiplier effects of institutional barriers. That is, the ‘institutional barriers’ category originates the other three barrier categories. Besides, the ‘institutional barriers’ have significant influence on sustainable housing development in the formal sector. Therefore, the ‘institutional barriers’ should be the focus of policymakers and practitioners for sustainable housing regarding the formal sector. Specifically, policymakers should ensure policy interventions or strategies for controlling the following underlying institutional barriers: *‘difficult land registration procedures’*; *‘policy instability’* and *‘weak enforcement of planning control on land development’*. Interventions on bureaucratic delays should entail expedited land registration procedures, planning permit approval and building permit. On policy instability, a legal system is essential for enforcing completion of public housing projects and for establishing public private partnerships (or customary landowners and developers partnership) for sustainable housing development. Moreover, improved macroeconomic policies (i.e. fiscal policies) and public incentive schemes should be ensured and sustained for sustainable housing. This could be achieved by ensuring that successive governments adhere to a common agenda for housing

development. On ‘*weak enforcement of development control on land*’, the Land and Spatial Planning Authority should be provided with adequate financial and human resources. Additionally, a collaboration between landowners (i.e. chiefs and family heads) and planning authorities on developing master plans could serve as a check on landowners for appropriate land allocation. This could also facilitate the prerogative of the spatial authority concerning development control on land.

The study has some limitations and potential extensions for future study. The sample size is relatively low. In addition, the PLS-SEM does not account for the dynamics of the sustainable housing barriers. Therefore, future study could employ the CB-SEM to confirm the findings of this study or otherwise. Besides, future study could utilize system dynamic modeling to account for the dynamics of barriers in sustainable housing development.

## **References**

- Adabre, M. A., & Chan, A. P. (2019). Critical success factors (CSFs) for sustainable affordable housing. *Building and Environment, 156*, 203-214.
- Adabre, M. A., & Chan, A. P. (2020). Towards a sustainability assessment model for affordable housing projects: the perspective of professionals in Ghana. *Engineering, Construction and Architectural Management*.
- Adabre, M. A., & Chan, A. P. (2021). Modeling the impact of barriers on sustainable housing in developing countries. *Journal of Urban Planning and Development, 147*(1), 05020032.
- Adabre, M. A., Chan, A. P., & Darko, A. (2021a). A scientometric analysis of the housing affordability literature. *Journal of Housing and the Built Environment, 1-33*.



- Amoatey, C. T., Ameyaw, Y. A., Adaku, E., & Famiyeh, S. (2015). Analysing delay causes and effects in Ghanaian state housing construction projects. *International Journal of Managing Projects in Business*.
- Arku, G., Luginaah, I., & Mkandawire, P. (2012). “You either pay more advance rent or you move out”: landlords/ladies’ and tenants’ dilemmas in the low-income housing market in Accra, Ghana. *Urban Studies*, 49(14), 3177-3193.
- Astrachan, C. B., Patel, V. K., & Wanzenried, G. (2014). A comparative study of CB-SEM and PLS-SEM for theory development in family firm research. *Journal of Family Business Strategy*, 5(1), 116-128.
- Bekun, F. V., Alola, A. A., & Sarkodie, S. A. (2019). Toward a sustainable environment: Nexus between CO2 emissions, resource rent, renewable and non-renewable energy in 16-EU countries. *Science of the Total Environment*, 657, 1023-1029.
- Chan, A. P., & Adabre, M. A. (2019). Bridging the gap between sustainable housing and affordable housing: The required critical success criteria (CSC). *Building and environment*, 151, 112-125.
- Cobbinah, P. B., & Amoako, C. (2012). Urban sprawl and the loss of peri-urban land in Kumasi, Ghana. *International Journal of Social and Human Sciences*, 6(388), e397.
- Cobbinah, P. B., Asibey, M. O., & Gyedu-Pensang, Y. A. (2020). Urban land use planning in Ghana: Navigating complex coalescence of land ownership and administration. *Land use policy*, 99, 105054.
- Djokoto, S. D., Dadzie, J., & Ohemeng-Ababio, E. (2014). Barriers to sustainable construction in the Ghanaian construction industry: consultants perspectives. *Journal of Sustainable Development*, 7(1), 134.
- Dong, H. (2018). The impact of income inequality on rental affordability: An empirical study in large American metropolitan areas. *Urban Studies*, 55(10), 2106-2122.

- Ebekozien, A., Abdul-Aziz, A. R., & Jaafar, M. (2019). Housing finance inaccessibility for low-income earners in Malaysia: Factors and solutions. *Habitat International*, 87, 27-35.
- Eduful, A. K., & Hooper, M. (2019). Urban migration and housing during resource booms: The case of Sekondi-Takoradi, Ghana. *Habitat International*, 93, 102029.
- Edwards, D. J., Rillie, I., Chileshe, N., Lai, J., Hosseini, M. R., & Thwala, W. D. D. (2020). A field survey of hand–arm vibration exposure in the UK utilities sector. *Engineering, Construction and Architectural Management*.
- Ehwi, R. J., & Asante, L. A. (2016). Ex-post analysis of land title registration in Ghana since 2008 merger: Accra lands commission in perspective. *Sage Open*, 6(2), 2158244016643351.
- Ehwi, R. J., Asante, L. A., & Morrison, N. (2020). Exploring the Financial Implications of Advance Rent Payment and Induced Furnishing of Rental Housing in Ghanaian Cities: The Case of Dansoman, Accra-Ghana. *Housing Policy Debate*, 30(6), 950-971.
- Ehwi, R. J., Morrison, N., & Tyler, P. (2019). Gated communities and land administration challenges in Ghana: reappraising the reasons why people move into gated communities. *Housing Studies*, 1-29.
- Eybpoosh, M., Dikmen, I., & Talat Birgonul, M. (2011). Identification of risk paths in international construction projects using structural equation modeling. *Journal of Construction Engineering and Management*, 137(12), 1164-1175.
- Fang, C., & Marle, F. (2012). A simulation-based risk network model for decision support in project risk management. *Decision Support Systems*, 52(3), 635-644.
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of marketing research*, 18(1), 39-50.



- Hosseini, H. M., & Kaneko, S. (2012). Causality between pillars of sustainable development: Global stylized facts or regional phenomena?. *Ecological Indicators*, *14*(1), 197-201.
- Hou, H. C., Lai, J. H., & Edwards, D. (2020). Gap theory based post-occupancy evaluation (GTbPOE) of dormitory building performance: a case study and a comparative analysis. *Building and environment*, *185*, 107312.
- Howes, M., Wortley, L., Potts, R., Dedekorkut-Howes, A., Serrao-Neumann, S., Davidson, J., ... & Nunn, P. (2017). Environmental sustainability: a case of policy implementation failure?. *Sustainability*, *9*(2), 165.
- Hulland, J. (1999). Use of partial least squares (PLS) in strategic management research: A review of four recent studies. *Strategic management journal*, *20*(2), 195-204.
- Jing, Z., & Wang, J. (2020). Sustainable development evaluation of the society–economy–environment in a resource-based city of China: A complex network approach. *Journal of Cleaner Production*, *263*, 121510.
- Kalantari, S., & Shepley, M. (2020). Psychological and social impacts of high-rise buildings: a review of the post-occupancy evaluation literature. *Housing Studies*, 1-30.
- Kasanga, R. K., & Kotey, N. A. (2001). Land management in Ghana: Building on tradition and modernity.
- Keivani, R., & Werna, E. (2001). Refocusing the housing debate in developing countries from a pluralist perspective. *Habitat International*, *25*(2), 191-208.
- Kim, D. Y., Han, S. H., Kim, H., & Park, H. (2009). Structuring the prediction model of project performance for international construction projects: A comparative analysis. *Expert Systems with Applications*, *36*(2), 1961-1971.
- Kwak, D. W., Rodrigues, V. S., Mason, R., Pettit, S., & Beresford, A. (2018). Risk interaction identification in international supply chain logistics. *International Journal of Operations & Production Management*.





- Sarkodie, S. A., & Strezov, V. (2019). Economic, social and governance adaptation readiness for mitigation of climate change vulnerability: Evidence from 192 countries. *Science of the Total Environment*, 656, 150-164.
- Scott, W. R. (2008). Crafting an Analytic Framework I: Three pillars of institutions. *Institutions and organizations*, 47-71.
- Siiba, A., Adams, E. A., & Cobbinah, P. B. (2018). Chieftaincy and sustainable urban land use planning in Yendi, Ghana: Towards congruence. *Cities*, 73, 96-105.
- Sivakumar, K., Jeyapaul, R., Vimal, K. E. K., & Ravi, P. (2018). A DEMATEL approach for evaluating barriers for sustainable end-of-life practices. *Journal Of Manufacturing Technology Management*.
- Soyeh, K. W., Asabere, P. K., & Owusu-Ansah, A. (2020). Price and rental differentials in gated versus non-gated communities: the case of Accra, Ghana. *Housing Studies*, 1-18.
- Sulemana, I., Nketiah-Amponsah, E., Codjoe, E. A., & Andoh, J. A. N. (2019). Urbanization and income inequality in Sub-Saharan Africa. *Sustainable Cities and Society*, 48, 101544.
- Tavakolan, M., & Etemadnia, H. (2017). Fuzzy weighted interpretive structural modelling: Improved method for identification of risk interactions in construction projects. *Journal of Construction engineering and Management*, 143(11), 04017084.
- Teo, T. S., Srivastava, S. C., & Jiang, L. (2008). Trust and electronic government success: An empirical study. *Journal of management information systems*, 25(3), 99-132.
- Tetteh, N., & Amponsah, O. (2020). Sustainable Adoption of Smart Homes from the Sub-Saharan African Perspective. *Sustainable Cities and Society*, 102434.
- Twumasi-Ampofo, K., Osei-Tutu, E., Decardi-Nelson, I., & Ofori, P. A. (2014). A model for reactivating abandoned public housing projects in Ghana. *Civil and Environmental Research*, 6(3), 6-16.

