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UNDERSTANDING INFLUENCE OF INTERNAL FACTORS IN GREENING CONSTRUCTION INDUSTRY IN THE GLOBAL SOUTH

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Abstract

The objective of this empirical study is to establish how internal factors (IFs) influences adoption of green practices in construction consultancy firms. Pro environmental practices scholars in other industry suggest the impact of these factors in green practices. However, evidence to indicate such in construction consultancy firms, particularly in the context of global south are limited. This study hypothesized a directional alternative relationship between environmental commitments, environmental knowledge, and firm characteristics on one hand, and green construction practices (GCP) on the other hand in a predictor - outcome relationship to determine their individual contributions. A sample of 375 survey questionnaires were personally administered through proportionate stratified random sampling to construction industry consultants (planners, architects, quantity surveyors, builders, and estate surveyors) in Nigeria. A total of 233 survey questionnaires were subsequently retrieved for analysis, yielding 62.1% response rate. Data were analyzed using SEM-PLS. Results of the analysis indicates, firm characteristics and environmental commitments have a statistically significant contribution, thus, serves as key predictors of GCP. The findings of this study provide additional empirical evidence regarding the relationship between IFs and green practices in construction; thereby complementing existing literature on GCP.

Key Words: Green Construction Practices, Environmental Commitments, Environmental Knowledge, Firm Characteristics, Global South

Introduction

The intense pressure to adopt green practices by the construction industry practitioners in the production process of the built environment has form part of the global green agenda (Akadiri, Chinyio and Olomolaiye, 2012). While countries in the global north as United State of America, United Kingdom, Singapore etc. have made significant progress in greening their construction industries, not much is generally achieved by the global south countries, particularly Nigeria.

However, the persisting environmental pressure has eventually led to the convening of several summits and workshops of stakeholders in the past years, which has translated into the process of establishing the Nigeria Green Building Council (Akindoyeni, 2012). These summits and workshops are intended to inculcate the attitude and spirit of green practices among key industry players.

Notably, only a few studies on green practices in the construction sector have been published (Fergusson and Langford, 2006), and the urgent need to understand all dimensions of pro environmental strategies, behaviors, and implementations have been stressed by Nunes and Bennette (2010). Even with the remarkable increase in the number of GCP literature, factors that influence such practices have not been fully examined and comprehended (Akadiri and Fadiya, 2013). Thus, we need to establish how firm internal factors (IFs), namely, environmental commitments, environmental knowledge, and firm characteristics, predict green practices adoption in construction. Zuo and Zhao (2014) undertake a critical review of GCP research and contend that most studies focus on definitions and scopes, benefits and costs, or means to achieve green construction.

Most studies indicate a positive association among environmental commitments, environmental knowledge, and green practices (El Dief and Font, 2012). We reviewed literature and noted that studies are either not in the construction sector (Sharma, 2000; Marshal *et al*., 2005; 2012; El Dief and Font, 2012) or conducted within the Western context (Akadiri *et al*., 2012; Akadiri and Fadiyi, 2013) and their findings cannot be generalized. Other studies, as Zainul Abidin (2010), focus on developers/contractors. Elham and Nabsiah (2011) argue that response to green practices is likely to vary based on cultural and geographic contexts. Thus, rendering it unfit for generalizing such findings.

Arif and Egbu (2008) observe that, every key construction stakeholder have different drivers for their activities; and construction consultants are key industry stakeholders. Consequently, an assessment of these drivers for various stakeholders is important to understand how green practice can be popularly implemented. In this study, we focus on consultancy firms that provide services within the built environment profession, which is expected to drive the industry toward environmentally friendly practices. The theoretical contribution of the present study is extending the work of Akadiri and Fadiyi (2013) by investigating other factors, such as firm characteristics and environmental knowledge in a developing country, and thus, closing the knowledge gap. The findings will help construction firms to formulate their strategies toward contributing to the green agenda. Strategic policy framework can be formulated to identify construction firms that meet certain environmental protection requirements.

Methodology

In this study, we utilize the survey method of data collection. Based on Darnall *et al.* (2010), the seven items for endogenous constructs (firm green practice) are as follows: (1) implementing environmental policies (Henriques and Sadorsky, 1996); (2) utilizing internal assessment tools, such as benchmarking and accounting procedures (Nash and Ehrenfeld, 1997); (3) establishing environmental performance goals; (4) publicly disclosing environmental performance information; (5) conducting internal and external environmental audits; (6) training employees in techniques to improve the environment; and (7) linking employee compensation to environmental performance.

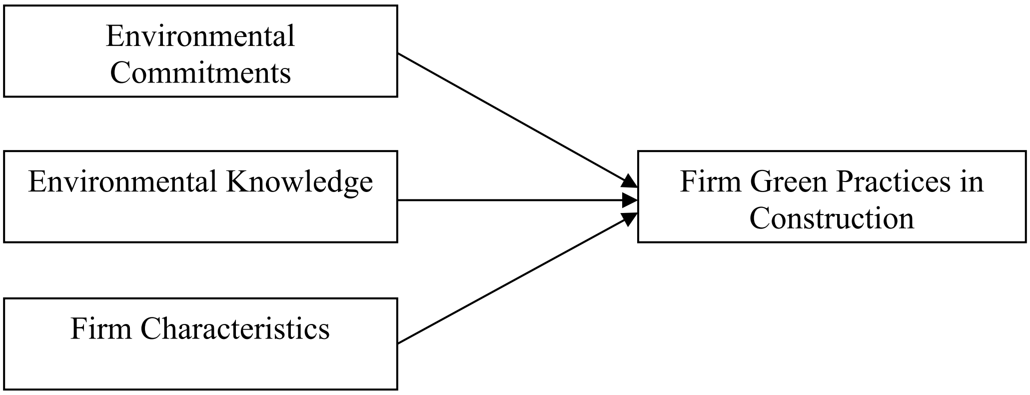

Figure 1: Study Framework

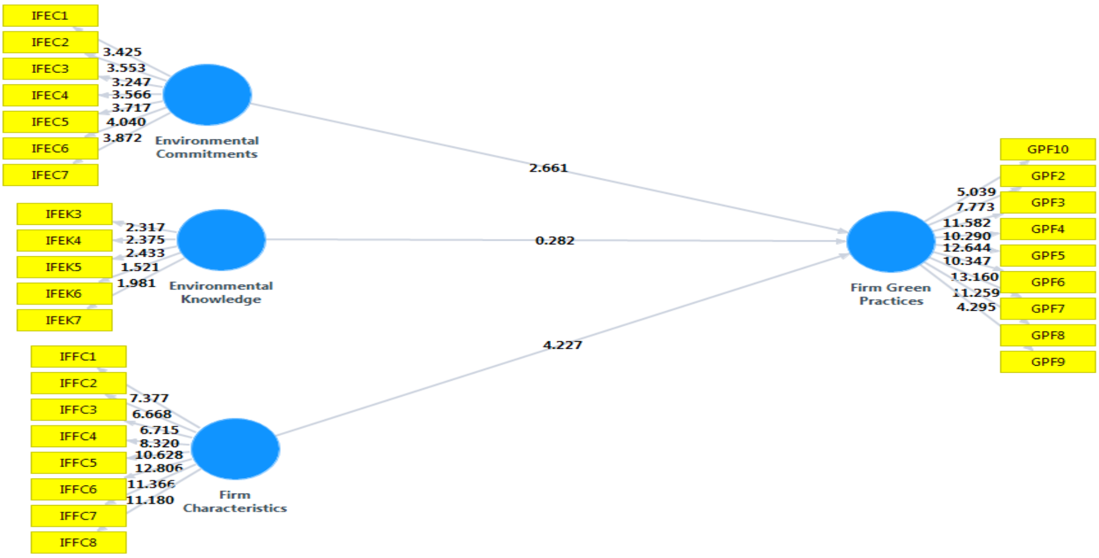

Figure 2: Structural Model

The measurement instrument for exogenous constructs were adapted from different sources, including seven items for environmental commitment (Akadiri and Fadiyi, 2013), eight items for environmental knowledge (Seroka-Stolka and Jeloka, 2013), and eight items for firm characteristics (El Dief and Font, 2012). These items are measured using a five-point Likert scale (1—disagree, 2—slightly agree, 3—moderately agree, 4—mostly agree, 5—completely agree) to elicit information on the influence of predictor variables on the green practices of construction firms.

The sampling frame for this study contains a total of 13,021 certified built environment professionals in Nigeria as of January 2014. Based on the sample size in the study of Krejcie & Morgan (1970), a total of 375 structured questionnaires were distributed through proportionate stratified random sampling to construction professionals in Nigeria who are qualified members of their various professional bodies and hold managerial positions in their respective firms. These professionals include planners, architects, quantity surveyors, builders and estate surveyors. Their addresses were obtained from the directory of their respective institutions. The questionnaires were personally administered to their practice offices and at the conference held in Uyo, Akwa Ibom State, Southeast Nigeria for estate surveyors and valuers. A valid response of 233, representing a response rate of approximately 61%, was used for analysis.

Data Presentation and Analysis

Demography

The survey was conducted in five key construction consultancy service firms. From the valid responses received, 25.8 % are from builders, which provided the largest response rate, followed by architects and designers, who contributed 22.3% of the overall responses. Estate surveyors contributed 20.2 % to the response rate. Meanwhile, planners and quantity surveyors each contributed 15.9 % of valid responses.

Assessment of Partial Least Squares Structural Equation Modeling (PLS-SEM) Path Modeling Results

The use of PLS-SEM path modeling for data analysis adopted a two-way approach in the evaluation and reporting of the results (Henseler, Ringle, and Sinkovics, 2009). These steps involve the assessment of the measurement and structural models (Hair *et al*., 2014). Individual item reliability was evaluated by using factor loadings greater than 0.5. Table 1 shows that all values of the items retained are greater than the minimum threshold mark of 0.40 (Hair *et al*., 2014).

Similarly, internal consistency was assessed using the composite reliability coefficient because it provides less biased estimates compared with the Cronbach's alpha coefficient as it considers individual loading contribution (Gotz, Liehr-Gobbers, and Krafft, 2010). Hair *et al.* (2014) observes that the composite reliability coefficient should at least be 0.70 or greater. Table 2 shows that the composite reliability of each latent construct exceeds the minimum level required. Convergent validity was examined using the average variance extracted (AVE) of each latent construct, as proposed by Fornell and Larcker (1981). Based on the rule of thumb of Chin (1998) for loading values not less than 0.50, the model indicates that the latent construct has an AVE value between 0.50 and 0.61.

The discriminant validity of all constructs was determined by comparing the indicator with cross loadings. Chin (1998) proposes that all indicators should be greater than the cross loadings. Table 3 shows the discriminant validity of the constructs.

Assessment of the Structural Model

In assessing the structural model, we applied the standard bootstrapping procedure that comprises 5,000 bootstrap samples to determine the significance of the path coefficient (Hair *et al*., 2014). Figure 2 shows the estimate of the complete structural model.

At the beginning of this study, three hypotheses were postulated. The first hypothesis (*H1*) predicted a positive relationship between environmental commitments and firm green practices. The results of the analysis (Table 4, Figure 2) indicate a statistically significant association ($\beta = 0.217$, $t = 2.661$, $p < 0.01$), in favor of the hypothesis. The second hypothesis (*H2*) predicted a significant and positive relationship between environmental knowledge and firm green practices (Table 4, Figure 2). The results indicate an association ($\beta = -0.036$, $t = 0.288$, $p < 0.01$) that does not support the hypothesis. The third hypothesis (*H3*) predicted a significant and positive relationship between firm characteristics and firm green practices (Table 4, Figure 2). This hypothesis was supported ($\beta = 0.257$, $t = 4.227$, $p < 0.01$).

The coefficient of determinants, known as the R^2 value, is an important criterion for assessing the structural model in PLS-SEM. The R^2 value represents the proportion of variation in the dependent variable that can be explained by one or more predictor variables (Elliott and Woodward, 2007). Falk and Miller (1992) contend that the R^2 value of 0.10 is an acceptable minimum level, although this conclusion generally depends on the research context (Hair et al., 2014). The results indicate that the model is capable of explaining 13.1 % of firm green practices. Considering the research context, the obtained R^2 value is satisfactory. The path modeling predictive relevance is assessed using the cross-validated redundancy measure. The obtained Q^2 value of 0.056 signifies the predictive relevance of the exogenous construct (Henseler *et al*., 2009).

Results

Table 1: Model Evaluation (Factor Loadings)

Latent Construct and Indicators	Factor Loadings
Firm Green Practices	
GPF10 ← Firm Green Practices	0.699
GPF2 ← Firm Green Practices	0.582
GPF3 ← Firm Green Practices	0.722
GPF4 ← Firm Green Practices	0.724
GPF5 ← Firm Green Practices	0.772
GPF6 ← Firm Green Practices	0.718
GPF7 ← Firm Green Practices	0.817
GPF8 ← Firm Green Practices	0.727
GPF9 ← Firm Green Practices	0.632
Internal Factor of Environmental Commitments	
IFEC1 ← Environmental Commitments	0.800
IFEC2 ← Environmental Commitments	0.842
IFEC3 ← Environmental Commitments	0.767
IFEC4 ← Environmental Commitments	0.754
IFEC5 ← Environmental Commitments	0.838
IFEC6 ← Environmental Commitments	0.768
IFEC7 ← Environmental Commitments	0.703
Internal Factor of Environmental Knowledge	
IFEK3 ← Environmental Knowledge	0.755
IFEK4 ← Environmental Knowledge	0.776
IFEK5 ← Environmental Knowledge	0.851
IFEK6 ← Environmental Knowledge	0.553
IFEK7 ← Environmental Knowledge	0.715
Internal Factor of Firm Characteristics	
IFFC1 ← Firm Characteristics	0.657
IFFC2 ← Firm Characteristics	0.700
IFFC3 ← Firm Characteristics	0.721
IFFC4 ← Firm Characteristics	0.801
IFFC5 ← Firm Characteristics	0.877
IFFC6 ← Firm Characteristics	0.859
IFFC7 ← Firm Characteristics	0.784
IFFC8 ← Firm Characteristics	0.847

Table 2: Model Evaluation (Internal Consistency Reliability)

Latent Constructs	Composite Reliability	AVE
Firm Green Practices	0.902	0.509
Environmental Commitments	0.917	0.613
Environmental Knowledge	0.854	0.543
Firm Characteristics	0.927	0.615

Table 3: Discriminant Validity Coefficients

	Environmental Commitments	Environmental Knowledge	Firm Characteristics	Firm Green Practices
Environmental Commitments	**0.783**			
Environmental Knowledge	0.511	**0.737**		
Firm Characteristics	0.295	0.233	**0.784**	
Firm Green Practices	0.273	0.134	0.307	**0.713**

Table 4: Cross Loadings

	Environmental Commitments	Environmental Knowledge	Firm Characteristics	Firm Green Practices
GPF10	**0.339**	0.199	0.126	0.699
GPF2	**0.113**	−0.019	0.136	0.582
GPF3	**0.075**	0.070	0.218	0.722
GPF4	**0.040**	0.003	0.299	0.724
GPF5	**0.146**	0.010	0.289	0.772
GPF6	**0.125**	0.039	0.212	0.718
GPF7	**0.283**	0.128	0.326	0.817
GPF8	**0.158**	0.152	0.261	0.727
GPF9	**0.384**	0.226	0.026	0.632
IFEC1	0.800	**0.383**	0.347	0.211
IFEC2	0.842	**0.434**	0.329	0.220
IFEC3	0.767	**0.378**	0.149	0.229
IFEC4	0.754	**0.382**	0.313	0.179
IFEC5	0.838	**0.396**	0.105	0.208
IFEC6	0.768	**0.406**	0.178	0.243
IFEC7	0.703	**0.423**	0.217	0.193
IFEK3	0.351	0.755	**0.055**	0.040
IFEK4	0.391	0.776	**0.129**	0.071
IFEK5	0.436	0.851	**0.149**	0.098
IFEK6	0.446	0.553	**0.050**	−0.035
IFEK7	0.429	0.715	**0.257**	0.118
IFFC1	0.415	0.329	0.657	**0.181**
IFFC2	0.293	0.292	0.700	**0.065**
IFFC3	0.218	0.131	0.721	**0.116**
IFFC4	0.152	0.060	0.801	**0.151**
IFFC5	0.135	0.048	0.877	**0.242**
IFFC6	0.245	0.221	0.859	**0.302**
IFFC7	0.283	0.254	0.784	**0.332**
IFFC8	0.185	0.166	0.847	**0.276**

Table 5: Path Coefficients

Hypothesis	Relationship	Beta (β)	*t* value (*t*)	Findings
H1	Environmental Commitments → Firm Green Practices	0.217	2.661**	Supported
H2	Environmental Knowledge → Firm Green Practices	−0.036	0.282	Not Supported
H3	Firm Characteristics → Firm Green Practices	0.257	4.227***	Supported

*p < 0.05, **p < 0.01, p < 0.001 (one-tailed)

Discussion

Findings of the current study have shown that, among the factors examined, firm characteristics and environmental commitments have made statistically unique contributions to the adoption of firm green practices. Although firm characteristics function as the main predictor, no relationship is observed between environmental knowledge and firm green practices. Firm characteristics are important elements that embody organizational culture, image, and market response strategy. The more an organization incorporates environmental requirement into their actions, the higher the level of adoption of green practices. This finding is consistent with that of Banerjee (2002) and Sarpell *et al.* (2013). Similarly, a strong environmental commitment of construction professionals in their respective core competencies promotes the adoption and implementation of GCP. This finding concurs with Akadiri and Fabiyi (2013) who posits that senior management commitment is associated with the decision to greening. Environmental commitment constructs have consistently influenced the adoption of green practices in other sectors (Wang, 2012; Marshall *et al*., 2005). Thus, construction firms should be motivated to integrate a specific environmentally friendly strategy, which will lead to overall environmental protection.

In contrast, environmental knowledge has not been observed to influence the adoption of green practices in construction consultancy firms. This finding is contrary to the empirical findings of Zainul Abidin (2010). However, we notice that most studies on the determinants of sustainable practices do not separate education from awareness, which should be treated ideally as separate constructs depending on the industry and study respondents. Notably, the focus of such studies was either personal level (Barr, 2007) or project level. A firm has organized structures and certain characteristics that guide its activities upon which every member must key into.

These findings indicate that, environmental knowledge of consultant's practitioners does not increase firm green practices, but rather commitments towards environmental concern. Similarly, in the global southern country as Nigeria, consultancy firms are limited to clientele scope of brief concerning the entire project.

This study has shown that consultant practitioners should be systematically encouraged to integrate environmental sustainability-based requirement into the formal system of firms for the successful adoption of a green agenda, in which the construction sector has a unique function. The construction firm must be committed to the ideals of environmental concern to provide the basis for a positive environmental effect. Construction practitioners are being mandated to invest heavily on issues associated with positive environmental effect, including materials and strategies that are environmentally friendly (Akadiri and Fabiyi, 2013).

For its theoretical contribution, this study has provided empirical evidence regarding factors that influence GCP, particularly the relationship between environmental commitments, environmental knowledge, and firm characteristics and the adoption of green practices of construction consultancy firms in Nigeria. Moreover, the study has reviewed existing literature on GCP that focuses on developing countries. The provided model can be used to test situations in countries with similar antecedents. The findings can be used in policy formation, analysis, or improvement to enable the construction sector to remain relevant in mitigating negative impacts on the environment. The entire idea of green practice in construction is securing the environment by considering the need for biodiversity in any proposed action and its integration as a lifestyle, corporate behavior, and project performance. The result indicates a positive relationship, that is, the greater the firm characteristics and environmental commitment exhibited by construction consultancy firms, the higher the rate at which green practices are being adopted. The findings further imply that construction professionals have a strategic role in advancing the global green agenda. Firms should have an efficient machinery to tailor their environmental approach in-house, with particular reference to the role and capability of the identified factors.

This study is limited to three IFs that influence green practices in construction consultancy firms. Replicating this research with additional variables, particularly those that contain various knowledge dimensions, such as what Schahn and Holzer (1990) referred to as abstract and concrete knowledge, is recommended. Environmental awareness, which was hitherto not considered in the current research, may provide better insight into the relationship. Interviews with relevant stakeholders to confirm these findings may be imperative.

In conclusion, we examined green practices in construction consultancy firms and IFs that influence green practices. We determined that, although firm characteristics and environmental commitments have a significant and positive relationship with green practices, environmental knowledge is associated with firm green practices. The strongest factor that predicts the adoption of green practices in construction firms is firm characteristics.

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