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EFFECTS OF INCENTIVES ON PASSIVE DESIGN STRATEGIES BY GOVERNMENT IN ENHANCING SUSTAINABLE BUILDING PRACTICE.

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Abstract

The building industry, projected to grow at 4.2% annually between 2018 and 2023, has become a formidable pollutant causing climate change that compounds environmental loads. Cities can be said to be "crucibles of hazards" due to several environmental challenges particularly that of fossil fuel's pollution. A growing consensus among organizations committed to environmental performance targets appropriate strategies to make building activities more sustainable. This paper aims to assess the effects of incentives on passive design strategies in enhancing sustainable building practice. Questionnaire design, employing qualitative strategy was adopted. Study population of Southwest Nigerian architectural firms was 553 as published by ARCON in 2021. Sample size was 170 firms using Cochran's formula with confidence level of 95 percent. The multi-stage sampling was used. Data for research were analysed using Exploratory Factor Analysis (EFA). Result revealed different types of incentives that government can offer to enhance sustainable building practice among construction stakeholders. Result also confirmed that rigid-regulatory approach to incentives does not encourage their uptake among construction stakeholders where available. Study recommends that government should enhance sustainable building process by introducing one or more of the forms of incentives, evaluating their preferences with respect to the form of incentives relative to projects to be executed, available resources and time.

Keywords: Assessment, Global warming, Greenhouse gas, Passive design strategies, Sustainability

1.0 Introduction

The world's population is projected to reach 8.5 billion by 2030, 9.7 billion by 2050 and exceed 11 billion in 2100, with India expected to surpass China as the most populous around seven years from now and Nigeria overtaking the United States to become the world's third largest country around 35 years from now (Merem *et al*., 2021). African countries are expected to have 61.8 percent in urban population (Abubakar and Aina, 2021). Today, fifty four percent (54%) of the world's population lives in urban areas, a proportion that is expected to increase to sixty six percent (66%) by 2050 (Prasad, 2018). The built environment is the anthropogenic surroundings that provides infrastructure and facilities for human activities (Opoku, 2019), and they are the fundamental components of the economy and social development of a nation.

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A country's future is greatly influenced by its availability to a clean, sustainable and effective electric power production system. Like many developing countries in Africa, Nigeria has experienced a significant increase in its electricity needs as it is developing. Combustion process of coal leads to an increase in pollution and environmental destruction. It should be noted that 70% of the Greenhouse gas (GHG) emissions comes from fossil fuel combustion from electricity generation (David, 2018).

The building industry is a vital element of any economy though with its attendant impact on the environment. The industry is projected to grow at 4.2 percent annually between 2018 and 2023 in terms of market value, with expansion opportunities in residential, non-residential, and infrastructure projects, according to Business Wire, (2018). Construction, by virtue of its size, is one of the largest users of energy, material resources, and water. This makes it a formidable polluter. Nadel and Ungar, (2019) posited that building construction has greatly increased and has been said to account for nearly half of all the greenhouse gas emissions and energy consumption owing largely to the energy used in the production and transportation of materials to building construction sites, and energy used to operate these buildings. In response to these impacts, there is growing consensus among organizations committed to environmental performance targets that appropriate strategies and actions are needed to make building activities more sustainable (Naidoo and Gasparatos, 2018). Due to the effect of climate change, many approaches have emanated most of which were based on the use of mechanical technologies also called active designs in the achievement of thermal comfort in the developing countries (Ochedi and Taki, 2022).

With the threat of dwindling renewable resources and unpredictable climate changes (Aluko *et al.,* 2020), building practices meant to preserve environmental value and scarce resources (Saidu and Yeom, 2020), are gaining momentum around the world. Many of them also offer economical and sustainable advantages. Nigeria, being a developing country, still has her building practice grappling with a lot of inherent challenges, ranging from inadequate technical and managerial know-how to insufficient financial, material and equipment capital base (Ezeokoli *et al*, 2021). Awareness and skill gap of modern technologies application, and epileptic power supply are another hindering factors in the country. Building industry practitioners have begun to pay attention to controlling and correcting the environmental damage by construction activities using passive strategies. About 40% of global electricity generation from fossil fuels essentially is being consumed by buildings and its occupants (Udomiaye *et al*, (2018) and this has a severe implication on the larger environment. While technologies and expertise to reduce the impact that building has on the environment to the barest minimum can be achieved, it can be very costly. Hence mitigating this environmental load through passive means becomes imperative.

Passive solutions can reduce mechanical system usage and energy requirements by 80%, and drastically reduce carbon dioxide emissions. Building a passive house requires careful planning. Passive design is therefore a prevalent issue for good and quality buildings, particularly nowadays, with the recent global warming reality, climate change, and economic recession (Akhimien and Latif, 2019). External variables such as climate, sun path, trade winds and temperature maintain a sustainable temperature in the design

procedure are exploited in improving the wellbeing and comfortability of people residing in houses prone to harsh climate (Ameur *et al*., (2020). The objective of the study is to find out the effects of incentives on passive design strategies by government in enhancing sustainable building practice among selected Architectural firms in Southwest Nigeria. The objective is to find out the effects of incentives on passive design strategies by government in enhancing sustainable building practice among selected Architectural firms.

2.0 Literature review

There are many forms of physical development aside from construction projects. Construction projects are critical to all forms of development. For instance, many infrastructure facilities in the built environment (Jiang and Wong, 2016) like residential houses, school and hospital buildings, access roads, irrigation dams, tourist centres, railways and airports are products of construction (Nyanchoka, 2011). If construction and its products can make or mar the quality of living of human beings in terms of health, economy, socio-cultural lifestyles (Xiong et al., 2016), there is therefore a link between construction and sustainable development (Anigbogu, 2015). It further means construction can be used to enhance sustainable development. According to Sev (2009), this happens by emphasising on resource management, whole-lifecycle design and design for human and environment in construction. The essence of designing for human environment is to reinforce human satisfaction in and around the constructed products within the context of the environment and ecosystem realities. There is usually the need to sustain harmony between nature and built environment in the process of physical development in construction (Du Plessis, 2002).

To increase sustainable development in the construction sector, the government promotes sustainable design and construction by providing incentives by way of reward and compensation for design and construction of projects. For instance, the government, at different levels provide incentives for green building promotion in the Australian construction sector (Steinfeld et al., 2011). Olanipekun (2017) deposited that the reward and compensation serve as motivation for construction stakeholders such as designers, contractors, consultants and private developers to construct green building projects. Creating public awareness through marketing and informative measures increases the attraction of clients to green building projects in practice (Fan and Hui, 2020). With financial support added to various incentives, it would promote positive effects just as Gou (2020) suggested that it could produce long-lasting green building construction efforts in China. The design of incentives on building construction by the government can be carried out either by making a law in the parliament or an outright executive order by the head of a government (Shapiro, 2011; Wang et al., 2014). The seminal study of (Olanipekun, 2017) in the Australian construction sector however revealed that the voluntary approach to promoting green building development is more effective than compulsion-based approaches.

3.0 Methodology

The study focused on Architecture professionals being the lead creators of built environment assets. Using SPSS version 26, descriptive and multivariate analysis was carried out to analyze the solicited data gathered from 128 senior architect respondents from selected architectural firms in Southwest Nigeria. The corresponding web calculator was used for the study population of Five Hundred and Fifty hree (553) architectural firms out of which One Hundred And Seventy (170) were selected with confidence level of 95%. As a result of the field work, a total of 128 (One hundred and twenty-eight) questionnaires were returned duly completed. This indicates a response rate of 75.29% as shown in Table1.

Table 1: Number, Percentage of Duly Completed Questionnaire and Overall Response Rate.

STATES	SAMPLE FRAME	NUMBER OF QUESTIONNAIRES DISTRIBUTED (Calculated sample size)	NUMBER OF DULY COMPLETED QUESTIONNAIRE	PERCENTAGE OF DULY COMPLETED QUESTIONNAIRE
EKITI	4	1	1	100%
OSUN	14	4	4	100%
ONDO	5	2	2	100%
OYO	57	18	14	77.77%
OGUN	14	4	4	100%
LAGOS	459	141	103	73.05%
TOTAL	**553**	**170**	128	75.29%

Data generated were mainly qualitative in nature. Data for research were analysed using Exploratory Factor Analysis (EFA) and presented in tables and charts. The questionnaire sought to assess the effects of incentives attached to the application of passive design strategies among construction stakeholders. While validity coefficient was found to be 0.768, implying that the sampling measure for the study was appropriate and adequate for the study, reliability coefficient was 0.930 which confirmed that the data were highly consistent.

4.0 Data analysis and discussion

Appendix 1 shows the effects of incentives on passive design strategies by government serving as motivation for construction stakeholders such as designers, contractors, consultants and private developers to promote sustainable building practice using SPSS version 26.

Government's introduction of direct grants by way of subsidizing costs of building features in building projects was ranked as first highest incentives attached to the application of passive design strategies on building owners and developers with average

of 2.93 as it shows that 121(94.5%), that is, majority of the respondent firms said yes with the statement.

Availability of special loans encouraging developers and contractors to set sustainable building standards ranked as second highest incentive attached to the application of passive design strategies on building owners and developers with average of 2.88. This shows that 114(89.1%) majority of the respondent firms agreed with the statement.

Government's rebates promoting sustainable building practice ranked as third highest incentive attached to the application of passive design strategies on building owners and developers with the average mean of 2.82, shows that 109 (85.2%) of the majority respondent firms said yes with the statement.

Provision of technical assistance by government supporting potential owners and developments at the commencement of sustainable project delivery was ranked as the fourth incentive attached to the application of passive design strategies on building owners and developers with the average of 2.59. This revealed that 91(71.1%) as majority of the respondent firms agreed with the statement.

Expedited permitting and plan reviews of building project proposals influencing the promotion of sustainable building construction was ranked as the fifth incentive attached to the application of passive design strategies on building owners and developers with the average means of 2.74, showing 76.6% majority of the respondent firms agreed with the statement.

Government's recognition and awards to building owners and developers who have demonstrated exemplary building practices encouraging high level of sustainability design was ranked sixth incentive attached to the application of passive design strategies on building owners and developers with the average mean of 2.62. This revealed that 93(72.7%) majority of the respondent firms agreed with the statement.

Eco-labeling by way of providing accurate information about environmental functionality and sustainable projects and features generating valued premium for sustainable building projects was ranked seventh incentive attached to the application of passive design strategies on building owners and developers with an average mean of 2.59 and 91(71.1%) majority of the respondent firms agreed with the statement of findings. To determine the effect of incentives attached to the application of Passive Design Strategies on building owners and developers, an assumption that Incentives Attached to the Application of Passive design strategies by the Architectural firms do not have effect on the Use of Passive Design Strategies in Southwest Nigeria was made. Incentives attached to the Application of Passive Design Strategies has the mean and standard deviation value of **(19.359±2.064)** of the factor analysis.

Model Specification

$$\text{Log UPDS} = \beta_0 + \beta_1 \log (\text{FAPDS}) + \mu_i$$

Where:

UPDS = Use of Passive Design Strategies (dependent variable)

IPDS = Incentives on Passive Design Strategies (independent variable)

Table 3: Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.279[a]	.258	.240	.879	1.983

a. Predictors: (Constant), Incentives on Passive Design Strategies

b. Dependent Variable: Use of Passive Design Strategies

Table 4: ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	8.187	1	8.187	10.601	.001[b]
	Residual	97.313	126	.772		
	Total	105.500	127			

a. Dependent Variable: Use of Passive Design Strategies

b. Predictors: (Constant), Incentives on Passive Design Strategies

Table 5: Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.179	.736		1.601	.112
	Incentives on Passive Design Strategies	.814	.250	.279	3.256	.001

a. Dependent Variable: Use of Passive Design Strategies

Interpretation of the coefficients

The above result was carried out using linear regression analysis of the coefficients. The dependent variable is Use of Passive Design Strategies (UPDS) while the independent variable is Incentives on Passive Design Strategies (IPDS). The estimation results show that the variable- **Incentives on Passive Design Strategies has statistically significant effect on the Use of Passive Design Strategies at the 5% alpha level of significant as estimation result shows that co-efficient of determination R-squared is 0.258. This implies that explanatory variable accounted for only 25.8% changes in Use of Passive Design Strategies (UPDS).** Un-standardized coefficient of determination value of (β= 0.814), indicated that 1% increase in the Incentives attached to the Application of Passive Design Strategies led to 81.4% increase in Use of Passive Design Strategies at higher rate with the (P-value of 0.001 < 0.05%).

Interpretation of Durbin Watson and F- Statistics

From the estimation, Durbin Watson statistics is (1.983). This implies that there is no serial or no positive autocorrelation between both the dependent and independent variables. So there is no evidence of first order serial correlation in residuals regression analysis. With the F-statistics value of (10.601) and a probability or significant level of P-value 0.001 < 0.05, it shows that the overall analysis of the model is of good fit and that the independent variable to a large degree explains changes to the dependent variable. Therefore, in conclusion, since at the overall level, incentives on passive design strategies bring significant effect to the use of passive design strategies, therefore, the assumption that says, **"*Incentives on Passive design Strategies by government do not have effect on the Use of Passive Design Strategies in Southwest Nigeria Architectural firms*", is thus rejected because they do. In other word, the study confirmed that incentives introduced by government on application of passive design strategies by Southwest Nigerian architectural firms have positive effects on construction stakeholders and therefore promote sustainable building practice.**

4.1 Research findings

The study offered new insights into benefits derivable from government's incentives on passive design strategies in enhancing sustainable building practice among construction stakeholders. It also revealed different types of incentives that government can offer to enhance sustainable building practice among construction stakeholders. The study also confirmed that rigid-regulatory approach to incentives does not encourage their uptake among construction stakeholders where available. A mix of both rigid-regulatory and voluntary would do better.

5.0 Conclusion

Incentives attached to the use of passive design do have effect on the application of passive design. Reward and compensation are voluntary incentives and these include rebates, that is, fee reduction, special loans, direct grants, that is, subsidies, technical assistance, that is, support and eco-labelling. Others are density bonus, government awards and demonstration projects. Also, the forms of reward and compensation exemplify the roles that government plays in ensuring voluntary sustainable building construction in the construction sector. Scaling enhances the adoption of incentives among beneficiaries, such as construction stakeholders. The study offered new insights into benefits derivable from government incentives on passive design strategies in enhancing sustainable building practice among construction stakeholders. It also revealed different types of incentives that government can offer to enhance sustainable building practice and confirmed that rigid-regulatory approach to incentives does not encourage their uptake among construction stakeholders where available.

5.1 Recommendations

Since it was proved that incentives on passive design strategies introduced by government enhances sustainable building construction, government cancome up with one and more of

the types of incentives discussed above. Government can also use the above to assess their preferences with respect to the forms of incentives relative to projects, available resources and time. The study also recommends the use of regulated-based and that with voluntariness approach to meet different phases of construction process needs.

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Appendix 1

Table 2: Effects of Incentives on Passive Design Strategies By Government in Enhancing Sustainable Building Practice

Effects of Incentives on Passive Design Strategies By Government in enhancing Sustainable Building Practice.	Yes	No	Undecided	Rank	Mean
Does your firm agree that government's introduction of direct grants by way of subsidizing costs of building features in building projects would support innovative and cutting-edge ideas that reduce energy use and greenhouse gas emissions significantly?	121 (94.5%)	2 (1.6%)	5 (3.9%)	1	2.93
Does your firm agree that government's recognition and awards to building owners and developers who have demonstrated exemplary building practices will further encourage high level of sustainability design?	93 (72.7%)	14 (10.9%)	21 (16.4%)	6	2.62
Does your firm agree that eco-labelling by way of providing accurate information about environmental functionality of sustainable projects and features generate valued premium for sustainable building projects?	91 (71.1%)	16 (12.5%)	21 (16.4%)	7	2.59
Does your firm agree that expedited permitting and plan reviews of building project proposals can be influential in promoting sustainable building construction?	98 (76.6%)	5 (3.9%)	25 (19.5%)	5	2.73
Does your firm believe that technical assistance would encourage potential owners and developers at the commencement of sustainable building project delivery?	108 (84.4%)	5 (3.9%)	15 (11.7%)	4	2.80
Does your firm believe that availability of special loans will encourage developers and contractors to set sustainable building standards?	114 (89.1%)	2 (1.6%)	12 (9.4%)	2	2.88
Does your firm agree that government's rebates can promote sustainable building practice?	109 (85.2%)	4 (3.1%)	15 (11.7%)	3	2.82

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